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EDITORIAL

Exercise-induced asthma in children

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"If from running, gymnastic exercises, or any other work, the breathing becomes difficult, it is called Asthma (αστμα)". Aretaeus the Cappodician; 1st Century AD [1].

Exercise-induced bronchoconstriction (EIB) was long ago recognized as a manifestation of asthma [1], and exercise-induced asthma (EIA) is a common presentation of childhood asthma. Backer and Ulrik [2] reported that 16% of 494 healthy Danish children and adolescents had a fall in forced expiratory volume in one second (FEV_1), of 10% or more after exercise test, and EIB is reported to occur in 70–80% of asthmatic children and adults [3]. EIA represents a major impairment of the everyday life of asthmatic children, influencing their self-perception, as they appraise themselves to a major extent by their successes in physical skill and mastery. Based upon the 1988 National Health Interview Survey in USA, Taylor and Newacheck [4] recently reported that of 2.7 million American children with asthma, 2.6% were unable to conduct major activities, compared to 0.3% of all children without asthma. Approximately 30% of asthmatic children had some limitations in activity, compared to 4.5% of children without asthma [4]. These limitations in physical activity remain a major obstacle to the asthmatic child's social and physical functioning.

When studied in a standardized way, EIB may be regarded as a measure of nonspecific bronchial hyperreactivity [5]. EIB is thought to be elicited by mediator release, provoked by respiratory heat and water loss, causing a change in osmolality of the pericilliary fluid lining the respiratory tract [3]. EIB is, therefore, considered an indirect measure of nonspecific bronchial responsiveness, whereas bronchial responsiveness measured by methacholine or histamine inhalation is considered a direct measure of bronchial responsiveness [6]. EIB is usually measured by the reduction in FEV_1 from pre- to post-exercise with a submaximal load. Running on a motor driven treadmill for 6 min, with a steady-state heart rate of 170–190 beats·min^{-1}, is a commonly used test. Running is usually more suitable than using a bicycle, as the muscles used during running are better trained as a result of daily life activity than those used during cycling. A reduction in FEV_1 of 15% or more after exercise is usually taken as a sign of EIA [7, 8]. Sometimes 10% reduction is employed [9]. EIB as a diagnostic criterion of asthma has a high specificity, but a low sensitivity, when compared to histamine or methacholine bronchial provocation [10].

A major aim of managing childhood asthma is to help the children to participate in play and sports on an equal level with other children. The follow-up statement from an international paediatric asthma consensus group [11] states as the primary aim of management: "The goal of treatment should be to allow children to be involved with normal activity, including full participation in exercise and sport." This is indeed possible, as 41 Olympic medals, including 15 gold medals and 21 silver medals, were won by American athletes suffering from EIA, during the XXIII summer Olympic games [12].

The high incidence of EIA among elite athletes raises the question of whether physical training with a high intensity level may, in itself, enhance bronchial responsiveness. Several studies suggest that short-term exercise with a high intensity level increases bronchial responsiveness [13–15]. It has been suggested that late bronchial response after exercise, in the same manner as after allergen bronchial challenge, might increase nonspecific bronchial responsiveness [16]. However, Boner *et al.* [8] found no increase in nonspecific bronchial responsiveness after late bronchial responses to exercise. They found that late responses after exercise were not reproducible, and suggested that these late reactions might have been within-day fluctuations in bronchial calibre, and pathophysiologically different from late allergen reactions [8]. Nevertheless, exercise testing in the laboratory at a submaximal level, is not comparable to the exercise intensity which elite athletes in endurance sports employ during their training. In the predisposed individual, high intensity training for 2–4 h daily for several years, may provoke airways inflammation, especially when combined with unfavourable environmental conditions, such as cold air temperature or air pollution [17, 18]. This conjecture is in agreement with reports of high prevalence of bronchial responsiveness among highly trained athletes [19].

Cochrane and Clark [20] found that submaximal training of controlled intensity, performed throughout three months, did not change bronchial responsiveness (histamine challenge) in adults with asthma, but improved fitness and cardiorespiratory performance. Nickerson *et al.* [21] reported that EIB and resting pulmonary function did not change after a distance running programme for six

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weeks, in 15 children with severe chronic asthma, whereas fitness improved. These are important observations, as improved fitness and physical endurance may be obtained through planned training, without intensifying the bronchial responsiveness [15]. The quality of life in children, which is connected to their physical performance, may improve through careful training and education, and their mastery of the illness may be further enhanced by appropriate medication.

Bronchodilating drugs taken prior to physical activity, especially inhaled β_2-agonists, are commonly used to prevent EIA. Also, the long-acting β_2-agonist, salmeterol, has been shown to be effective in this respect [22].

As EIB may be a manifestation of ongoing inflammatory processes in the respiratory tract [3], the use of anti-inflammatory drugs is important in the prevention of EIA. Inhaled disodium cromoglycate has been shown to be effective taken shortly before exercise, either alone or in combination with an inhaled β_2-agonist [23]. On the other hand, the use of an inhaled corticosteroid taken shortly before exercise has not been proven effective against EIA [24], even though a bronchodilating effect has been demonstrated by inhaled budesonide [25].

Corresponding to common clinical experience, WAALKENS *et al.* [9] demonstrate nicely, in the present volume of the journal, the beneficial effect of long-term inhaled budesonide upon EIA in children. Using the criteria of EIA, of a reduction in FEV_1 or peak expiratory flow (PEF) of 10% or more after exercise with submaximal load, they found an occurrence of EIA in 82% of asthmatic children using inhaled bronchodilator + placebo, in contrast to 55% of asthmatic children on inhaled bronchodilator and inhaled budesonide. After two months of treatment with bronchodilator and inhaled budesonide, the occurrence of EIA decreased to 59% in the initial placebo group. In this group, the mean reduction in PEF after exercise decreased from 33 to 16% after two months of inhaled budesonide [9]. This reduction and stabilization in indirect nonspecific bronchial responsiveness occurred much sooner than the reduction and stabilization (20 months) in direct nonspecific bronchial responsiveness (provocative dose of histamine producing a 20% fall in FEV_1 (PD_{20}-histamine)) previously reported from the same study group [26]. This improvement in EIB occurring over a two month period is an important observation, which should be employed in clinical practice when treating asthmatic children, and also when starting physical training programmes for asthmatic children. However, the results from this study also underline that in most asthmatic children EIA may not be completely abolished, even with the use of inhaled steroids, and that the pre-exercise use of inhaled β_2-agonist should not be omitted, even with improved symptom control. This message is also important when treating asthmatic athletes, in order to help them fulfil their goals in sport.

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