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Editorials

Asthma and exercise: a suitable case for rehabilitation?

Asthma and exercise have a difficult relationship. On the one hand, certain people with asthma can participate in sport at the highest competitive level.[1 2] Sixty seven of 597 (11·2%) American athletes in the 1984 Olympics suffered from asthma, despite which they won 41 medals.[3] On the other hand, there are few medical conditions (angina and osteoarthritis are two others) where exercise has such a direct and potentially deleterious effect on the underlying illness. Asthma is perhaps unique, because of our use of the term exercise induced asthma, in presenting to public consciousness the image of a negative relationship between exercise and the disease. Not surprisingly, particularly in view of the current debate on the cause of deaths from asthma,[4] there is considerable uncertainty among asthmatic patients, the parents of asthmatic children, and doctors about what constitutes safe exercise in asthma. This provides the respiratory specialist with a window of opportunity for extending the management of asthma beyond the traditional goals towards assisting patients to achieve their maximum potential in work and leisure pursuits. The principles of exercise testing and prescripton are simple[5] and can be usefully applied by the respiratory specialist; special expertise in exercise physiology is not required. Such an approach would incorporate the practice of pulmonary rehabilitation into the management of asthma. The paradigm of pulmonary rehabilitation treatment has been defined as "the art of medical practice where an individually tailored multidisciplinary programme is formulated which through accurate diagnosis, therapy, emotional support and education stabilises or reverses both the physiology and psycho-pathology of pulmonary diseases and attempts to return the patient to the highest possible functional capacity allowed by his pulmonary handicap and overall life situation."[6] Most asthmatic patients have mild to moderate disease and therein lies a paradox. Such patients often find their asthma frustrating and disabling precisely because of their expectations of continuing in demanding jobs and their desire to live a normal life, whereas more severely disabled patients and those with chronic symptoms often have different, generally lower, expectations. The important approach of pulmonary rehabilitation[7 8] should therefore not be reserved for patients with end stage chronic lung disease.

Published reports indicate that many patients with asthma are less fit than their condition would allow. These studies of cardiorespiratory performance in patients with asthma have recently been reviewed[9] in terms of the methods used, the categories of patients studied, and the outcomes of various approaches to improving fitness. Four of these studies, which were on patients with asthma of a wide range of severity (three in children and one in young adults), present compelling evidence of a lack of fitness. Ludwick *et al*[10] evaluated cardiopulmonary endurance in 65 children aged 8–17 years with moderately severe or severe asthma. Endurance testing (with a maximal exercise protocol) showed that half had values greater than 2 SD below the mean, a level that defines severe abnormalities in conditioning. An additional 10% were 1–2 SD below the mean. Orenstein *et al*[11] showed that peak oxygen consumption was significantly lower in 39 children with asthma than in normal children matched for activity. Strunk *et al*[12] used a standardised nine minute run to document the fitness of 76 children aged 9–17 years. Seventy four per cent of the patients scored below the 25th centile for the nine minute run, which indicates poor fitness. Anthropometric measurements were not significantly different from the normal range and could not therefore account for the lack of fitness. Clark and Cochrane[13] studied 64 young adults with asthma (mean age 27 years), comparing them with age and activity matched control subjects. The subjects with asthma had a significantly lower mean oxygen consumption and oxygen pulse, both indicating poor fitness, though there was no significant difference in the heart rate achieved during maximum exercise. Although a correlation understandably exists between measures of airways obstruction and exercise tolerance across the broad range of disease,[14] this does not hold within subgroups defined on the basis of severity.[13] Psychological aspects, such as motivation and the perception of "risk" of exacerbations, may influence measures of fitness. Strunk *et al*[15] recently assessed the relationships between levels of fitness and medical and psychological factors in 90 children with moderately severe or severe but stable asthma. Psychological factors accounted for a significant amount of variability in performance, suggesting that mental adjustment to the disease is at least as important as severity of disease in determining fitness. Another study, which examined the attitudes to physical activity and asthma in 408 children, showed that they were more anxious before exercise than normal children.[16] Meyer *et al*[17] have shown that experimentally induced "harmful anticipation" of exercise in adults with asthma has a major influence not only on subsequent performance but even on somatic responses such as peak flow. A recent study on breathlessness during exercise in asthmatic patients, by Mahler *et al*,[18] has shown that for a given exercise prescription asthmatic subjects with broadly similar lung function show considerable variability in breathlessness and also therefore in the perceived "cost" of exercise, which is an important factor influencing motivation to participate.

Benefits of exercise programmes

Exercise programmes and lifestyle initiatives have major benefit in reducing the risk of cardiovascular disease in healthy individuals.[19] There is no reason to believe that this should not occur in patients with respiratory disease provided that they retain sufficient exercise capacity to participate in similar programmes, though further research is required.

The results of various exercise programmes also indicate that many patients with asthma of differing severity have sufficient ventilatory reserve to allow tolerance of training routines. Improvements in fitness ranging from 10% to

92% have been reported (these studies have recently been collectively reviewed in detail[9]).

There is little evidence for the idea that regular participation in exercise improves resting lung function or for the corollary that deterioration occurs as result of not taking exercise. Non-specific bronchial responsiveness remains unchanged,[20] suggesting that reported improvements in exercise induced asthma after training[21] are most likely to be due to the reduction in minute ventilation that occurs at equivalent high intensity work loads,[20] resulting in a decrease in the stimulus for exercise induced asthma rather than any change in the underlying pathophysiological process. There is experimental evidence[22] that the balance between the normal exercise induced bronchodilatation[23] and exercise induced bronchoconstriction may shift slightly in favour of the former after training. This is unlikely, however, to be of additional benefit during exercise in optimal conditions where adequate premedication with β_2 agonists has already been prescribed. The potential benefit of decreased ventilation at submaximal work loads after physical training may result in reduced breathlessness during exercise.[20-22] There may also be a central desensitising effect of physical training on the sensation of breathlessness, akin to the reduction in "perceived exertion" reported in normal individuals. This may be due in part to familiarisation but may also be secondary to the effects of rhythmical repetitive exercise on brain endorphin concentrations.[24] This is analogous to the effects of drugs such as chlorpromazine, which reduce breathlessness by a central (type II) effect independent of changes in ventilation.[25]

In the light of the wide variability in the severity of asthma both between patients and in a given patient at different times, we should have two goals in rehabilitation—firstly, identification of the individual patient's requirements and capability, which necessitates objective measurement of exercise performance and limiting factors; and, secondly, provision of a range of options for improving exercise capacity or mobility, or both, during submaximal exercise, which requires objective measures of outcome to audit the efficacy of particular programmes in individual patients.

There are essentially two different practical strategies for exercise rehabilitation, depending on the patient under consideration.

The first approach is intended to improve cardiorespiratory fitness by aerobic (continuous and rhythmic) exercise of 20–30 minutes' duration at least three times a week. The type of activity is not critical but the exercise preferably should be conducted indoors in conditions of warmth and controlled humidity, with appropriate warm up and warm down components to reduce the likelihood of breakthrough exercise induced asthma.[26] The exercise intensity should be sufficient to increase oxygen uptake to a level that correlates with a heart rate (measured by the patient) about 70% of the predicted maximum.[5] Individual exercise evaluation using progressive incremental exercise testing may be helpful both to identify the most appropriate training intensity in the light of the patient's ventilatory response[13,27] and to monitor the effects of the programme on exercise capacity. Some groups[28,29] have used progressive incremental exercise evaluation to implement training at or around the "anaerobic threshold" identified from the slope of $\dot{V}CO_2/\dot{V}O_2$. This approach also identifies those patients with more severe ventilatory limitation for whom an anaerobic threshold cannot be identified and who require alternative training strategies. For the respiratory physician without routine access to progressive incremental exercise testing a more empirical "trial and error" approach may be effective. This consists of evaluating the tolerability of submaximal exercise at the work intensity that will be required during training, which is expressed in terms of the target heart rate, calculated from the formula for predicted maximum heart rate[5] as follows:

$$[210 - 0{\cdot}65 \times \text{age (years)}] \times 0{\cdot}7$$

With a "rule of 5s," a treadmill, and simple heart rate monitor, this can be achieved in about 20 minutes. The first of the four stages is treadmill exercise consisting of a warm up period of five minutes' brisk walking (5 km/h, 0% incline); the second stage is five minutes of relaxed jogging (8 km/h, 0% incline); the third stage is five minutes of relaxed jogging at a low incline (8 km/h, 2·5% incline); the fourth stage, which may be required to achieve the desired work intensity in patients with very mild asthma who have already been conditioned by regular exercise, consists of five minutes of jogging at a higher incline (8 km/h, 5% incline). The patient either will have achieved the target heart rate and tolerated steady state exercise during one of these stages or alternatively will have shown an inability to continue at the required work intensity owing to breathlessness. In either case there will be no need for further evaluation. If symptoms have remained stable with mild but tolerable breathlessness, the patient may be expected to participate in an aerobic exercise programme, with the achievement of improved cardiovascular fitness. Premedication with β_2 agonists is, of course, necessary to prevent exercise induced asthma. Peak flow measurement at the beginning and end of exercise may be used to monitor the effectiveness of prophylaxis against exercise induced asthma. The response to the programme may be evaluated by means of "field tests,"[30] which are simple and do not require sophisticated facilities.

The second approach is for patients who cannot sustain exercise of sufficient intensity to improve aerobic fitness because of breathlessness; they require techniques to condition peripheral muscles with the objective of improving mobility and stamina. Inactivity due to breathlessness leads to peripheral muscle deconditioning, and this is an important additional factor limiting exercise capacity.[31] Such patients with moderate to severe chronic airflow limitation can undertake low intensity isotonic training of individual muscle groups to improve the strength and endurance of these muscles and increase overall exercise tolerance.[32,33] Additional components of this second approach include callisthenics, breathing retraining exercises,[34] and walking at the maximum tolerable rate. Pulse oximetry provides a simple method of identifying the few patients who have arterial oxygen desaturation during exercise, due to exacerbation of ventilation-perfusion abnormalities.[35] These patients form a subgroup for whom there are no guidelines for rehabilitation programmes. Carefully supervised exercise conditioning (based on the second of the two strategies) with oxygen supplementation in a hospital gymnasium setting would seem to be an appropriate approach.

It is important to remember the adage that for "exercise to be habitual it should be easily accessible and without adverse sequelae." Ideally it should also be dynamic, interesting, fun, and varied.[36] Most communities respond to the need for help in the rehabilitation process. Paramedical staff, such as physiotherapists and community nurses, are currently gaining experience in cardiac rehabilitation both in hospital and in the community. The same staff and facilities can be used to provide practical and enthusiastic support in starting programmes for patients with asthma under the direction of the respiratory physician. Sponsored programmes, dance classes, swimming clubs, etc, provide an outlet for patients once a formal pulmonary rehabilitation programme has been completed and an appropriate exercise prescription has been worked out. In our experience patients who participate in the initial supervised process learn about the relation of their illness to exercise performance, gain confidence to continue, and are better motivated and less fearful about exercise thereafter.

The principles of exercise rehabilitation for patients with asthma are applicable across the spectrum of disease but perhaps are most useful early in a patient's disease, when the setting of appropriate expectations can minimise restrictions from the disease. Respiratory physicians can play a leading part by incorporating exercise rehabilitation into the complete management of the patient with asthma.

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