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Effect of long-term ionized air treatment on patients with bronchial asthma

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Jones, D. P., O'Connor, S. A., Collins, J. V., and Watson, B. W. (1976). *Thorax*, **31**, 428–432. **Effect of long-term ionized air treatment on patients with bronchial asthma.** Seven patients with bronchial asthma requiring continuous medication were subjected to eight weeks of nocturnal exposure to negatively ionized air, and their progress was followed using objective tests of lung function and clinical assessment. During exposure, four patients showed significant increases in morning PEFR, which in two of these patients was not sustained when exposure ceased. In two patients the observed increase in PEFR was accompanied by subjective improvement. From the results of all our assessments we conclude that, although this treatment may lead to an improvement in some patients with asthma, further objective studies are required to determine the value of negatively ionized air in the routine management of asthma.

Air is ionized when an electron is added to or removed from any of its constituent atoms or molecules. The charged particles so formed usually attract to themselves between four and 12 other gaseous molecules to form a cluster of comparatively low mobility; the ratio of ions to non-ionized molecules is low and rarely exceeds 1 part in 10^{12} even when enhanced artificially (Kreuger, 1962). The atmosphere at ground level is at all times ionized to some degree, the ion concentration mainly depending upon natural factors such as the abundance of radioactive elements and cosmic rays and also upon atmospheric conditions such as humidity and the concentration of dust particles. Normally the positive ion concentration is slightly larger than the negative ion concentration. There are several practical methods of artificially altering the ratio of positive to negative ions in a room; the most commonly used ones either depend upon a high-voltage electric field or make use of the radiation from a small radioactive source.

Several investigations (Kornblueh and Griffin, 1955; Kornblueh, Piersol, and Speicher, 1958; Palti, De Nour, and Abrahamov, 1966; Boulatov, 1968) have reported temporary relief of symptoms in patients with asthma on exposure to negatively ionized air, although others have failed to detect such an effect (Zylberberg and Loveless, 1960). No objective lung function tests or statistical analyses were attempted in any of these studies and, except for the trial in infants where exposures of up to 40 hours were used (Palti *et al.*, 1966), the patients were exposed for comparatively short periods varying between 10 minutes and 3 hours. Today air ionizers are on sale to the general public from manufacturers who claim that considerable benefit can be derived from their use by patients with asthma, bronchitis, and hay fever. These claims are based largely upon reports of the above kind and informal surveys conducted among users of these ionizers. We have attempted to determine the efficacy of negatively ionized air in the treatment of bronchial asthma by the use of objective tests of lung function and diary cards in a group of patients making long-term domiciliary use of an ionizer.

PATIENTS AND METHODS

Seven patients aged 10 to 54 years who had attended our chest clinic regularly in the preceding year were chosen for the study because they had not had a recent severe exacerbation of their asthma although they had continued to show variable airways obstruction. In each patient the

clinical diagnosis of asthma had previously been confirmed by demonstration of a blood eosinophilia in excess of 500×10^9 per litre and an increase of at least 20% in forced expired volume in one second (FEV_1) or peak expiratory flow rate (PEFR) after the inhalation of a salbutamol aerosol (420 nmol: 100 μg).

All patients were examined by one of us (JVC) on entry to the study and at monthly intervals thereafter. At each examination the following measurements of lung function were also made: FEV_1, PEFR, forced mid-expiratory flow (FMF), forced vital capacity (FVC), and static lung volumes by helium-dilution and single-breath carbon monoxide transfer factor. Details of the patients and their treatment are given in Table I; during the trial the treatments shown were unchanged. Pollen counts in the trial period were low, there were no severe climatic changes, and no patient suffered an upper respiratory tract infection.

Throughout the study each patient recorded in a diary card details of nocturnal and daytime wheezing, cough, and sputum production on a 4-point (0 to 3) scale. They were also asked to note how often they used a salbutamol aerosol. All patients were given Wright peak flow meters and recorded the highest of three readings taken before use of a salbutamol aerosol immediately on rising and before retiring each day.

The trial was divided into three consecutive periods of four, eight and four weeks. During the first twelve weeks the patients were asked to place their ionizer[1] on a table about 1 m from the head of the bed and to leave it switched on overnight. Unknown to the patients, the ionizers which were of the electric field type, were fitted with defective fuses during the first four weeks and so remained inactive, thus allowing any placebo response to be detected. For the next eight-week period the ionizers were rendered fully operational, they were checked at each clinic visit, and there were no equipment failures. At the end of 12 weeks the ionizers were collected so that during the final period of four weeks the effect of returning to a normal overnight atmosphere could be assessed.

[1]Medion portable type

RESULTS

Statistical comparisons between the daily PEFR for the trial periods were made using the two-tailed Mann-Whitney U-test (Siegel, 1956). The mean and standard deviation for the PEFR for both morning and evening in each of the three trial periods are shown in Table II.

In four patients (2, 3, 6, and 7) the morning readings during the period of active negative ionization showed a statistically significant improvement compared with the placebo period ($P<0.05$ in all cases). This is illustrated for patient 6 in the Figure where $P<0.001$. The Figure also shows that there was some improvement in the morning PEFR readings before the start of treatment, although only the reading immediately preceding active ionization was outside one standard deviation of the mean for the placebo period. The reason for this change in PEFR remains obscure as treatment was not changed during this time. In three of the above patients (2, 3, and 7) the even-

TABLE I

PATIENTS AND TREATMENT WITH RESULTS OF LUNG FUNCTION TESTS ON ENTRY TO THE STUDY

Patient	Sex	Age	Intrinsic or Extrinsic	Daily Treatment during Trial	% Predicted				
					TLC	FVC	PEFR	FEV_1	T_{LCO}[1]
1	M	12	Extrinsic	Beclomethasone 400 μg DSCG 4 capsules Salbutamol aerosol	77	91	93	76	100
2	M	42	Extrinsic	Beclomethasone 400 μg Choline theophyllinate 600 mg Salbutamol aerosol	98	83	54	58	88
3	M	54	Intrinsic	Beclomethasone 400 μg Salbutamol tablets 12 mg DSCG 3 capsules Salbutamol aerosol	90	91	91	88	100
4	M	10	Extrinsic	Salbutamol aerosol	75	86	37	82	100
5	M	51	Intrinsic	Beclomethasone 400 μg DSCG 4 capsules Salbutamol aerosol	105	105	92	78	110
6	F	22	Extrinsic	Beclomethasone 400 μg Salbutamol aerosol	82	87	95	92	80
7	M	50	Intrinsic	Beclomethasone 400 μg Salbutamol aerosol	127	119	85	95	88

DSCG = disodium cromoglycate (Intal).
[1]T_{LCO} = lung transfer factor (single-breath carbon monoxide).

TABLE II

MEANS AND STANDARD DEVIATIONS FOR PEFR, FOR BOTH MORNING AND EVENING, IN EACH OF THE THREE TRIAL PERIODS

Patient	PEFR Morning						PEFR Evening					
	Placebo		Ionizer		No ionizer		Placebo		Ionizer		No ionizer	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	5·7	0·3	5·8	0·4	5·2	1·2	5·8	0·6	6·1	0·5	5·5	1·2
2	3·0	0·5	3·7	0·5	3·5	0·4	3·4	0·4	3·8	0·5	3·8	0·5
3	7·0	0·2	7·1	0·3	6·8	0·2	6·9	0·3	7·1	0·3	6·8	0·3
4	4·1	0·6	4·1	0·7	4·3	0·5	4·1	0·5	4·5	0·7	4·5	0·4
5	7·7	0·2	7·7	0·1	6·7	0·1	8·2	0·2	7·9	0·1	7·7	0·1
6	4·4	0·6	5·4	0·6	3·6	0·3	5·7	0·5	5·6	0·4	3·9	0·3
7	3·3	0·8	4·2	0·7	5·1	0·8	4·7	0·6	5·6	1·2	5·1	1·0

Means and standard deviations in litres sec^{-1}.

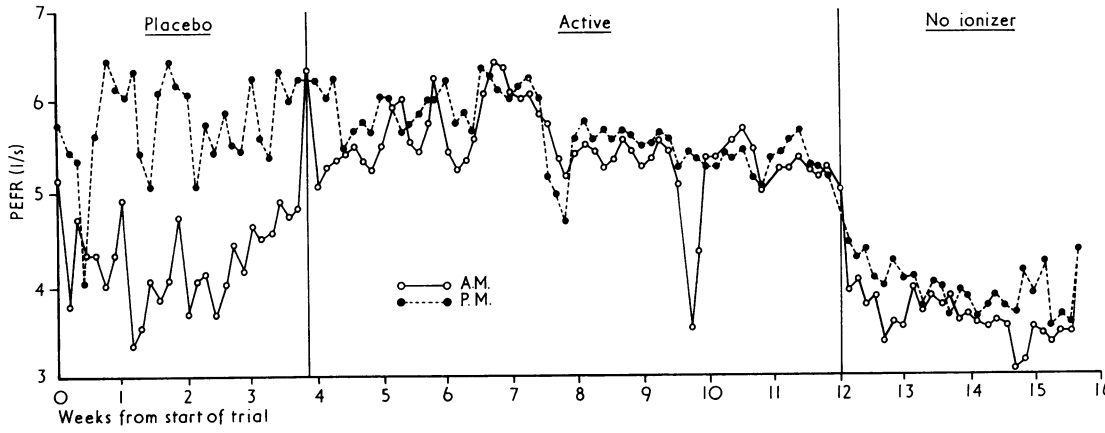

FIGURE. *Patient 6. Morning and evening PEFR v time*

ing PEFRs also showed significant increases after the start of the active period ($P<0·01$ in each case), although this was not observed in any of the other patients.

The transition from the active period to the final four-week period was associated with a significant decrease ($P<0·001$) in both morning and evening PEFR readings in three patients (3, 5, and 6) while no significant reduction was found in the others; again, this effect is demonstrated in the Figure. Two patients (2 and 6) reported subjective improvement during the period of active ionization.

These PEFR results, together with the results from our other assessments of lung function, were analysed statistically so as to obtain an objective estimate of the effect of the ionizer treatment on the patients as a group. Two methods of analysis were employed. In the first, variables derived from the diary cards and the lung function tests were given weighting factors on a 1 to 5 scale by one of us (JVC) in accordance with an assessment of their importance in determining the condition of patients. This introduces an element of subjective clinical judgement but it should be less than when reliance is placed solely on clinical examination. The results for each variable for the placebo period (P), the active ionizer period (I), and the period with no ionizer (N) were ranked according to the patient's condition as assessed on the basis of that variable (3=best condition; 1=worst condition). The weighted rankings for each period were then summed, and the resulting totals themselves were ranked. Hence a comparison of the three periods which takes account of each of the 18 variables used is obtained. These variables, together with their weighting factors, are listed in the Appendix. The procedure was repeated for the other patients and the final rankings were all incorporated into

Table III for a Friedman two-way analysis of variance test (Siegel, 1956). No significant difference could be found between the three periods ($\chi_2^2=2{\cdot}0$, $P>0{\cdot}4$).

TABLE III
FINAL RANKINGS FOR FIRST METHOD OF ANALYSIS

Patient	Period[1]		
	P	I	N
1	3	1	2
2	3	2	1
3	2	3	1
4	1	2	3
5	3	2	1
6	3	2	1
7	2	1	3
Total	17	13	12

[1]See text.
Using Friedman two-way analysis of variance, $\chi_2^2=2{\cdot}0$, $P>0{\cdot}45$, NS

For the second method the results of the lung function tests alone for the P, I, and N periods (but no patient identification) were given to two independent physicians (one of whom had not participated in the trial), who were asked to rank the periods for each patient as above. In this way two tables similar to Table III were constructed from the interpretation of the lung function tests by each clinician. When the Friedman test was applied to each table in neither case was there a significant difference between the periods ($\chi_2^2=3{\cdot}4$, $P>0{\cdot}2$; $\chi_2^2=0{\cdot}8$, $P>0{\cdot}7$).

From this analysis these patients did not appear to be placebo responders since there was no significant difference in the results obtained during the initial placebo period compared with the final period. However, we cannot exclude the possibility of a residual effect on the active ionization period persisting to influence the results of the final period in some patients.

DISCUSSION

At the outset we did not expect to find that exposure to negatively ionized air would affect our patients; however, a significant and sustained improvement in the morning PEFR was observed in some patients during the active ionizer period, suggesting an interaction between negatively ionized air and airway calibre. One possible explanation for these findings is contained in a hypothesis developed by Kreuger (1962). He showed in preparations of animal tracheas that exposure to positively ionized air resulted in reduced ciliary activity and increased contraction of the posterior wall muscle, effects similar to those produced by intravenous injection of 5-hydroxytryptamine (5HT). He postulated that positively ionized air releases tissue serotonin (5HT) while negatively ionized air, which he found to produce the reverse effects to those of positive ions, accelerates the metabolic destruction of 5HT. In support of this hypothesis, Sulman (1971) demonstrated the presence of large concentrations of serotonin in the urine of patients adversely affected by high levels of positive ions occurring naturally near some desert regions. Inhalation of 5HT causes wheezing and a reduction in FEV_1 in man, but direct evidence that this substance is an important mediator of bronchoconstriction in asthma is lacking (Brocklehurst, 1975).

In conclusion, we have subjected patients with well-controlled asthma, but with persistent variable airflow obstruction, to comparatively long overnight exposure to negatively ionized air for several weeks and have attempted, where possible by objective tests, to determine if such exposure could be of benefit in bronchial asthma. Although the number of patients in the present study was small, it seems reasonable to infer from the results that it is unlikely that exposure to negative ions will be of significant benefit in the majority of patients with asthma. We have not studied patients with poorly controlled asthma and severe airways obstruction; the effects of negatively ionized air on such patients remains to be determined.

Further objective studies are needed before the use of ionizers could be recommended as part of the routine management of patients with asthma.

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APPENDIX

The 18 variables actually used in the first method of analysis and their weighting factors were: am mean PEFR (5); pm mean PEFR (4); am standard deviation of PEFR (4); pm SD of PEFR (4); frequency of asthmatic attacks (4); FVC (3); FVC as % predicted (4); FVC post-bronchodilator (3); FEV_1 (4); FEV_1 % predicted (5); FEV_1 post-bronchodilator (5); ratio FEV_1/FVC (3); ratio FEV_1/FVC (post-bronchodilator) (3); PEFR in lung function laboratory (4); PEFR (lab) as % predicted (5); PEFR (lab) post-bronchodilator (4); RV as % predicted (4); TLC % predicted (4).

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