ASSESSMENT OF THE VALUE OF POSITIVE PRESSURE BREATHING APPARATUS IN INDUCING COUGH[1]

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In the last decade, numerous papers have discussed what has been called the indiscriminate use of intermittent positive pressure breathing therapy (IPPB) for the treatment of obstructive airways disease (Curtis *et al.*, 1968; Loke and Anthonisen, 1974; Cheney *et al.*, 1976; Baker, 1974; Murray, 1974; Barach and Segal, 1975; Sheldon and Gold, 1976; Dolovich *et al.*, 1977). These papers have all failed to show any advantage of positive pressure breathing therapy, either in the acute or chronic stages of obstructive airways disease. IPPB apparatus is expensive, requires careful maintenance and cleaning and may lead to patient dependence. However, physiotherapists in this hospital gained the impression that patients who were receiving nebulisation with positive pressure appeared to cough more frequently, and to produce greater volumes of sputum, suggesting that IPPB apparatus may be a useful adjunct of physiotherapy. Therefore a study was designed to compare the effectiveness of nebulisation therapy, with and without positive pressure, on the production of cough and sputum volume in patients with chronic obstructive airways disease.

METHOD

Ten male patients were chosen (Figure 1). All had a chronic productive cough and were diagnosed as suffering from chronic obstructive airways disease. Physiological tests performed were measurement of forced expiratory volume in the first second (FEV_1) as a percentage of that predicted, vital capacity (VC), static lung volumes using the helium dilution method, diffusing capacity for carbon monoxide by the single breath method, and arterial blood gas analysis. Each patient was treated twice daily—once in the morning and once in the afternoon for four consecutive days. Alternate patients were given positive pressure nebulisation with the "Bird Mark 7" positive pressure apparatus. These patients were treated in the morning of the first and third days and in the afternoon of the second and fourth days. The order was reversed for the remaining patients. The other

PT NO	AGE Yrs	DIAGNOSIS	$\frac{FEV_1}{PRED\ FEV_1}$ %	NORMAL RANGE * 10.6 K Pa $Pa O_2$ (KPa)
1	77	CHRONIC OBSTRUCTIVE BRONCHITIS	38%	10.1
2	16	CHRONIC OBSTRUCTIVE BRONCHITIS AND BRONCHIECTASIS	39%	9.0
3	67	CHRONIC OBSTRUCTIVE BRONCHITIS	93%	8.8
4	56	CHRONIC OBSTRUCTIVE BRONCHITIS AND EMPHYSEMA	63%	10.3
5	58	CHRONIC OBSTRUCTIVE BRONCHITIS AND EMPHYSEMA	36%	11.2
6	67	CHRONIC OBSTRUCTIVE BRONCHITIS	38%	-
7	67	CHRONIC OBSTRUCTIVE BRONCHITIS AND EMPHYSEMA	21%	8.9
8	45	CHRONIC OBSTRUCTIVE BRONCHITIS AND EMPHYSEMA	23%	7.9
9	71	CHRONIC OBSTRUCTIVE BRONCHITIS AND ASTHMA	102%	11.2
10	57	CHRONIC OBSTRUCTIVE BRONCHITIS AND EMPHYSEMA	20%	8.9
MEAN	56.1		47%	9.6

FIGURE 1

Details of subjects.

treatments were carried out using a disposable nebuliser, the "Inspiron Mini-Neb". Each day, spirometry was performed to obtain the FEV_1 and the VC. The pulse rate was measured at the beginning and end of each session, as was a reading which was termed "cough flow". This "cough flow" is a modification of the peak flow rate. The patient

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was asked to give a hard cough with his lips tightly clamped round the mouthpiece of the Wright Peak Flow Meter. Each nebuliser was filled with 3 ml of sterile water, plus 0.5 ml of 0.5% w/v Salbutamol respirator solution for the positive pressure apparatus. One ml (5 mg) of the solution was used for the simple nebuliser. The patient was instructed in the use of each nebuliser, and provided with a graduated sputum container. Contrary to usual procedure when using IPPB, the patient was not instructed to cough during nebulisation. However, the number of spontaneous coughs during nebulisation was counted, and the volume of sputum produced from this coughing was measured. Each patient then received ten minutes of conventional physiotherapy, that is, percussion, vibrations, breathing exercises interspersed with coughing, and postural drainage where indicated. Again the volume of sputum produced was measured.

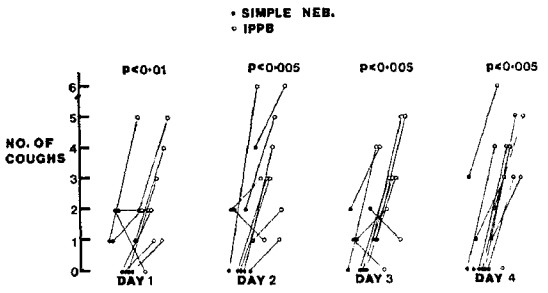

FIGURE 2

Number of coughs by each patient during different forms of nebulisation therapy.

RESULTS

There was no significant change in the pulse rate during either method of nebulisation, nor was there any significant difference in the small rises in cough flow rates after the two methods of nebulisation. Figure 2 shows a comparison of the number of spontaneous coughs produced by each patient, on each day of treatment.

There was a highly significant increase on each day in the number of spontaneous coughs produced during intermittent positive pressure breathing compared to the number produced during simple nebulisation (paired t test). Figure 3 shows a comparison of the volume of sputum produced by each patient, on each day of treatment. There was a highly significant increase on each day in the volume of sputum produced during intermittent positive pressure nebulisation, compared to that produced during simple nebulisation.

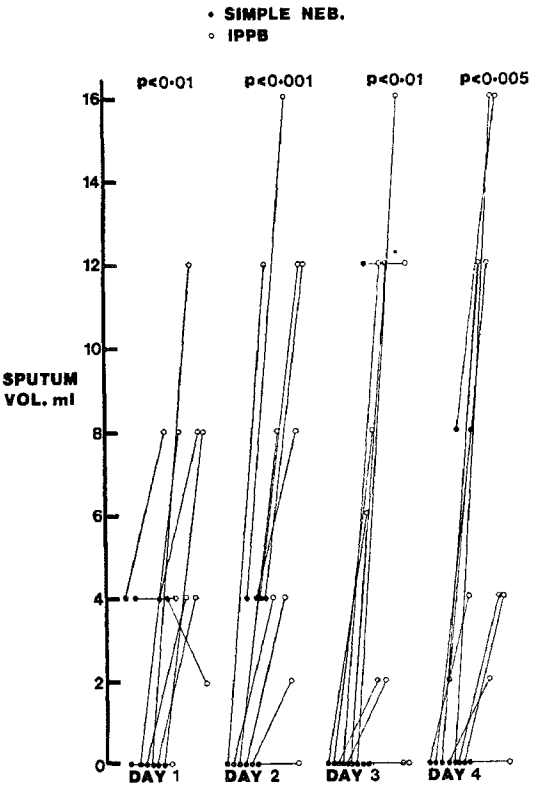

FIGURE 3

Sputum volumes produced by each patient during different forms of nebulisation therapy.

Figure 4 shows a comparison of the volume of sputum produced by each patient, on each day, using the two different methods of nebulisation, followed by physiotherapy. There was a significant increase in the volume of sputum produced during the combination of IPPB and physiotherapy, compared to simple nebulisation and physiotherapy. This difference, although remaining significant until the third day, decreased towards the end of the four days as the patient's condition improved and there were lesser volumes of sputum remaining. On the fourth day the significance did not reach the 5% level.

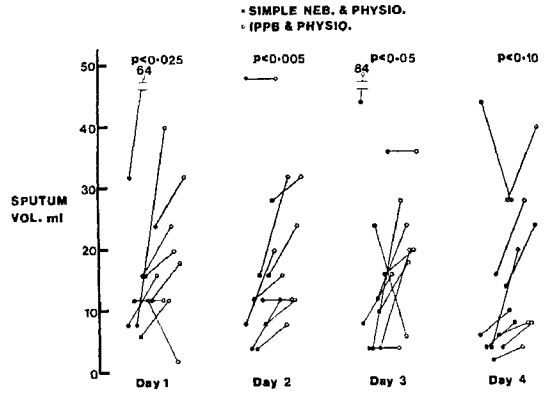

FIGURE 4

Sputum volumes produced by each patient during different forms of nebulisation plus physiotherapy.

Figure 5 shows a step-wise increase in the total volumes of sputum produced by all the patients on the four days during (i) simple nebulisation, (ii) intermittent positive pressure nebulisation, (iii) simple nebulisation and physiotherapy, (iv) intermittent positive pressure nebulisation and physiotherapy.

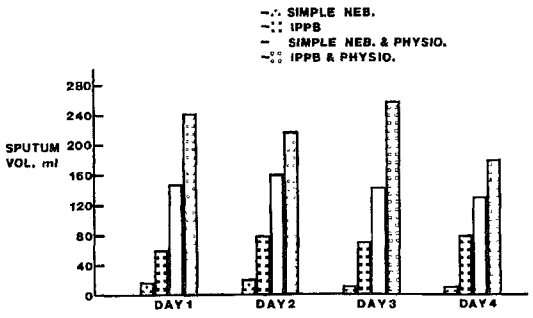

FIGURE 5

Total sputum volumes produced by all patients on each day after differing forms of treatment.

DISCUSSION

In both simple nebulisation therapy and IPPB therapy there was a highly positive correlation between the number of coughs and the sputum volume, the correlation coefficient for simple nebulisation being 0.88, and that for IPPB 0.96. Thus the increased sputum volumes seen in IPPB therapy can be accounted for by the greater number of coughs produced by this method compared with simple nebulisation therapy. Perhaps the positive pressure irritates the airways and stimulates coughing. The addition of physiotherapy to either method of nebulisation greatly increases the volume of sputum produced. This increase could be due to the efficient coughing which is taught and encouraged by the physiotherapist, and percussion of the chest, which has been proven to be effective in clearing material, not only from the airways, but even from the alveoli (Kao *et al.*, 1975).

From this study the following conclusions may be drawn:

1. On each day there were significantly more spontaneous coughs produced by intermittent positive pressure nebulisation, than by simple nebulisation.
2. On each day there was a significantly greater volume of sputum produced by intermittent positive pressure nebulisation, than by simple nebulisation.
3. On each of the first three days there was a significantly greater volume of sputum produced by the combination of physiotherapy and intermittent positive pressure nebulisation than by physiotherapy and simple nebulisation.
4. The addition of physiotherapy to either method of nebulisation is much more effective in the production of sputum than either method alone.

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