Breathing exercises

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In a fit person the resting position of the chest wall is at approximately mid-vital capacity. From this level inspiration requires relatively little muscular effort. Expiration is effected passively by the elastic recoil of the lung tissue and chest wall. By contrast, in a chronic bronchitic with emphysema who has not been reeducated, the resting lung volume is large and the chest wall rigid; more work is therefore needed for inspiration. Expiration is hindered by a rise in intrapleural pressure which leads to dynamic compression of airways. There is associated active contraction of the respiratory muscle.

The main aim of breathing reeducation should be to reduce to a normal level the work of inspiration and to restore passive expiration. To this end it is suggested that the lung volume should be maintained at above the level at which airways shut down occurs. In addition, the depth of inspiration should if possible be increased whilst expiration should be relaxed and not prolonged, in order to avoid compression. These objectives are the converse of traditional teaching. In practice they can be achieved by raising the resting respiratory level by a relatively small amount.

For purposes of training the patient, the physiotherapist's hand or hands may be placed in the middle of the abdomen and controlled pressure applied. The patient is taught to inspire by making the abdomen swell into the hand, and to expire by gently letting go, so that the abdomen returns to the normal resting position. The change from inspiration to expiration should be smooth, not abrupt; this is helped by carefully grading the resistance given by the physiotherapist's hand on the abdomen. If difficulty is encountered, or if uncoordinated or see-saw movements of chest and abdomen occur, these may be overcome by increasing the pace of breathing.

Abdominal tightening on expiration increases the intrathoracic pressure and aggravates the tendency to collapse airways, so it should be avoided.

The points requiring emphasis are: to relax the thorax, to avoid full expiration and to begin inspiration a little sooner in the cycle than usual.

DISCUSSION

Dr D J Lane said that in his experience diaphragmatic breathing led to a decrease in functional residual capacity and an increase in gastric pressures, which was the opposite of what was intended.

Miss Innocenti said that this was due to faulty technique; the patient should aim to relax and not to push forward the abdominal wall. The physiotherapist could easily tell the difference.

Ten years follow up in patients with chronic obstructive lung disease submitted to a programme of pulmonary rehabilitation

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Patients with chronic obstructive pulmonary disease have a high mortality after their first episode of respiratory failure, especially if this includes right ventricular failure. The present report reexamines the long-term course of 21 survivals from a study (Gimenez 1970) of 31

Table 1. Mean pulmonary function of patients

	Initial	At Five years
Arterial oxygen saturation (%)	83.5	88.8
Arterial carbon dioxide tension (mmHg)	55.8	46.5
Haematocrit (%)	55	50
Resting tidal volume (ml BTPS)	311	509
Resting respiratory frequency (min^{-1})	24.8	15.1

All indices show improvement at five years compared with initial value ($P<0.01$)

patients who were enrolled twelve years ago in a prospective study of pulmonary rehabilitation. The age range was 40–59 years, the patients gave a long history of chronic bronchitis and had had at least one acute chest illness, with hypoxaemia (arterial oxygen saturation $Sao_2<85\%$), hypercapnia (arterial carbon dioxide tension $Paco_2>50$ mmHg (6.7 kPa)) and some peripheral oedema. The mean levels for these and other indices at the start of the study are given in Table 1.

The programme of pulmonary rehabilitation consisted of (1) bronchodilators and if necessary antibiotics and diuretics; (2) physiotherapy using directed breathing (Gimenez *et al.* 1977) and with supplementary oxygen during the first stage of breathing and training exercises. The initial treatment at hospital was for two to three months. Subsequently the patient was seen in the respiratory ambulatory care unit every three or six months, for clinical assessment, for assessment of pulmonary function and for physiotherapy. After five years there was an improvement in all the indices of lung function, including a reduction in respiratory frequency and increase in tidal volume (Table 1). The minute ventilation and spirometric values did not vary. After ten years follow up there was a deterioration in most of the indices towards the levels observed at the start of the study. Four patients died after eight years, and three other patients during the ten years follow up. The total mortality of 7 out of 21 patients in this study is less than that reported in the literature. The persistence of a high haematocrit, and of disturbances of the normal respiratory pattern at rest, seemed to be sensitive indicators of worse response to therapy. The results presented support the belief that patients with chronic bronchitis and chronic hypoxaemia and hypercapnia benefit from planned long term pulmonary rehabilitation.

References

Gimenez M (1970) Atti del 33 Congresso Nazionale de Medicina del Lavoro, Cagliari; p 454
Gimenez M, Uffholtz H & Penafielcolas M (1977) *Poumon et Coeur* **33**, 23

DISCUSSION

In answer to questions Dr Giminez said that the physiotherapy training sessions were of two hours duration each day for two to three months. One physiotherapist could look after ten patients. Discussion ensued as to what control procedure should be used, since ineffective breathing exercises could have an adverse effect. Dr D J Lane said it was important that the patients and the control group should receive equal attention.