Ionisers in the management of bronchial asthma

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ABSTRACT Because of recent interest in the possible benefits to asthmatic patients of negative ion generators and the largely uncontrolled and inconclusive nature of earlier studies a double blind crossover study of this treatment was carried out in 20 subjects with stable asthma over six months. After an initial two week period without an ioniser, active or placebo ionisers were installed in subjects' bedrooms for two eight week periods separated by a four week "washout" period when no ioniser was present. The study was completed by a final four week period when no ioniser was present. Subjects were randomly allocated to receive an active or a placebo ioniser first. Subjects recorded their peak expiratory flow rate (PEFR) twice daily, completed a daily symptom score questionnaire, and noted any treatment they took on a diary card. Recordings were completed throughout the trial. Ion counts and dust concentrations were measured in subjects' bedrooms during the study. Mean ion counts rose considerably when ionisers were activated ($p < 0.001$). There were no significant differences in PEFR, symptom score, or consumption of medication between the periods that active ionisers and either no ionisers or placebo ionisers were in operation. This study has failed to show a statistically significant benefit in asthmatic subjects from the use of negative ion generators.

There has been much interest in recent years in the physiological effects of positive and negative air ions. Studies have been carried out to examine the possible effects of ionisers in such diverse conditions as hayfever (GW King, paper presented to International Academy of Preventive Medicine, Dallas, 1979), migraine¹ and the rate of healing of burns (CA Laws, paper presented to Congress on Man Made Disease, Melbourne, 1978). Benefits in normal subjects have been reported with regard to concentration, vigilance, and reaction time.²

Air ions are electrically charged particles consisting of atoms or molecules which have lost or gained electrons to become positively or negatively charged. These can be found free in nature but they commonly attract neutral atoms and molecules, especially water, to form heavier charged particles. Such ions are produced in nature by cosmic radiation and natural radioactivity and, to a lesser extent, by lightning, waterfalls, ultraviolet radiation, and hot, dry winds which blow in certain parts of the world. These winds—the Sirocco (Italy), the

Chamesin (Israel), the Foehn (Central Europe), and the Santa Anna (California)—have long been associated with various ailments in the folklore of their area.

Air ions can be artificially produced by thermionic emission, charge separation, gamma radiation, and high voltage discharge (corona discharge). This last is the most common method and has been used in our experiments.

There have been several inconclusive studies on the effect of negative air ions in asthmatic subjects. Osterballe *et al*³ showed a slight improvement in lung function with both negative and positive air ions compared with controls in a group of asthmatic subjects. The period of exposure was short and there was no change in sensitivity to inhaled histamine. Jones *et al*⁴ studied longer term exposure and showed some benefit in symptom scores and peak expiratory flow rates in some patients.

We report here the results of a six month double blind, crossover study of negative ion generators in a group of asthmatic subjects.

Methods

We studied 20 adults with asthma; one was withdrawn from the study in the initial assessment period

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Table 1 Characteristics of patients participating in the study

	Group 1 (n = 10)	Group 2 (n = 9)
Sex (M:F)	8:2	2:7
Mean age (y)	33.9	39.6
Mean height (m)	1.74	1.65
Mean baseline/ predicted peak expiratory flow rate	0.73	0.69

because of his admission to hospital for treatment of severe asthma. The remaining 19 (10 men and nine women, mean age 36 years) gave their informed consent to participation in the study. Subjects were randomly allocated to two groups to receive either an active or an inactive negative ion generator for the first observation period. Table 1 shows the characteristics of the two groups.

The asthmatic subjects were initially assessed by clinical examination; measurement of peak expiratory flow rate (PEFR), height and weight, and skin prick tests for common allergens to detect atopy. Subjects with immediate hypersensitivity to more than one allergen were classified as atopic. At the first visit the use of the peak flow meter and of the diary card was explained. The use and nature of the ioniser were explained and the aim of the study was discussed. The double blind crossover with placebo, however, was not explained. Subjects were asked to continue with their previous medication and any variation in dosage of bronchodilators was left to their discretion. Dust and negative ion counts were meas-

ured monthly in their bedrooms with a RADeCO air sampler and a Medion Atomospheric Ion Analyser.

Subjects were assessed by diary cards, on which they recorded symptom scores, medication, and PEFR as measured with a Wright peak flow meter. PEFR was recorded when they woke up and before they retired, the best of three blows on each occasion being noted. Symptoms were scored as follows: wheeze (0-3), activity (0-3), cough (0-2), sputum production (0-2), and disturbance of sleep by asthma (0-3). Consumption of inhaled or oral bronchodilators, corticosteroids, sodium cromoglycate, and other medications was also recorded.

All subjects were asked to record the data during an initial run in period of two weeks without any ioniser installed. They were then provided with a negative ion generator for the next eight weeks. Generators were installed with a time switch which activated the device from 10 pm to 8 am. Subjects were asked to sleep on cotton or cotton mixture sheets to promote adequate earthing. Measurement of ion counts were obtained in the bedroom before and after the device was activated. Samples of airborne dust were obtained monthly. Ion counts were maintained above 150 000/ml at the level of the subject's pillow. These measurements were obtained by a physicist who took no part in assessment of the subjects. Subjects were not informed of the dust or ion counts obtained in their homes.

The two randomly assigned groups were given active or inactive placebo ion generators initially and crossed over to receive the alternative in the second eight week observation period after a four

Table 2 Peak expiratory flow rate (PEFR, l/min), symptom scores, and medication scores (means with standard deviations in parentheses)

Group 1					
Period code	B No generator 2	D Active generator 8	F No generator 4	H Placebo generator 8	J No generator 4
No of weeks					
Morning PEFR	399 (132)	403 (120)	423 (126)	416 (121)	407 (130)
Evening PEFR	442 (126)	435 (103)	459 (116)	454 (115)	443 (121)
Symptom score*	1.80 (1.85)	1.31 (1.49)	1.03 (0.84)	1.04 (1.42)	1.59 (1.61)
Medication*	5.85 (2.89)	5.96 (2.99)	5.33 (3.48)	5.16 (3.12)	5.52 (3.38)
Group 2					
Period code	A No generator 2	C Placebo generator 8	E No generator 4	G Active generator 8	I No generator 4
No of weeks					
Morning PEFR	295 (138)	294 (152)	296 (153)	317 (151)	308 (155)
Evening PEFR	333 (122)	331 (128)	324 (142)	344 (134)	331 (137)
Symptom score*	3.11 (1.29)	2.46 (1.23)	2.50 (1.50)	1.81 (1.39)	2.53 (1.81)
Medication*	6.62 (3.37)	6.72 (4.37)	6.69 (5.58)	5.56 (4.92)	6.03 (4.37)

*See under "methods."

week "washout" interval. Both active and inactive generators were enclosed in a suitable box with a metal screen and disguised to prevent identification of the inactive and active devices. Inactivation was achieved by connecting the corona points to the metal mesh screen. Subjects were not made aware of this aspect of the study.

Group 1 (eight men and two women) received active generators first and after a four week washout interval received the active generators for the second eight week observation period. Group 2 received their inactive ioniser first. Table 2 shows the design of the experiment.

Mean morning and evening PEFs were calculated for each period for each subject. Symptoms and bronchodilator use were scored as outlined above and mean scores for each period were calculated. These values are shown in table 2. Statistical analysis was performed to compare the different periods with Student's *t* test for paired observations using log *e a/b*.

Results

CHANGES IN PEF

When both groups were looked at together, there was no statistically significant improvement in PEF during the active generator periods (D + G) over the times when there was either a placebo (H + C) or no generator (A + B, F + E, J + I). There were no significant differences in PEF between periods without a generator and periods where a placebo generator was installed (A:C, F:H, H:J, C:E).

CHANGES IN SYMPTOM SCORES

When both groups were analysed together, there was no significant improvement in symptom scores during the active ioniser periods (D + G) over the placebo (H + C) or no generator periods (A + B, F + E, J + I).

CHANGES IN BRONCHODILATOR USAGE

There were no significant differences in bronchodilator consumption between periods where active and placebo generators were installed. Similarly, there were no significant differences between the no generator and active generator periods.

ION COUNTS AND DUST LEVELS

No significant differences were seen between the two groups with regard to dust counts obtained in the subject's bedrooms. The mean dust count for group 1 was 7.1×10^{-8} (SD 3.3×10^{-8}) and for group 2 10.2×10^{-8} (5.19×10^{-8}).

In group 1 the mean ion count was 1546 (SD 647) units before and 203 000 (38 600) units after the

ioniser had been activated. In group 2 the mean count before activation was 1675 (957) units and afterwards 183 000 (28 700) units. No significant differences were found between the groups either in initial counts or in those obtained after activation of the ionisers.

Discussion

The presence of atmospheric electricity has been discussed since its discovery by Benjamin Franklin in the mid eighteenth century. The Abbé Nollet⁵ in 1752 suggested that the course of disease could be influenced by the phenomenon. The relationship between atmospheric electricity and charged air ions was shown by Elster and Gietel⁶ in 1899.

With the development of ion generators it became possible to study the effect of these ions when their concentration was raised 10–50 fold above the normal atmospheric levels of 1500–4000/ml. Since then negatively charged ions have been shown to inhibit the growth of bacteria and fungi,⁷ affect the growth of cells in tissue culture,⁸ and influence the mortality from pulmonary infections in mice.⁹

Many studies, largely uncontrolled, have been undertaken on respiratory disease, in particular asthma. Several workers^{10–13} have reported a temporary improvement in asthmatic symptoms on exposure to negatively charged air ions while others¹⁴ have failed to confirm this effect. Exposures were short and generally only subjective assessments were used to judge the response. The more objective assessment of Osterballe *et al*³ showed that short term exposures of 15 minutes to ions of both charges caused small changes in forced expiratory volume in one second (FEV₁) but no change in bronchial reactivity to inhaled aerosols of histamine.

In the only longer term study previously performed⁴ seven patients completed diary cards and measured PEF for a 16 week period comprising a four week placebo period, an eight week active generator period, and a four week period without a generator. There was no crossover and no account was taken of seasonal or environmental changes which would have effected all subjects at the same phase of the study. The authors found a significant and sustained improvement in morning PEF in four of seven patients and in evening PEF in three.

In our study the provision of a negative ion generator did not significantly affect lung function as assessed by objective measurement. Symptom scores and consumption of medication were similarly unchanged.

Negative ion generators are known to enhance the precipitation of airborne dust and any benefit shown in earlier ioniser studies^{3,4} could have been attribut-

able to this phenomenon. A previous study with electrostatic precipitators¹⁵ failed to show any significant benefit in asthmatic subjects. This study has been criticised, however, in that any improvement might have been offset by the production of positive air ions by the precipitators used.¹⁶

Another possible mechanism was suggested by Kreuger,¹⁴ who showed that positively charged ions caused a reduction in tracheal ciliary activity and increased contractility in tracheal smooth muscle, an effect thought to mimic the action of serotonin. They postulated that negatively charged air ions might influence serotonin metabolism. Other workers, however, have failed to confirm these findings.¹⁷ Some support for the suggestion offered by Kreuger is found in the observation¹⁸ that blood serotonin concentrations fall in rats exposed to negative air ions while an opposite effect is seen when they are exposed to positive ions.

One possible cause of our failure to demonstrate significant benefit in asthmatic subjects from the installation of negative ion generators could be the bronchoconstrictor action of ozone produced by the corona discharge. Bench testing of ionisers before installation, however, failed to detect ozone when measurements were made 2 metres from the discharge points.

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