

Exercised Induced Asthma in Young Male Asthmatics with Symptoms, and in Remission

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ABSTRACT: A treadmill exercise test was carried out on 154 male subjects aged 15-25 years who gave a history of mild asthma in childhood, and on 31 similarly aged control subjects. The results were expressed as an exercise lability index, (ELI), based on measurement of FEV₁. The mean ELI of the control group was 7.6%, range 2.9-12.2% and a positive result in the asthma subjects was an ELI greater than 15%. Seventy five of the asthma subjects were found to have been asymptomatic for a year or more (group 1) and, in 15 of them (20%) the test was positive. The remaining 79 were currently symptomatic, or had been symptomatic within a year (group 2), and in 52 of these (66%), the test was positive. The difference between the two results was significant, $p \geq 0.001$. We believe this observation suggests that exercise induced asthma (EIA) cannot be demonstrated in the majority of asthmatics who are in remission.

Introduction

A large proportion of childhood asthmatics improve as they enter adolescence; some remit completely, others suffer occasional relapses^{1,2} and provocative exercise testing has shown persistence of EIA even in apparently normal adult ex-asthmatics^{3,4}. Recently however EIA was shown to exist in a group of children only whilst they suffered from asthma, and disappeared when the disease went into remission⁵.

Exercise is considered to be an infrequent cause of asthmatic attacks in adults⁶, though in our experience it is not an uncommon condition, particularly in military training where vigorous, sustained physical exertion frequently produces asthma in predisposed individuals.

Since 1979 we have used a standard treadmill test to help us identify those potential recruits with a past history of asthma most likely to develop EIA in training and we have used the same test in recruits who have developed symptoms of EIA in training.

We report here the results of applying the test to these two groups and to a further group of normal control subjects of approximately the same age.

The 154 subjects of the study were all young men with a past history of childhood asthma who were referred for exercise testing either before military training or as a result of developing symptoms during it.

Materials and Methods

Before the treadmill test each of the subjects was interviewed, and questioned carefully by either of us, about trivial or previously unnoticed symptoms of asthma at rest or on exercise. They were asked about smoking, and also symptoms suggestive of an atopic diathesis. We were then able to form two groups of subjects, the first consisting of those who claimed to have had no symptoms of asthma for at least a year, and were

judged to be in remission, and a second consisting of subjects who had mild symptoms of asthma currently, or within a year.

Group 1 (In remission). Consisted of 75 subjects, with an age range of 15-25 years and a mean age of 18.4 yrs \pm 2.5 (SD) and mean duration of remission of 7.6 years \pm 4.63 (SD). All of these subjects were referred to the Army Chest Centre after their initial medical examination for specialist's opinion on their past history of asthma; none had undergone military training therefore.

Group 2 (Symptomatic). Consisted of 79 subjects with an age range of 16-25 years and a mean age of 18.6 yrs \pm 2.2 (SD). Some of these subjects were referred with asthmatic symptoms noted at their initial medical examination, before military training; the remainder were judged fit at this stage and referred when symptoms of EIA developed during military training. (It is now official policy for all potential recruits with a past history of asthma to be referred for specialist opinion.)

Group 3. Consisted of 31 subjects who had completed military training and had no history of past or present respiratory symptoms. Their age range was 16-29 years, and a mean age of 20.32 yrs \pm 2.6 (SD).

The test procedure was as follows. The small number of subjects in group 1 who were receiving treatment were asked to discontinue the night before the test. All the tests were carried out between 9.30 and 11.30 am. The ambient temperature range was 17-25°C, mean 20.6° \pm 1.7 (SD). Before the test the subjects' FEV_{1,0} and FVC was measured on a dry wedge spirometer (Vitalograph Ltd) and the best of three measurements selected as the baseline. The FEV₁ was then measured at 1, 3, 5, 7, 9 and 12 minutes after the test and the ELI calculated using the following formula:-

$$ELI\% = \frac{\text{Highest FEV}_1 - \text{Lowest FEV}_1}{\text{Baseline FEV}_1} \times 100\%$$

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and a result exceeding 15% was regarded as positive. The treadmill settings were the same for all the subjects, the speed was 6 km.h, incline 90, and duration 6 minutes.

The difference in the percentage of positive tests between the two groups, the relationship between age, smoking history and a positive result was analysed for statistical significance using the Chi-squared test with Yates continuity correction.

The mean ELIs of the three groups were transformed by natural logarithms and then compared by means of unpaired *t* tests. The relationship between duration of remission and a positive result was tested by Fisher's exact test.

Results

Group 1. In 15 of the 75 subjects or 20% the test was positive (Fig 1). The mean ELI for the group was $10.6\% \pm 6.8$ (SD) (Fig 2). The mean duration of remission was 7.6 years ± 4.63 (SD), range 1–16 years (Fig 3). Twenty one of the 47 subjects or 45% of those questioned about it, smoked, and 39 of 75 or 52% gave a history of atopy.

Group 2. In 52 of the 79 subjects or 66% the test was positive (Fig 1). The mean ELI for the group was $21.8\% \pm 14.3$ (SD) (Fig 2). Twenty seven of the 51 or 53% subjects questioned about it smoked and 42 of 79 or 53% gave a history of atopy.

The difference in the percentage of positive tests between the two groups was statistically very highly significant ($p > 0.001$).

The positive test results in each study group were then

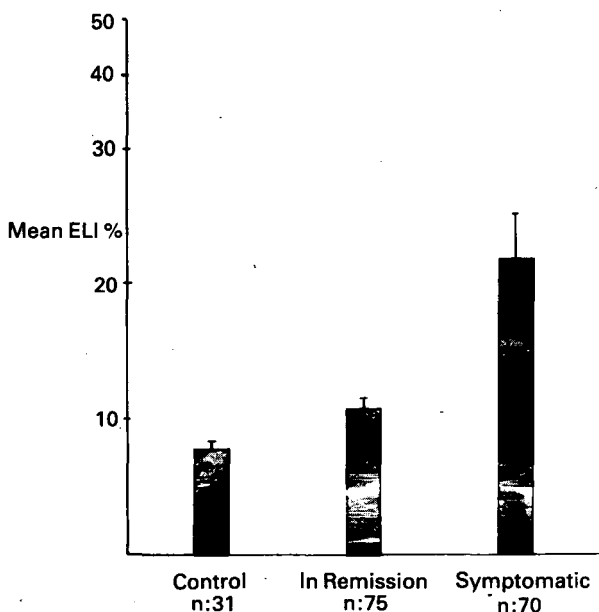


Fig 1 The proportion of the two study groups with a positive test

divided into subgroups by age; atopic history; and smoking history; and the proportions examined by the same statistical method. It was found that there were no statistically significant differences by age, atopic status or smoking history (Table I).

Group 3. The mean ELI of the 31 subjects was $7.6\% \pm 2.6$ (SD), range 2.9–12.2% (Fig 2).

Discussion

We have shown that if young men with a past history of childhood asthma undergo an exercise test then there is a significant difference in the percentage of positive tests between those in remission and those with persistent mild asthma, such that the former are much less likely to have EIA. We believe that this finding supports the observation that EIA is no longer detectable when asthmatic children enter remission⁵ and is at variance with the finding of persistent EIA in asymptomatic late adolescents and young adults^{3,4}. The

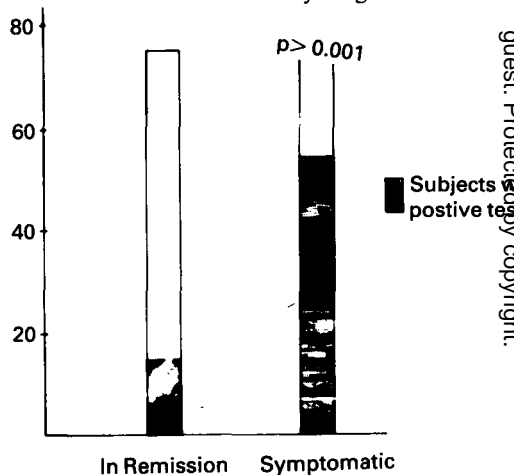


Fig 2 Mean ELI (+SEM) for all three groups

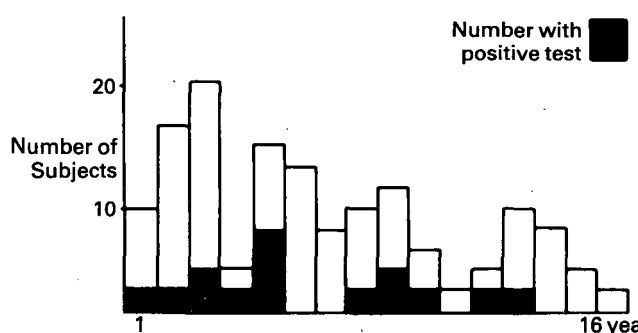


Fig 3 The relationship between duration of remission and the proportion of positive tests in each yearly sub-group of group and subjects, (not statistically significant)

Table I
Positive exercise test results in the two study groups divided into age sub-groups, and according to atopic and smoking history

| | Years | Total n | Positive test n | % Pos | Chi ² |
|-----------------|-------------|------------|--------------------|-------|------------------|
| Group 1 | 15-20 | 57 | 11 | 19 | NS |
| | 20-25 | 18 | 4 | 22 | |
| Group 2 | 15-20 | 65 | 41 | 63 | NS |
| | 20-25 | | | | |
| Atopic History | | | | | |
| Group 1 | Present | 39 | 7 | 18 | NS |
| | Not Present | 36 | 8 | 22 | |
| Group 2 | Present | 42 | 28 | 67 | NS |
| | Not Present | 37 | 22 | 59 | |
| Smoking History | | | | | |
| Group 1 | Smokers | 21 | 6 | 38 | NS |
| | Non-Smokers | 26 | 7 | 27 | |
| Group 2 | Smokers | 35 | 26 | 74 | NS |
| | Non-Smokers | 22 | 12 | 55 | |

strength of this conclusion depends upon firstly, the accuracy with which our subjects were divided into the two groups and secondly the validity of the exercise test procedure we used.

We relied on an interview carried out by one of us to determine whether our subjects were in remission or otherwise as we believed that this was the best way to discourage potential recruits from concealing symptoms. There was an inconsistency between the interview and the exercise test result in that 15 of the 75 subjects in group 1 judged as in remission did have a positive test. This could have arisen either because the initial interview failed to uncover mild symptoms of asthma or because some of the subjects were unaware of persistent mild obstruction as many asthmatics are⁷. Of the remaining 61 subjects in remission the interview findings were confirmed by the exercise test result and later by military training, in that all but two completed this without developing EIA.

The gradient and speed of the treadmill together with the duration of the test were the same for each of the subjects and were estimated, using published data⁸, to produce a total oxygen consumption close to the 200 mls/kg body weight at which it is suggested⁹ the maximal

amount of EIA is produced. It has been recommended that the slope or speed be adjusted to provide a maximal stimulus appropriate for each subject's age and height¹⁰; in practice we have found the test provides an adequate test stimulus as we have demonstrated EIA in 46 of 50 trained soldiers with asthma¹¹.

Our control group underwent the same exercise test as the other two groups and the upper limit of normal for the ELI was based on the mean ELI of this group plus three standard deviations, 15.4%. A fall in FEV of 20% has recently been recommended¹⁰ as the level at which exercise induced changes are significant, but in our experience an upper limit of normal for the ELI, of 15% when used with out treadmill test is sensitive and specific.

It is of interest that there did not appear to be a significant fall in the percentage of positive tests with the increase in duration of remission (Fig 3). Of the five subjects who had been in remission for just one year, in one only was the exercise test positive. That EIA is no longer demonstrable within months of the patient entering remission is also suggested by the study referred to earlier⁵ in which the children were tested at six monthly intervals on a treadmill, and did not display EIA in the next test after they had gone into remission.

In conclusion we believe our results generally support the view that EIA is part of the clinical spectrum of asthma⁵ and does not persist when the asthmatic is in remission, and that the test is best used by us to determine whether potential recruits with a past history of asthma are truly in remission or have persistent increased airways liability.

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