

Effect of lung resection for bronchial carcinoma on pulmonary function in patients with and without chronic obstructive bronchitis

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Legge, J. S. and Palmer, K. N. V. (1975). *Thorax*, 30, 563–565. **Effect of lung resection for bronchial carcinoma on pulmonary function in patients with and without chronic obstructive bronchitis.** Pulmonary function was measured before and after lung resection (pneumonectomy or lobectomy) in 58 patients with bronchial carcinoma, 33 of whom also had chronic obstructive bronchitis. Lung resection was well tolerated and caused no greater impairment of lung function postoperatively in the bronchitics than in those without bronchitis.

In a previous report of 330 patients with bronchial carcinoma, 62% had impaired pulmonary function due to coincident chronic obstructive bronchitis (Legge and Palmer, 1973), this diagnosis being based on criteria from a report to the Medical Research Council (1965), namely dyspnoea on exertion, chronic or recurrent mucopurulent sputum, and persistent widespread narrowing of the intrapulmonary airways at least on expiration as shown by spirometry. Lung resection in such patients may result in an unacceptable degree of dyspnoea or ventilatory failure. We have now investigated the results of lung resection in a group of 58 patients with bronchial carcinoma, 33 of whom (57%) had chronic obstructive bronchitis according to the MRC criteria with a forced expiratory volume in one second as a percentage of the forced vital capacity (FEV₁%) of less than 70 but who were considered fit for operation on other clinical and pulmonary function criteria (Legge and Palmer, 1973).

PATIENTS AND METHODS

Fifty-eight patients with histologically proven bronchial carcinoma were divided into groups according to whether the FEV₁% was greater or less than 70. Group I, in which the FEV₁% was greater than 70, comprised 25 patients, 20 men and 5 women, mean age 61.5 (range 42–77) years, mean height 1.68 (range 1.53–1.80) metres, and mean weight 65.9 (range 49–83) kg. In group

II, the FEV₁ was less than 70. Here there were 33 patients, 31 men and 2 women, mean age 60.5 (range 37–73) years, mean height 1.69 (1.52–1.88) metres, and mean weight 70.0 (54–102) kg. Dynamic and static lung volumes, transfer factor, and arterial blood gas tensions were measured in all patients before and between three and six months after lung resection.

To determine the dynamic lung volumes, the forced vital capacity (FVC), forced expiratory volume in one second (FEV₁), and the FEV₁ as a percentage of the FVC (FEV₁%) were calculated in litres from the best of three forced expiratory spiograms.

To determine the lung volumes, the functional residual capacity (FRC) was measured in duplicate by the closed-circuit multiple breath helium dilution method, and after measuring the inspiratory capacity and expiratory reserve volume, the total lung capacity (TLC), residual volume (RV), and RV/TLC% were calculated in litres (ATPS).

Single breath carbon monoxide transfer factor (TF) was measured in duplicate by the method of Ogilvie *et al.* (1957).

Arterial blood samples were obtained with the patient breathing air and the arterial oxygen (Pao₂) and carbon dioxide (Paco₂) tensions were measured in duplicate using electrodes (Radiometer, Copenhagen).

The mean values for FEV₁ and FVC, lung volumes, and TF are expressed as the per cent of predicted normal values from the tables of Cotes

(1968) to allow for variations in age, sex, and height.

Of the 25 patients in group I, 12 had a lobectomy and 13 had a pneumonectomy. Of the 33 patients in group II, 20 had a pneumonectomy and 13 had a lobectomy.

RESULTS

A comparison of preoperative pulmonary function is shown in Table I; per cent predicted FEV₁, FEV₁%, and TF were all significantly less in group II while in these subjects per cent predicted RV was significantly more.

Table II shows a comparison of the changes in pulmonary function measurements between the groups after pneumonectomy. In both, the dynamic and static lung volumes fell from between 20–30% but there was no significant difference in this fall between the groups. The FEV₁% rose significantly ($P < 0.05$) in the bronchitic group. The Pao₂ rose by about 0.67 kPa in both groups and this rise, compared with the preoperative value, is significant ($P < 0.05$).

Table III shows a comparison of the effects of lobectomy on pulmonary function in the groups. Again there is a fall, though a smaller one, in the region of 15% in the dynamic and static lung volumes, and a fall in TF. The changes were not

TABLE I
PREOPERATIVE PULMONARY FUNCTION IN GROUPS I AND II

	Group I (FEV ₁ % > 70)	Group II (FEV ₁ % < 70)	P
FEV ₁ % of predicted	84.5	73.0	< 0.05
FVC% of predicted	86.8	94.1	NS
FEV ₁ %	75.5	58.2	< 0.01
TLC% of predicted	95.8	105.0	NS
FRC% of predicted	123.5	138.8	NS
RV% of predicted	116.0	138.9	< 0.05
RV/TLC%	43.3	45.0	NS
TF% of predicted	78.6	64.1	< 0.05
Pao ₂ (kPa)	10.1	10.4	NS
Paco ₂ (kPa)	5.3	5.4	NS

TABLE II
MEAN PERCENTAGE CHANGE IN PULMONARY FUNCTION AFTER PNEUMONECTOMY

	Group I (FEV ₁ % > 70)	Group II (FEV ₁ % < 70)	P
FEV ₁ % of predicted	-25.8	-28.6	NS
FVC% of predicted	-24.6	-37.6	NS
FEV ₁ %	+ 1.1	+ 6.8	< 0.05
TLC% of predicted	-26.1	-30.3	NS
FRC% of predicted	-22.8	-31.5	NS
RV% of predicted	-16.7	-26.5	NS
RV/TLC%	+ 1.1	+ 2.5	NS
TF% of predicted	+ 2.2	- 8.4	NS
Pao ₂ (kPa)	+ 0.84	+ 0.65	NS
Paco ₂ (kPa)	+ 0.01	- 0.05	NS

TABLE III

MEAN PERCENTAGE CHANGE IN PULMONARY FUNCTION AFTER LOBECTOMY

	Group I (FEV ₁ % > 70)	Group II (FEV ₁ % < 70)	P
FEV ₁ % of predicted	-18.8	-11.2	NS
FVC% of predicted	-15.7	-16.8	NS
FEV ₁ %	- 1.4	+ 3.5	NS
TLC% of predicted	-15.0	-15.1	NS
FRC% of predicted	-12.7	-11.2	NS
RV% of predicted	-10.3	-15.8	NS
RV/TLC%	+ 2.6	+ 0.2	NS
TF% of predicted	-11.0	-12.3	NS
Pao ₂ (kPa)	+ 0.39	- 0.15	NS
Paco ₂ (kPa)	+ 0.12	- 0.16	NS

significantly different between the two groups, and the blood gas tensions were not altered from the preoperative values.

DISCUSSION

As a result of lung resection, the dynamic and static lung volumes fell more after pneumonectomy than lobectomy. This reflects the removal of lung tissue and has been described before (Cournaud and Berry, 1942; Curtis *et al.*, 1959; Bie-Erikson, and Refsum, 1960). A reduced FEV₁% may be found in patients with bronchial carcinoma where there is local obstruction to the bronchus by the tumour, in addition to generalized airway obstruction due to chronic obstructive bronchitis (Simonsson and Malmberg, 1964). The significant postoperative rise in the FEV₁% and the larger postoperative fall in RV in group II, patients after pneumonectomy might reflect an improvement in airway obstruction due to removal of the tumour rather than improvement in bronchitis.

The mean RV/TLC% was unaltered by either procedure, indicating that hyperinflation of the remaining lung did not develop during the first postoperative year. Similar results were found by Friend (1954) and Ogilvie *et al.* (1963) at 10 years.

TF fell in the group II patients after pneumonectomy but this difference did not vary significantly from a slight rise in the group I patients. Wide variations in the postoperative TF were noted. This has been observed also by Curtis *et al.* (1967).

After pneumonectomy, there was a significant rise in Pao₂ in both groups but no change in Paco₂. This improvement in Pao₂ may have resulted from the removal of arteriovenous shunts commonly found in patients with bronchial carcinoma (Cudkovicz, 1967), or to the removal of perfused but unventilated atelectatic areas.

We have previously shown that, in patients with chronic airways obstruction, the following tests of

pulmonary function were most valuable in predicting the risk of postoperative ventilatory failure: FEV₁, FEV₁%, RV, RV/TLC%, Paco₂, respiratory rate, and V_D/V_T on exercise. On the other hand, the FVC, TLC, FRC, TF, PaO₂, minute ventilation, and the heart rate on exercise were not found helpful in recognizing this high risk group (Legge and Palmer, 1973). In the present study, the preoperative values for FEV₁% and TF were significantly lower and the RV significantly higher in group II than in group I patients, but there was no significant difference in RV/TLC% and Paco₂ between the two groups.

Our thanks are due to Mr. F. J. Sambrook Gowar and Mr. P. L. Brunnen for permission to study their patients, and to Fiona Fiddes and Keith Minty for technical assistance. During this work Dr. Legge held a Medical Research Council Junior Fellowship. We gratefully acknowledge the support given by the Medical Research Council.

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