17. Asthma

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Summary

Reduced physical performance is common in both adults and children with asthma. Chronic obstruction of the airways and an increased sensitivity to different stimuli (e.g. physical exertion) contributes to the reduction in performance. Physical activity is valuable and necessary for all persons with asthma. Physical training improves physical capacity, reduces dyspnoea (shortness of breath), and improves exercise-induced breathing difficulties. People with a low to moderate degree of obstruction can take part in physical training on the same terms as healthy individuals. The training should comprise aerobic exercise (fitness training), strength training and flexibility training (see table below). Suitable activities include swimming, ball sports, cycling, walking and aerobic exercise on land and in the water. The recommendation for people with severe obstruction should be strength training, flexibility training and light physical activity.

Type of training	Intensity	Frequency (times/week)	Duration
Aerobic fitness training	Low intensity: > 55% of max HR* > 40% of VO_2 max**	≥ 5	≥ 30 min
	High intensity: > 70% of max HR* > 60% of VO_2 max**	≥ 3	≥ 20 min
Strength training	70% of 1 RM***	≥ 2	8–12 reps, 2–3 sets

* Max HR = Maximal Heart Rate.

** VO_2 max = Maximal Oxygen Uptake.

*** RM = Repetition Maximum. 1 RM corresponds to the maximum weight that can be lifted through the entire exercise movement one time.

Definition

According to the Global Initiative for Asthma (GINA), asthma can be briefly described as follows: Asthma is a chronic inflammatory disorder of the airways, in which the chronic inflammation is associated with airway hyperresponsiveness. The airflow obstruction is often reversible either spontaneously or with treatment (1).

Cause and risk factors

Asthma is a multifactorial and heterogeneous disease. Risk factors include genetic predisposition, atopy (tendency toward allergy) and hyperresponsiveness. In recent years, a relation between overweight and asthma has also been reported in both children and adults (2). Environmental factors such as tobacco smoke and mould and mildew can contribute to development of the disease in children. Approximately 5–15 per cent of people who became asthmatic as adults are classified as occupational asthmatics (3). Among these, are bakery, industry and agricultural workers, hairdressers, and people who have been exposed to welding fumes and solvents.

Prevalence/Incidence

During the past decades, the prevalence of asthma has increased all over the world. According to current Swedish studies, the prevalence in Sweden is approximately 10 per cent (4). The increase is highest in young adults, then drops and is lowest in upper middle age, to increase once again. In adults, asthma is considered a chronic disease, while children often grow out of it (5).

Pathophysiology

Asthma is a disease characterised by an inflammation of the bronchial tubes. A large number of inflammatory cells, including the mast cells, eosinophils, T lymphocytes, macrophages and neutrophils, are involved (1). Inflammation can occur after exposure to things such as allergens (allergy-causing substances) and obstruction is due to a constricting of the smooth muscle, oedema, remodelling (structural changes in the mucous membranes of the airways) and an increase in mucus production (1).

Exercise-induced bronchial obstruction

Most people who have asthma experience difficulty breathing during physical exercise, which is due to exertion causing the airways to constrict (6). This is called exercise-induced airway obstruction. Exercise-induced airway obstruction is defined as a case of a PEF (peak expiratory flow) greater than or equal to 15 per cent, or a FEV_1 (forced expiratory volume in one second) greater than or equal to 10 per cent, in connection with physical exertion (6). The problems arise during physical exertion, or commonly 5–15 minutes

afterwards, and persist for 30–60 minutes. Often symptoms disappear by themselves. The degree of exercise-induced breathing difficulty varies with the intensity of the exercise, the type of activity, and the surroundings (environment) in which the training occurs. Running, for example, produces more problems than jogging or walking. The problems are greatest when training in cold, dry air, and least when training in warm, humid environments. Air pollutants have been shown to increase the level of exercise-induced breathing difficulties. In approximately 20–50 per cent of people with asthma, exercise-induced breathing difficulties can also be observed several hours after the exertion. This is called late-phase reaction.

There are two theories on exercise-induced asthma, the hyperosmolar theory and the airway rewarming theory. The hyperosmolar theory is where the high ventilation during physical exercise leads to drying of the bronchial mucous membrane (the air taken in must be humidified and the airways give off water), which in turn entails a hyperosmolar stimulus. The increase in osmolarity activates surrounding cells, such as mast cells, and bronchial constriction occurs. The airway rewarming theory is where an increased ventilation of air that is colder than body temperature leads to vasoconstriction of the bronchial mucous membrane. After the exertion, vasodilation occurs, and the dilated vessels fill with blood, swelling and obstructing the airways (7).

Symptoms and diagnosis

The diagnosis of asthma is made after a careful case history is taken, where attacks on the airways such as hissing and wheezing, respiratory distress and cough are present (8). The obstruction of the airways should be examined with a reversibility test (a comparison before and after administering drugs to dilate the airway). An increase in FEV_1 of at least 15 per cent (at least 200 ml) or a PEF increase of at least 20 per cent indicates the presence of asthma. A negative reversibility test does not rule out asthma. Continued investigation includes daily registration of PEF in an aim to determine whether a variable obstruction of the airway is present. In the case of asthma, it is typical that the airway obstruction does vary over time. The next step is to perform a steroid test. The patient is given a high dose of oral steroids for 2–3 weeks. During this time, the patient also keeps a PEF diary. Allergy tests and in some cases also a lung x-ray can be included in an asthma investigation.

In exercise stress tests for diagnosing asthma, the exercise should be conducted at a high load (80% of maximal aerobic capacity) (8). The exercise should not be preceded by a warm-up, but should begin at approximately 60 per cent of maximal aerobic capacity and then be increased every minute until the patient is unable to continue. The patient should use a nose clamp to avoid breathing through the nose. A drop in FEV_1 of more than 10 per cent compared to the baseline value should be considered pathological.

Prognosis

The introduction of inhaled steroids has had a big impact on asthma morbidity, prognosis and mortality (9). People with asthma have a larger annual decrease in FEV_1 than

non-asthmatics and asthmatics who smoke have a larger decrease than non-smoking asthmatics (10). Few people with asthma die of asthma. In Sweden, approximately 300 people per year die as a result of asthma.

Treatment principles

Pharmacological treatment

The pharmacological treatment of asthma is effective. Most asthmatics should use inhaled steroids regularly. Treatment with inhaled steroids yields reduced asthma symptoms, better lung function, reduced bronchial response, fewer asthma attacks, improved health-related quality of life, and a reduced risk for death from asthma (4). Maintenance therapy should combine beta-2 agonists with inhaled glucocorticosteroids. Leukotriene inhibitors (Singulair), which are given orally, are an alternative for patients who are unable to inhale. An additive effect is achieved if Singulair is used with inhaled steroid treatment. Singulair also has a protective effect against exercise-induced asthma. In patients who suffer from asthma only periodically, inhalation treatment with short-acting beta-2 agonists should be sufficient. In severe cases of asthma, oral steroids can also be used. In the case of acute deterioration of the disease, repeated doses of beta-2 agonists should be taken and, if symptoms do not subside, the inhaled glucocorticosteroid dose quadrupled. Systemic treatment with steroids can also have a dramatic effect (4).

Pharmacological treatment of exercise-induced obstruction of the airways

Exercise-induced breathing difficulties can be alleviated or even prevented by pre-medicating with beta-2 agonists and/or sodium cromoglycate (Lomudal), 10–20 minutes before the physical exercise (7). Leukotriene inhibitors (Singulair) can reduce or prevent constriction of the airways up to 24 hours after medication (11). Regular treatment with inhaled steroids also reduces the severity of exercise-induced symptoms.

Effects of physical activity

Physical training and physical activity have positive effects, from both a physiological and psychological standpoint, and in both the short- and long term (3 years) (12–14). Patients who have taken part in exercise are less afraid to exert themselves and dare to be more physically active in their daily life.

Acute effects of fitness training

Aerobic exercise improves cardiovascular capacity, measured as maximal oxygen uptake and maximal ventilation output per minute (15). Lung function and hyperresponsiveness are not changed by aerobic exercise. Improvement is seen in asthma and exercise-induced symptoms, and in limitations in daily life, number of visits to the emergency department, and the number of sick days (12, 14). Quality of life can also improve after a period of training (16).

Long-term effects

In the long-term, physical performance can be retained at a moderate level, even in people who have only been physically active in daily life. In people who perform physical exercise regularly, the amount of inhaled steroids has been able to be reduced (13). The number of emergency visits and sick days is also reduced (13).

Indications

Physical training should only be carried out under optimal conditions, that is, when no- or only a low level of obstruction is present. Precaution must also be taken with training in the case of exercise-induced problems. In the case of exercise-induced breathing difficulties, metabolic and circulatory changes occur in the body and we do not know how these changes affect the disease in the long term.

Prescription

Several international studies have shown that physical capacity in children and adults with asthma is lowered (17, 18). Children with asthma choose to a greater extent to participate in physical activities of moderate and low intensity, that is, they avoid high intensity physical activities (19). Many patients also feel physically limited in daily life as a result of their breathing difficulties (20). Breathing problems can also contribute to a strong sense of uncertainty in connection with physical activity, and it is of utmost importance that people unaccustomed to exercising receive advice, information and knowledge on how physical training can be carried out. The training should include aerobic training, and strength, flexibility and relaxation training, as well as breathing exercises.

The recommendation for people with a mild form of asthma, who experience bronchial obstruction only with infections and who are able to manage their exercise-induced breathing difficulties by taking beta-2 agonists before training, is to be physically active or take part in regular physical training to the same extent as healthy individuals (12, 14, 17). Training can occur outside the direction of medical care. For these people, their physical training should only be under the direction of medical care during periods when their asthma is getting worse or when a boost in motivation is needed.

People with variable airway obstruction require the assistance of a physiotherapist to get started with low intensity aerobic training and/or strength training.

People with chronic bronchial obstruction who, despite optimal medication, have significant limitations need the help of a physiotherapist to exercise at the level at which they are able. Training should begin with flexibility training, strength training and light physical activity.

Aerobic training can be carried out at low intensity or high intensity (see Table 1) and either continually or in interval form (21). All activities involving large muscle groups, and thereby loading the oxygen-supplying organs, are beneficial. Suitable activities include swimming, ball sports, cycling, walking and aerobic exercise training on land or in the water. In interval training, 2–3 minutes of high intensity training should be alternated with low intensity training or active rest of 1–2-minute intervals. The training should continue for at least 6–10 weeks. The greatest effect (measured as oxygen uptake) is achieved through high intensity training. Training in a heated pool or indoors should be recommended initially to those who are unaccustomed to exercising, to minimise the degree of exercise-induced breathing difficulties.

Strength training should include dynamic endurance training (see Table 1), above all for the arm, leg, shoulder and core muscles. Each exercise should be performed 8–12 times and repeated in 2–3 sets (21). A rest period of 1–3 minutes should be added between each set. The training should continue for at least 8–10 weeks. With low intensity training (40–50% of 1 RM), the training can occur daily; for higher intensity (60–80% of 1 RM), however, training should occur 2–3 times per week.

Flexibility training should cover flexibility exercises for the neck, shoulders, thorax, thigh and calf muscles, and be included in every training session.

Table 1. Description of different types of training.

Type of training	Intensity	Frequency (times/week)	Duration
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Special considerations for the training

In order to reduce exercise-induced symptoms, the training should be preceded by premedication with beta-2 agonists, 15 minutes before exercising (7). A long warm-up (approx. 20 min), gradual intensification of the warm-up and using interval training has been shown to be highly effective in alleviating or completely preventing breathing difficulties (7). Every training session should end with a 5–15 minute cool-down. A heat

exchanger can be used when training in cold temperatures. People with asthma who experience exercise-induced breathing difficulties can have a refractory response to further exertion, that is, their breathing problems seem less severe in new physical exertions if they occur within 30 minutes to 3 hours (22).

Functional mechanisms

People with asthma with no obstruction achieve the same cardiovascular improvements as healthy individuals achieve after a period of aerobic training (17). The ventilation improvements seen after a training period are likely due to metabolic changes, which would also occur in healthy individuals who perform aerobic exercise. The improvement in exercise-induced difficulties can likely be explained in that the minute ventilation for the same exertion decreases after a period of training (14). Physical training, which involves a loading of the body, can probably prevent the development of osteoporosis (brittle bones), a risk that is especially high for steroid-dependent people.

Functional tests

A functional test should be conducted before physical training begins, in part to facilitate planning of adequate training, and in part to facilitate evaluation of the training. In all testing, measurement of PEF and oxygen saturation should be carried out before, during and up to 15 minutes after the test.

Cycling test and treadmill test

Standardised maximal or submaximal tests are carried out to investigate the patient's tolerance and limitations with respect to physical exertion. PEF, heart rate, oxygen saturation, shortness of breath, exertion and chest pain should be recorded both during and for a short time after the test. This type of test can also be used to evaluate the effects of physical training.

Walking test

Standardised walking tests are often used in clinical contexts to assess physical capacity in relation to activities of daily life. In a 6- or 12-minute walk test, the patient is encouraged to walk as far as possible in 6 or 12 minutes, respectively, on a measured stretch of hallway (23, 24). In all of the walking tests, the length of gait, heart rate, oxygen saturation and perceived exertion and shortness of breath are measured on a Borg scale (25). Note that a 6-minute walk test may not be sensitive enough to record changes in relatively healthy people with asthma.

Muscle function

Both dynamic muscle strength and endurance can be measured with isokinetic devices. Dynamic muscle strength can in addition be measured by the repetition maximum (RM), that is, the heaviest weight that can be lifted through an entire movement exercise one time. Dynamic endurance strength can be measured by the person performing a maximum number of repetitions at a given load. After a period of training, the test is repeated with the same load. An increase in the number of repetitions is an indication of an increase in muscle endurance.

Perception of quality of life and symptoms

A person's overall health-related quality of life can be measured with the Short-Form Health Survey (SF-36) (26), while the St. George's Respiratory Questionnaire (27) is often used to measure disease-specific quality of life. The severity of symptoms can be measured with a visual analogue scale (VAS) or the Borg scale.

Risks

No serious events need occur if the patient has undergone a functional test before commencing training, so that the physical limitations the patient demonstrates are known to the person in charge or instructing the training. No intensive training should occur if the disease is deteriorating.

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