Exercise reconditioning and sports practice in asthma*

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ABSTRACT:

The spectrum of disability in patients with asthma is very wide. Pure exercise-induced asthma does not preclude competition at the highest competitive level. The pathophysiology remains controversial, but treatment can often be controlled by adjusting the pysical variables linked to the condition combined with key drug medications, inclusive of beta-adrenergic agents. Lack of cardiorespiratory fitness in children and young adults with asthma is a cause of considerable concern and links in part to the perception of "risk" of exacerbation or death.

Practical approaches to exercise rehabilitation include identification of outcome objectives such as improved cardiovascular fitness, or simply increased mobility within the confines of unchanged disease activity. Exercises evaluation is a prerequisite for rehabilitation programmes and a variety of simple screening tests are available.

KEY-WORDS: Asthma exercise and sport

This paper reviews the important topic of exercise-induced asthma, the relationship of asthmatics to exercise and their management, with particular reference to rehabilitation. There is a spectrum of disability in patients with asthma varying from very mild disease, including pure exercise-induced asthma (EIA), *i.e.* with no interval bronchospasm, to severe disease with continuous airflow obstruction and a corresponding reduction in exercise capacity. Thus, there is a variable relationship between asthma and exercise across the spectrum of disease. On the one hand, for certain asthmatics participation in sport is possible at the highest competitive level, *e.g.* 67 of 597 US athletes in the 1984 summer games suffered from EIA. These athletes won 41 medals (15 gold, 20 silver and 6 bronze)[1]. On the other hand, the term "exercise-induced asthma" suggests to some asthmatics that exercise may have a deleterious effect on their underlying disease as found in other diseases *e.g.* angina and osteorarthritis. The impact of this goes far beyond the management of simple exercise-induced asthma, which can usually be safely and effectively controlled with appropriate pre-exercise medication, to affect the asthmatic population in general, who through fear of exercise of rehabilitation treatment is, therefore, not only to provide exercise programmes for these patients, but to promote the habit of regular participation thereafter by improving self-awareness and dissipating fear.

PHYSIOLOGICAL ASPECTS OF EXERCISE-INDUCED ASTHMA

One to two minutes of strenuous exercise causes slight bronchodilatation in normal subjects, which lasts no more than 5 min. Six to 12 min of rigorous exercise usually elicits airway obstruction, either during exercise or more often within 5-10 min. afterwards[2]. The bronchospasm may not return to pre-exercise baseline for over 2h, and a late phase asthmatic response may occur, although its incidence is the subject of debate[3]. Exercise-induced asthma is often also associated with a refractory period. If within 40 min after the provoking exercise the patient repeats the same exercise intensity, a milder EIA response will occur. Successive short exercise bouts elicit smaller falls in forced expiratory volume in one second (FEV_1) and intervals of 2h or more are usually associated with restoration of hyperresponsiveness to its usual level[4]. The type of exrcise is an important factor influencing the precipitation of, and severity of, exercise-induced asthma. Each of the following exercises is slighty more asthmogenic than the one after: free running, treadmill running, cycling, walking, swimming and kayaking[5]. For a specific type of exercise, the intensify of work required to produce EIA varies among asthma-prone subjects, but, in general, the most severe asthmatic tend to have the more severe episodes of EIA[6]. A number of theories have been considered and some discounted, to explain the pathophysiology of EIA. Changes in arterial

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blood gases[7], fall in arterial pH[8], temperature change[9], and humidity[10] have all been intensively investigated, and the latter two physiological variables may be co--determinants. It is, however, difficult to weight separately the contributions of these two variables to the production of bronchospasm during exercise, since temperature changes are closely associated with water loss, as can be seen by Deal's equation[11] for respiratory heat exchange:

$$RHE = \dot{V}_E\,[HC\,(T_I - T_E) + HV\,(WC_I - WC_E)]$$

where RHE is the respiratory heat exchange, $\dot{V}_E$ is minute ventilation, HC is the heat capacity of air, T_I is inspired air temperature, T_E is expired air temperature, HV is latent heat vaporisation of water, WC_I is water content of inspired air and WC_E expired air.

THE TREATMENT OF EXERCISE-INDUCED ASTHMA

It is important to note that EIA can be controlled by adjusting the physical linked to the condition. For example, exercising in a warm, humid environment decreases the severity of attacks[12]. Exercising in repeated spurts of less than 5 min each, less than 40 min apart, and breathing slowly through the nose is also effective[13]. Finally, attacks can be diminished through cortical control, *i.e.* using post-hypnotic suggestion[14]. Before considering drug treatment it is also important to note that nasal congestion or obstruction requires treatment either with medication or mechanical removal of an obstruction, such as a polyp. Nasal obstruction correlates directly with the onset of EIA[15]. Also, certain sporting events such as water sports which involve pressure changes, if associated with aspiration into the sinus cavities and trauma, predispose to sinusitis, which requires treatment. Atopic and contact dermatitis are commonly associated with grass and equipment usage, and are essential factors to treat. There are four key drug medications available for the treatment of EIA: 1) beta-adrenergie agents; 2) sodium cromoglycate, 3) theophypllines; 4) anti-cholinergics. The first two agents are the most effective, and one can predict that in the vast majority of patients, exercise--induced asthma can be prevented simply by premedication with beta-adrenergic agents prior to participation in sport. These medications vary in absorption time and duration of effect[16].

ASTHMA AND EXERCISE

This section considers the relationship of asthma to exercise capability, as distinct from EIA. It is often not appreciated that exercise capability does not directly correlate with disease severity. Perception of "risk" of exacerbation or even death is a major inhibitory factor[17]. For example, in 90 children with moderately severe to severe but stable asthma, levels of fitness, medical and psychological criteria were tested using regression analysis. Psychological factors accounted for a highly significant amount of variability in performance, suggesting that mental adjustment to the disease is at least as important as severity of the disease in determining fitness[18]. An interesting study has recently demonstrated that experimentally-induced "harmful anticipation" has a major influence not only on subsequent exercise performance but even on somatic responses, such as peak flow measurement[19]. It is perhaps, therefore, not surprising that there is compelling evidence that suboptimal fitness is common in asthmatic patients. Four studies in particular demonstrate this. LUDWICK et al.[20] in an evaluation of cradiopulmonary endurance in 65 children aged 8 to 17 yrs, with moderately severe to severe asthma quantified endurance by a maximal exercise protocol with a bicycle ergometer. Fifty percent of the children had values >2 SD below the mean, a level that defines severe abnormalities in conditioning. An additional 10% were within 1-2 SD below the mean. ORENSTEIN et al.[21] measured exercise tolerance by peak oxygen consumption and workload in 39 children with asthma who required long-term oral or aerosolized bronchodilator therapy. Peak oxygen consumption was significantly lower in the children with asthma than in the normal children. We[22] recently studied 64 young adults with asthma (mean age 27 yrs) who were compared to age anf activity-matched control subjects. Although there was no significant difference in heart rates achieved during maximum exercise, the subjects with asthma had significantly lower mean oxygen consumption and oxygen pulse, both indicative of poor fitness. The cardiovascular fitness results did not correlate with FEV_1 either before or after bronchodilator. At a level of submaximal work sufficient to guarantee cardiovascular conditioning, ventilatory reserve, *i.e.* minute ventilation/maximal voluntary ventilation (V_E/MVV), was only 40% and, therefore, we concluded that there was residual capacity to improve fitness.

Perhaps the greatest cause of concern is the identification of poor cardiorespiratory fitness in this age spectrum, *i.e.* children and young adults for whom the long-term consequences are ominous. Epidemiological studies confirm the results of these more detailed laboratory investigations *e.g. STRUNK et al* [23] used a standardized 9 min run to document the fitness of 76 asthmatic children aged 9-17 yrs. Normal values for this test have been obtained in studies of over 12,000 normal boys and girls ranging in age from 6-17 yrs. Seventy four percent of the patients scored below the 25 th percentile for the 9 min run, indicative of poor fitness. Anthropometric measurements were not significantly different from the normal range, and it can be concluded that asthmatic status, rather than co--existing factors, determines poor fitness levels.

PRACTICAL APPROACHES TO PULMONARY REHABILITATION

If exercises is to be habitual, it should be easily accessible and without adverse sequelae. Ideally, it should also be dynamic, interesting, fun and varied [24]. Most communities are receptive to providing health in the rehabilitation process. Sponsored programmes, dance classes, swimming clubs, ice skating, etc. may be available "at special rates". The role of a formal pulmonary rehabilitation programme for asthmatic patients it to provide the principles of exercises based on objective evidence of patient capability within the confines of his/her disease. The setting of appropriate expectations can minimize restrictions both from the disease and its treatment. Progress with rehabilitation goals, therefore, requires access to vocational physicians with appropriate facilities to provide objective measurement.

In considering the golas of exercise rehabilitation programmes, two outcome objectives need to be identified: a) to improve cardiovascular fitness and/or b) to improve mobility within the confines of unchanged cardiovascular fitness.

To achieve the first goal general principles relating to aerobic training should be applied. The patient requires to perform aerobic (continuous and rhythmic) exercise of 20-30 min duration, a minimum of 3 times per week. The exercise intensity should be sufficient to increase oxygen uptake to 60-70% maximum, a level that usually correlates with a heart rate of between 70-80% maximum. The exercise period should be preceded by 5-10 min of warm-up exercises, and followed by a period of gradual cooling down. This is particularly pertinent to the asthmatic patient with exercise-induced asthma, although premedication prior to exercise should be sufficient to pre-empt adverse sequelae. The type of exercise employed does not matter, bur adequate exercise intensity should be ensured, most conveniently by the use of heart rate measurements before and after exercise can identify those few patients who develop EIA despite prior bronchodilator medication.

The alternative training strategy for patients with moderate to severe asthma, who cannot sustain exercise of sufficient intensity to improve aerobic fitness because of breathlessness, consists of conditioning of peripheral muscles to improve mobility. It must be remembered that inactivity due to breathlessness results in secondary peripheral muscle deconditioning. Many asthmatics will for example have leg or arm fatigue as a limiting sympton, depending on the exercise strategy chosen. From this, it can be concluded that sequential isolated conditioning of individual muscle groups, *e.g.* anterior, deltoid and quadriceps muscles, will not only improve the strenght and endurance of these muscles but perhaps even improve overall exercise tolerance, as judged by simple walk tests despite no change in the maximal achievable oxygen consumption[25].

THE OUTCOME OF REHABILITATION PROGRAMMES FOR ASTHMA

The outcome of rehabilitation programmes for asthma has recently been reviewed in detail[26]. Several key studies have demonstrated that patients with asthma will improve fitness between 10-92% after various exercise training programmes [20,21,27-29]. Other benefits include reduced breathlessness and minute ventilation at equivalent work after training, but no change in underlying disease activity as determined by bronchoprovocation testing[27]. The latter study hypothesized that a reduction in ventilation at equivalent workloads could explain sporadic reports of improvement in EIA after training.

Finally it should be stressed that exercise evaluation for participation in rehabilitation programmes should provide information regarding the level of fitness of subjects compared with normal predicted values, and also an understanding of the basis for decreased exercise capacity. Tests should be performed using premedication with bronchodilators, so that EIA provides no limitation. Progressive incremental exercise testing to a symptom-limited maximum is the method of choice, but other standardized tests are available for "field" screening, with peak flow measurement before and after exercise, and these have recently been reviewed[30].

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