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Rehabilitation of a patient with asthma in the outpatient setting

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Asthma is a common chronic illness in all age groups. The goal of treatment of asthma is to allow the individual with asthma to lead a full life. These goals are achieved by (1) providing medically sound management to decrease the extent of airway inflammation and obstruction, thereby reducing asthma symptoms, school/work absences, and hospitalizations; this management should intrude on the life-style of the patient as little as possible, (2) providing education about asthma to decrease anxiety, motivate independence, and encourage self-control of the asthma, (3) encouraging the patient to have normal

Abbreviation used

EIA: Exercise-induced asthma

(or at least close to normal) activity, and (4) providing psychologic support so that the patient can be less anxious and have good relationships with family members and peers. Although these goals are often achieved, some patients do not do well and continue to have frequent episodes of asthma, require medications that cause side effects, and have significant restrictions in daily activities. Achieving the goal of leading a full life is enhanced by careful follow-up and attention to detail by both the family and the physician. Part of the management of patients with asthma involves consideration of the principles of rehabilitation.

Rehabilitation involves all aspects of the patient's care, with the goals of expanding as much as possible the patient's potential (mental, social, and economic) while the restrictions from both disease and its treatment are being minimized. Achieving these goals re-

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quires careful coordination of medical care, asthma education, care in the community at large (especially in the school/workplace), physical conditioning programs, and, in some cases, psychologic care. This care involves a team of health care professionals and is interdisciplinary, collaborative, and comprehensive. The patient should be included as a full partner. As coordinator of care, the physician must identify the professionals needed for the team and maintain regular contact with them. The physician must play the role of team leader.

In this article, we will focus on physical conditioning programs, coordination of care in the school/workplace, and psychologic care. Although consistent medical care, asthma education, and cooperative management are essential to successful rehabilitation, they have been presented thoroughly by other authors.

WHO SHOULD RECEIVE REHABILITATION?

The principles of rehabilitation should be included in the care of all patients, regardless of the severity of the disease. Information needed to evaluate the need for, and the effectiveness of, a rehabilitation program should be obtained in the course of caring for patients on a regular basis. Thus, in addition to assuring adequacy of medical care and asthma education, the physician should be aware of the patient's level of physical conditioning, performance in school/workplace, and the presence of psychologic and social problems.

For each of these issues, patients will present a spectrum of adaptation. The type of specific rehabilitation methods and the intensity of their application will vary widely from patient to patient, as well as with age and differences in severity of the asthma. Taking physical conditioning as an example, patients may need only encouragement for a good job (e.g., to continue an active conditioning program) or may require active intervention (referral to a formal physical rehabilitation program to initiate the process of conditioning). Initial screening procedures and ongoing follow-up should be included for all patients regardless of the severity of the underlying asthma.

GOALS OF REHABILITATION

The goals of rehabilitation are

1. To allow participation of the patient in age-appropriate physical conditioning activities with peers
2. To maximize school/work attendance, participation, and productivity
3. To promote self-esteem and self-confidence and decrease anxiety about the illness

PHYSICAL ACTIVITY

Recommendations for evaluation of level of physical activity

Recommendations for evaluation are

1. Educate the patient about (1) EIA, (2) the prophylactic use of drugs to prevent EIA, and (3) the overall value of exercise.
2. Prescribe drugs to prevent EIA and monitor their effectiveness with a diary and a peak flow meter.
3. Question the patient at each visit concerning his/her level of activity and capacity to keep up with peers.
4. Demonstrate an ongoing interest in the capacity of the patient to exercise and make repeated efforts to determine that there really are no limitations of physical activity.
5. If limitations in capacity to exercise are reported by the patient, consider testing to provide objective information about the level of fitness. This testing should define the extent of the problem and the underlying basis of the abnormalities. Testing strategies are discussed in "Assessment of Level of Physical Fitness" in this article.
6. Design a rehabilitation program based on the results of the physical fitness testing. Follow-up should confirm the appropriateness of the program, as well as determining its value in increasing the level of fitness.

Importance of physical activity

Physical activity is important for individuals of all ages. Children relate to peers through active play, and exercise is important in maintaining general health in adulthood.¹ Patients with asthma have the same overall need for exercise as all other individuals. Good habits of regular exercise must be established in childhood to assure that regular exercise will be a part of adult life.

Benefits of a regular aerobic exercise are similar for individuals with and without asthma.² Improvements are observed in parameters necessary for an increased work capacity, such as a decrease in body fat, increases in cardiac output and stroke volume, an increase in the perfusion of muscle, and increases in size, number, and oxidative capacity of mitochondria. Both heart rate and ventilation at rest and at any given submaximal work load are decreased by training. Ventilation at maximum work load is also improved, with increases in maximal ventilatory capacity and tidal volume, and a reduction in residual lung volume.

There are also some benefits that are specific for patients with asthma. Increased aerobic fitness lessens EIA. Better conditioned individuals require lesser in-

creases in heart rate and ventilation for a given task.³ Thus, a fixed amount of exercise would produce less respiratory heat and water loss; therefore, there is less stimulus for bronchospasm than before conditioning. Although EIA may still occur, more work can be done before it begins. Some authors have also obtained evidence that regular exercise programs will result in a decrease in the overall need for medication to control asthma.⁴ Regular exercise may also decrease frequency of asthma attacks and school absenteeism. Physical fitness programs probably produce a variety of psychologic and social benefits as well.⁵ Individuals with asthma can think of themselves as being different from other individuals and therefore tend to be isolated. Isolation appears to be a particular problem for children with asthma, especially at school. Interference with a child's ability to participate can have far-reaching effects, such as diminished self-concept and interference with ability to socialize with peers. Successful involvement in physical activities with peers facilitates successful integration of a patient into the group.

Patients with asthma are not as fit as their normal peers

Four recent studies, three in children and one study in young adults, have demonstrated that patients with asthma do not have normal levels of fitness. In all the studies, the patients exercised to maximal levels and used medications to prevent EIA so that amount of exercise performed would not be limited by the asthma. Ludwick et al.⁶ evaluated cardiopulmonary endurance in 65 children, aged 8 to 17 years, with moderately severe to severe asthma, 48% of whom had been receiving at least continuous every-other-day steroids for the year before being studied. Endurance was quantitated by a standardized maximal exercise protocol with a bicycle ergometer. Fifty percent of the children tested had values <2 SD below the mean, a level that defines severe abnormalities in conditioning. An additional 10% were within 1 and 2 SD below the mean; children in this range benefit considerably from minimal training. One of the most interesting features of this study of patients with asthma was that neither the nurses nor the physical therapists who evaluated the patients predicted the outcome of the fitness tests. Therefore, history alone did not predict the presence of abnormalities, at least in this group of patients.

Orenstein et al.³ studied 39 children with asthma who required long-term oral or aerosolized bronchodilator therapy. None of these children had required steroids for control of their asthma. Exercise tolerance was measured by peak oxygen consumption, as well as peak work load. Although the peak work load was

not decreased compared to the work load of normal children, peak oxygen consumption was significantly lower in the children with asthma than in the normal children.

In the third study, Clark and Cochrane⁷ studied young adults with asthma (mean age, approximately 27 years) and compared these adults to age- and activity-matched control subjects. Maximal exercise tests were performed on a bicycle ergometer, and oxygen uptake (for calculation of total oxygen consumption), oxygen pulse (oxygen consumption per heart beat), and carbon dioxide production were measured. Although there was no significant difference in heart rates achieved during maximum exercise in the subjects with asthma and in the control subjects, the subjects with asthma had significantly lower mean oxygen consumption and oxygen pulse, both indicative of poor fitness. The cardiovascular fitness results in the individual subjects with asthma did not correlate with FEV₁s measured either before or after bronchodilator.

The fourth study used a standardized 9-minute run to document fitness in 76 children, aged 9 to 17 years.⁸ The test was formulated by the American Alliance for Health, Physical Education, Recreation, and Dance, and is standardized by testing $>12,000$ normal boys and girls ranging in age from 6 to 17 years. A good effort during the 9-minute run was assured by documentation of a heart rate at least 75% of maximum for age after the completion of the run. Seventy-four percent of the patients scored below the 25th percentile for the 9-minute run, a level generally indicative of poor fitness. The American Alliance for Health, Physical Education, Recreation, and Dance test also includes measures of skin-fold thickness (to estimate body fat), abdominal strength, and flexibility, all of which were not significantly different from the normal range.

Subsequently, Strunk et al.⁹ studied relationships between cardiopulmonary fitness and both medical and psychologic features of a group of 90 children with asthma. Associations between fitness and medical and psychologic criteria were tested with a stepwise regression analysis, which allowed determination of how much a variable accounted for the distribution of the fitness results. Of the 11 medical variables analyzed, only three accounted for a significant variability in the fitness results. These three were (1) recent course of disease, (2) FEV₁, and (3) specific airway conductance. (Low levels of fitness were associated with recent exacerbation, low FEV₁, and low specific airway conductance.) These three variables together accounted for 8.1% of the variability, which, although this was significant, was not clinically useful for any single variable. Fitness did not correlate with

indicators of the most severe disease, for example, history of respiratory failure, the degree of steroid use in the past year, or with how overweight the children were. A measure of the child's psychologic adjustment, the Child Global Assessment Scale, correlated with fitness better than all the medical variables combined, accounting for 11.6% of the variability in the fitness results. (Low levels of fitness were associated with poor psychologic function.) The mechanism(s) of the interrelationship between fitness and poor psychologic adjustment was not defined. However, it is possible to speculate that the effect of poor adaptation is mediated through decreased interest in participating in exercise programs. Children with poor psychologic functioning would not exercise, even when they were well, and would not be able to maintain normal fitness, even though they may have the least severe asthma. Thus, it appears that the adjustment to the asthma may be as important as the asthma itself.

It is easy to understand how a patient with asthma could have a problem developing good exercise habits. Asthma frequently does really interfere with exercise. Parents often discourage their child from exercising because they are worried about another attack of asthma being precipitated by exercise. Physical educators and teachers are fearful of asthma occurring while the child is in class and allow, or even encourage, the child to avoid exercise, and the children with asthma can manipulate physicians, parents, and school administrators to gain unnecessary exclusion from physical education and sports.

Patients with asthma can participate in fitness programs

Patients with asthma can participate in most physical activities. Clark and Cochrane⁷ demonstrated that patients with asthma have sufficient ventilatory reserve to allow tolerance of training routines. Not only can they participate in activities and conditioning programs, but the many examples of Olympic athletes with asthma in recent years indicate that subjects with asthma can even excel.¹⁰ The extent of achievement for most individuals with asthma appears to be the same as for individuals without asthma, based primarily on athletic capabilities and interest, and having little or nothing to do with the asthma itself. A small subset of patients with severe asthma may have some necessary restrictions on intense exercise. However, even these patients can participate in exercise programs and can improve their fitness, allowing increased participation in physical activities on a regular basis.

All types of physical activity can be tolerated by patients with asthma. Certain types of exercise, such as tennis and swimming, are best tolerated.¹¹ These

exercises are associated with short bursts of activity and/or an environment with warm, moist air that results in less cooling and drying of the airways. Although sports, such as long-distance running, basketball, and ice-skating, can also be tolerated by most subjects with asthma, these sports produce more airway cooling/drying and may require use of more pretreatment to prevent EIA. A recent study indicates that EIA can be reduced by the use of a "warm down" period at the end of exercise.¹² Another technique to avoid EIA involves repetitive short bursts of exercise to induce a "refractory period" during which EIA does not occur.¹³ The mechanisms of these phenomena are unclear. Use of a mask in cold weather to warm the inhaled air may also be helpful.

Probably all types of aerobic exercise can be used to improve levels of fitness in children with asthma. Fitch et al.⁴ first demonstrated that children with asthma could tolerate a vigorous program of long-distance swimming. Subsequently, Nickerson et al.,¹⁴ Orenstein et al.,³ and Fitch et al.¹⁵ found that children with asthma could even tolerate long-distance running. In each study of vigorous training, the patients with asthma improved their exercise capacities and had no increase in asthma symptoms.

Although most studies in individuals with asthma have focused on increases in fitness, most studies have not compared fitness of patients with levels of fitness in normal subjects to determine if fitness in the normal range could be obtained. Ludwick et al.⁶ demonstrated that 84% of the children who entered the study with abnormal levels of fitness on the bicycle ergometer test were able to achieve normal levels after a training program. In another study comparing results of children with asthma to results of normal subjects, patients increased the distance they could run in 9 minutes, but the final scores were still below the normal range for most children. In several studies, patients with asthma improved their fitness from 10% to 92% after various exercise training programs.^{3, 4, 8, 14, 20} Most authors state that the critical variable in the outcome of the fitness program (i.e., whether fitness of the patient improves or not) depended on the degree of participation, not the severity of the asthma. In contrast to the effects of supervised exercise programs, an unsupervised home exercise program for children with asthma did not improve fitness.²¹ These authors suggested that fitness programs and more interesting play activities may need to be organized and supervised to obtain optimal benefit.

It is important to note that, even with optimal conditioning, maximal exercise can still cause EIA in the susceptible individual. Almost all subjects with asthma will continue to need medications before maximal exercise to prevent asthma.

Assessment of level of physical fitness

Most patients with asthma can exercise enough to maintain fitness levels simply with encouragement and proper use of medications to prevent EIA. However, even with these measures, some patients will still not be able to keep up with their peers. These patients may need to be tested to determine the basis of their problem so that appropriate intervention can be designed to return the patient to full activity. The testing should provide information on the level of fitness relative to normal values. Testing should also provide an understanding of the basis for decreased exercise capacity, such as unresponsiveness to the drugs recommended for prophylactic use or weakness in muscle groups specifically required for aerobic exercise.

Standardized tests to determine levels of fitness are available for both children and adults. These tests should be performed with use of the patient's usual bronchodilators so that performance is not limited by EIA. Standardized tests with either a bicycle ergometer or distance run in a standard time have been used to assess the fitness of patients with asthma without significant asthma being precipitated. Also available for children are the standardized tests performed in regular physical education classes at school. For individuals with severe asthma, special arrangements for testing may be needed, but standard tests can be used for most patients. Some physicians think that sedentary adults older than 50 years should have a stress test with cardiac monitoring before initiating a vigorous exercise program.

Once the level of fitness has been defined, a program for physical conditioning can be prescribed. A decision on the level of entry would be based on the actual cardiovascular fitness observed in the screening test. Therapeutic modalities may also include breathing exercises and relaxation techniques (see below), in addition to one of several forms of aerobic exercise. All programs should include activities suited to the patient's personality and resources to assure that it will be sustainable and lifelong. A physical therapist can be helpful in the process of assessing fitness, as well as in helping the patient return to full activity. The goal of these programs should be for the patient to perform aerobic (continuous and rhythmic) exercise for 20 to 30 minutes duration a minimum of three times a week. The exercise intensity should be sufficient to increase oxygen uptake to 70% to 80% of maximum, a level that usually correlates with a heart rate of 70% to 80% maximum. (Maximum heart rate is calculated as 220 minus age in years.) The exercise period should be preceded by 5 to 10 minutes of warm-up exercises and should be followed by a period of gradual cooling down.²² Exercise prescriptions should be reviewed periodically to assure appropriateness; for

example, is the patient able to achieve the heart-rate goals or are the physical resources required for the program available? Once established, exercise programs must be sustained. There is a significant reduction in working capacity after only 2 weeks without regular exercise participation.

Breathing exercises and postural retraining

Breathing exercises and postural retraining have been used widely in subjects with asthma and appear to be useful. Although the benefits of these techniques may be obtained through actual improvements in the use of respiratory muscles during exacerbation of asthma, the techniques are probably most valuable because they provide patients with added confidence that they can maintain some control over breathing during an attack.

Some patients with asthma have what is considered a "tight" posture, forward slumping of the upper back and flattening of the sacrolumbar area. This posture is often associated with overuse of accessory muscles and underuse of the diaphragm.²³ It has been suggested that this breathing pattern may result in reduced respiratory capacity. Underuse of the diaphragm may be further accentuated during periods of severe dyspnea, when the diaphragm is depressed because of hyperinflation. The goals of breathing exercises are to improve posture, strengthen abdominal muscles, and teach diaphragmatic and lower costal breathing. Several authors have demonstrated that chest expansion during breathing is increased by breathing exercises.^{24, 25} Achieving these goals may decrease work of breathing, improve ventilation, and decrease oxygen consumption. Use of breathing exercises are also believed to provide psychologic support and decrease anxiety.

Postural exercises include side bending, rotation, and elbow circling.²³ One technique that is often useful is to have the patient with asthma clasp his hands behind his head, allowing parent or therapist to pull back his elbows to stretch the pectoral muscles while the trunk is being stabilized. This exercise may also help to correct kyphosis and increase expansion of the intercostal muscles. Some patients may also benefit from more traditional relaxation training, such as Jacobsonian relaxation or biofeedback.

Role of the physician in the patient achieving and maintaining fitness

The benefits of improved cardiovascular fitness are achievable for almost all patients with asthma. These benefits can only be achieved if an exercise program is regularly maintained. Strong motivation is essential, especially because acute asthma symptoms will interrupt an exercise program intermittently. The phy-

sician is a crucial component in providing this motivation by expressing interest in the goal of improved cardiovascular fitness and establishing a program designed to achieve the goal (e.g., medicines for prophylaxis of EIA and appropriate referral to an exercise program that provides guidance in amount of exercise performed). The American Academy of Pediatrics recommends that written records of annual and other periodic health evaluations by the physician managing the asthma should be on file in the office of the school nurse or physician and, for athletes, with the team physician or athletic trainer. Furthermore, the American Academy of Pediatrics states that "physicians who assume responsibility for the medical care of asthmatic children can be of greater usefulness to their patients if they become familiar with the character of the physical education and athletic programs in the schools."²⁶ Physician encouragement is even more important in the setting in which there is no school athletic program.

The physician must lead the patient and family to appropriate recognition that certain adjustments in the daily routine may be necessary to achieve the goal of normal fitness. The patient and family, with the assistance from the physician, must attain a balance between the needs of the patient to participate in activities (with as few restrictions and as little distress as possible) and the necessary limitations needed to live a full life (need for prophylactic medications to prevent EIA, avoidance of irritants and allergens that exacerbate asthma, etc.).

Practical approaches to pulmonary rehabilitation

Larson and Bruce,²⁷ in discussing health benefits of exercise in an aging society, have stated that, "if exercise is to be habitual, it should be easily accessible and without adverse sequelae. Ideally, it should also be dynamic, interesting, fun, and varied." There are several programs in the country at this time that should be considered as models for community rehabilitation programs. In Ft. Collins, Colo., an asthma parent support group has established the "Breathing Buddies" program. This program has an activities book for the children.²⁸ Children are rewarded for exercise participation with bogus \$1 bills, which are redeemable for special prizes. In addition, their group has arranged for special reduced rates for children with asthma at local swimming pools, skating rinks, and other facilities. This program has been in existence for several years, has been very successful, and has indicated that participation of children with asthma with other children with asthma is reassuring and supportive.

In Scranton, Pa., Dr. Melvyn Wolk has established a community skiing program for children with asthma (Wolk MH. Personal communication.). Local ski areas in the Scranton area have offered reduced rates for skiers with asthma. Asthma ski day in 1989 was attended by >400 participants. Dr. William Silvers in Colorado has a similar program in that state. The ski programs are useful in facilitating long-term rehabilitation because they demonstrate to the patients with asthma that they can participate in a vigorous activity. It is hoped that these patients would then participate in other activities in nonski seasons.

The private office setting is another site for conducting exercise classes. One such experience started by teaching breathing exercise classes in Dr. Stanley Wolf's private office more than 35 years ago. Patients eagerly accepted the training, but the exercises were all too often found to be boring and soon forgotten unless they were performed in a group setting. In an attempt to set breathing exercises to music, an aerobics class was formed in the office. A local aerobics instructor choreographed a dance program using upper torso exercises with low- or no-impact dance steps. A dance group with asthma was started in the waiting room. Results of this program have been published.²⁹ Because of the enthusiastic response to this program, an "Aerobic for Asthmatics" videotape was prepared. This videotape has been supplied by Glaxo, Inc. to allergy-training programs throughout the country. Aerobic dance is certainly one type of exercise program that meets the criteria recommended by Larson and Bruce.²⁷ Patients can perform these exercises three times a week at home while they monitor their pulse rates and use bronchodilators at the first sign of EIA. There were tremendous psychologic benefits from this program. Many of the patients who participated had been unable to participate in other sports. With the use of inhaled bronchodilators, all patients were able to complete the program. They were encouraged by their success to continue to remain active. There was a sense of companionship and recognition of accomplishment by regular participation in the group activity. Patients who thought of themselves in a negative manner as "an asthmatic" had improved their self-image.

Most communities have facilities that can be helpful in the rehabilitation process. YMCAs, church-sponsored programs, dance classes, swimming clubs, ice skating and roller skating rinks, judo and karate instruction classes may all be contacted. Most facilities appear to be receptive to the concept of offering special rates for children with asthma, especially if a group of participants can be provided.

The school system is also important in the rehabilitation process. The physician should consider meeting with the physical education instructor(s) in the school. Frequently, these instructors are still of the mind-set that children with asthma cannot participate, especially in basketball and soccer. Learning about the use of bronchodilator medications, both orally and by inhalation, is enlightening for many of these gymnasium instructors. Their encouragement of children with asthma to participate regularly in sports is certainly helpful in any rehabilitation process.

Cost is also a factor in recommending regular sports activity. Not all patients can afford the cost of joining an athletic club in which rowing, indoor pools, etc., are readily available. These exercise expenses may be covered by insurance. The cost of a videotape, such as "Aerobics for Asthmatics" or video exercise programs for stationary cycling, may also be covered by insurance. Can expenses for pulmonary rehabilitation be deducted from taxes? Under the new tax law, a patient must have catastrophic expenses to make a deduction even worthy of consideration. Swimming pool expenses have been deducted and approved by the Internal Revenue Service for patients with arthritis and other orthopedic diseases. Support for such a claim for severe asthma might be justified.

SCHOOL/WORKPLACE

Recommendations for evaluation of attendance, participation, and productivity in the school workplace

Recommendations for evaluation in the school/workplace are

1. Patients should be questioned about school/work absences. More than 7 to 10 days of school missed per year or more than the maximum absence from work allowed per year should initiate concern.
2. For patients with excessive absences, the physician should communicate with the school/workplace to obtain information about the reason(s) for the increases in absences so that appropriate intervention can be initiated. The possible role of poor psychologic adjustment in causing the excessive absenteeism should be considered.
3. If initial intervention is not effective and problems continue, a meeting with the relevant people (e.g., school nurse or supervisor) may be required to discuss specific issues and make more detailed plans; the physician should be the coordinator of this ensemble.
4. Teachers and supervisors at the workplace may require education about asthma. Physicians may consider being part of in-services for schools.
5. Vocation counseling may need to be considered as the patient approaches adulthood.

School absenteeism and performance

Several studies have demonstrated that subjects with asthma are absent from school significantly more often than their peers without asthma.³⁰⁻³² In fact, asthma accounts for more school absenteeism than any other chronic illness.³³ An early study suggested that rates of school absence varied directly with maternal perception of the severity of the child's asthma.³⁰ In another study, approximately 40% of the parents interviewed indicated that their child with asthma had problems in school,³⁴ primarily with increased numbers of absences or reading difficulties. However, information about school attendance, classroom performance, and the nature of the academic problems was obtained only through parent interviews.

Recently, Gutstadt et al.³⁵ evaluated school performance in 99 children with moderately severe to severe chronic asthma. The extent of absenteeism was evaluated by obtaining school records for the semester before evaluation. Academic achievement was documented on standardized academic achievement tests for reading and mathematics. Similar to other studies, the rate of absenteeism was high, with the median for days missed in the semester before evaluation at 20% of possible days (range from 0 to 94). Most days of school missed were not spent in hospital (the median for days in hospital was 6 in the preceding year, compared to approximately 40 school days missed). School absenteeism did not correlate with severity of the asthma. None of the children in this study exhibited signs of school phobia.

In contrast to the high rates of absenteeism, scores for the children in this study on the standardized tests for academic performance were average or slightly above average, with mean scores of 52.5 and 52.4 for reading and mathematics, respectively (compared to means of scores in a normal population of 50). Intelligence quotient scores were also average to above average and correlated with the mathematics and reading scores. Grades for the semester before evaluation were consistent with average functioning on the standardized tests; 80% of the patients on whom information could be obtained received at least average grades in reading and mathematics. Factors associated significantly with low performance in reading and mathematics were low socioeconomic status, older age, a large amount of steroid use in the year before evaluation, and presence of emotional and be-

havioral problems. School absenteeism, numbers of hospitalizations and emergency room visits, history of severe complications of asthma (respiratory failure and hypoxia seizures), steroid dose at the time of testing, other medications used to treat asthma (including theophylline), and pulmonary function test results were not associated with academic performance. These results suggest that investigation of poor classroom performance of a child with chronic asthma should include investigation of the roles of socioeconomic status, steroid therapy, and emotional and behavioral problems. Similar to the results of the fitness evaluation,⁹ the child's adjustment to the asthma appeared to be at least as important in determining school performance as the asthma itself. Performance of adults with asthma in the workplace (e.g., absenteeism and achievement) has not been studied in a similar manner.

Occupational and vocational counseling and rehabilitation

As adulthood approaches, career and therapeutic goals must be coordinated. This general area may be one of the most critical situations faced by patients and their physicians. A satisfactory outcome requires that the physician be knowledgeable, sensitive, and willing to act as a partner with the patient in reaching the decision. One issue that must be addressed is the prognosis of the asthma in the patient. General information is available and should be reviewed with the patient.³⁶⁻³⁸

How do we decide which patient should be counseled to avoid choosing a career that will lead to a life of continuous respiratory disease? What if a child is counseled against a certain goal and that child outgrows the asthma? If the physician believes that a child's asthma is so severe that full remission in adulthood is not a reasonable expectation, then guidance by teachers, parents, and physicians must begin early to prevent a disastrous choice of career. Despite exceptional treatment, some subjects with asthma simply must realize that there will be some things in life that cannot be achieved. The emotional trauma accompanying asthma that is worsened by the patient's occupation will almost certainly be far greater than the experience of an adolescent's realizing that he or she must pursue an alternative career choice.

Most children change their minds many times when they are deciding what they want to be when they grow up. One should not be too quick to intervene every time a child with asthma says, "I want to be a fireman when I grow up." However, if we observe that a child is focusing all or most of his attention on a career that could be harmful to lung function, it

might be wise to take some steps to temper the choice. This choice is where school guidance counselors may be needed. It is important to expose the student to careers that are both potentially attainable and that will not provide exposure to toxic agents and/or allergens. Most school systems are now using computerized searches to help students choose fields of endeavor that they may never have considered. Most students have multiple options, and with the foresight of parents and guidance counselors, in coordination with physicians, children with asthma can be channeled toward realistic and safe careers.

There are some occupations that are inappropriate for patients with severe asthma and some may even be detrimental to subjects with mild to moderate disease. Fire fighting is an excellent example. Sparrow et al.³⁹ studied the chronic effects of fire fighting on pulmonary function in 168 fire fighters and 1474 non-fire fighters during a 5-year period in a study of normal aging. They questioned their subjects about smoking habits, respiratory symptoms, and other illness. During the 5-year period of the study, fire fighters had a greater loss of pulmonary function than nonfire fighters when these data were corrected for age, height, and smoking status. Fire fighters also reported more respiratory symptoms than the control subjects. Although the issue of fire fighters with asthma was not addressed, it should be clear that anything that reduces pulmonary function may adversely effect a patient with asthma. Fire fighting is a strenuous occupation. Even individuals with normal function at the start of their career frequently must retire early or transfer to a desk job because of lung or other injuries.

In The JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY, November 1989 supplement, "Guidelines for the Diagnosis and Evaluation of Occupational Lung Diseases," 41 substances were listed as capable of eliciting an IgE-mediated response, as measured by either in vivo or in vitro tests.⁴⁰ Substances capable of producing occupational asthma range from baby's breath found in the local florist's shop, to dyes and chemicals in various industries, *Bacillus subtilis* enzymes in detergent, laboratory animals, and penicillin in pharmaceutical manufacturing.

Irritant substances in the workplace, such as hemp, cotton, and cigarette smoke, also place the patient with asthma at significant risk. The issue of cigarette smoking in the home or workplace is perhaps the most talked-about issue in public health today. Many patients with asthma complain that they cannot get family and friends to refrain from smoking in their presence. Even more of an issue is that many patients themselves smoke cigarettes. Despite the increased attention focused on this issue, patients are exposed

to this hazard daily, and significant losses of work and schooltime occur. Recent studies have demonstrated that physicians can have a profound influence on patients' decisions to stop smoking. Convincing patients to stop smoking must be the highest priority in the rehabilitation of patients with asthma.

Individuals who develop occupational asthma with or without past history of atopy must be counseled and retrained for other occupations or careers unless exposure can be avoided by respiratory protective gear that is close to 100% effective. Continued exposure may result in lifelong asthma and may cause permanent lung damage.

PSYCHOLOGIC FUNCTIONING

Recommendations for evaluation of psychologic functioning

Recommendations for evaluation of psychologic function are

1. Be alert for the presence of psychologic symptoms or disorders (primary or secondary) in the patient.
2. Address these psychologic symptoms during ongoing management of the patient's asthma.
3. Obtain psychiatric consultation if psychologic problems are not yielding to the approach used by the physician; refer to a mental health professional if this is indicated after the consultation.

It is beyond the scope of this article to review the theories of interaction between psyche and soma in asthma. Suffice it to say that psychologic problems are frequently encountered in patients with asthma.^{41, 42} Interestingly, the degree of the psychologic problems demonstrated in children with moderately severe to severe asthma did not correlate with the severity of the disease. (Strunk RC, Fukuhara JT. Unpublished observations.) Although there is no evidence that psychologic issues have a primary etiologic role in the state of asthma, most would agree that how the patient with asthma is functioning, cognitively, emotionally, and within the family and peer network, is a crucial aspect of rehabilitation.

As with other areas of rehabilitation, psychologic problems are best approached early in their evolution or, even better, prevented. There are two important areas in this approach. The first is maintaining open channels of communication between the physician and patient, since problems that may present can only be addressed if the patient has a trust in the physician. The second is education of the patient. A patient is more likely to be able to make good adjustments when he or she is informed and given guidelines for optimal health maintenance.

Many patients with a chronic illness have inter-

mittent psychologic problems. Transient periods of depression, anxiety, or noncompliance are universal and are not necessarily indications of psychiatric illness nor do they always require a referral for more comprehensive psychologic or psychiatric evaluation. When these symptoms are present, the physician should first clarify the areas and degrees of severity and chronicity and then provide advice and guidance on how to deal with these normal reactions to chronic disease. In a large number of patients, the opportunity to share their concerns and receive appropriate reassurance is all the support they will need to return to their usual level of functioning. It is important that the physician be aware of the development of more significant problems.

The best test for screening for psychologic problems is the physician asking herself or himself about the presence of problems recognized during routine care. In addition to her or his clinical estimate of the presence, severity, and chronicity of psychologic problems, a number of screening tests are available. When the following questions are asked in the course of caring for a patient, some indication of problems may be elicited:

1. Is there evidence of persistent medical noncompliance or poor self-care?
2. Am I aware of anger, frustration, or antagonism toward the patient and/or family?
3. Have there been important losses to the patient, such as death of spouse, parent, or child, divorce, loss of employment, or geographic relocation?
4. Am I concerned about depression or have there been references to death, self-harm, guilt, and/or expression of hopelessness?
5. Have there been notable personality change, unusual behavior, emotional lability, decline in school or work function, or onset of drug or alcohol use/abuse?
6. Is there evidence of sexual or physical abuse?

If the answer to any of these questions is "yes," the physician should consider the possibility that psychologic problems may be present. At this time, the practitioner should share with the patient and family his concern that there may be emotional stresses or other life circumstances that are affecting the asthmatic condition. The practitioner should then obtain psychiatric consultation for additional definition of the problem and, possibly, recommendation for treatment by a mental health professional. The referring physician should delineate his or her perception of the problem(s) for the psychiatrist. The physician should also determine that the mental health professional who will be treating the patient understands the role psychologic

problems can play in the course of asthma. If treatment is recommended, the practitioner should insist that the patient and/or family follow through with the treatment as recommended.

Appropriateness of any treatment recommended for the psychologic problems will, of course, be determined by the nature of the problems. Like any other medical treatment, the usefulness of the treatment in solving the problem must be evaluated on an ongoing basis. Although such reevaluation would be done during the part of ongoing care of the asthma by the practitioner, periodic psychiatric reevaluation should also be arranged, whether or not the psychiatrist is the treating mental health professional.

SUMMARY

Although traditional rehabilitation medicine approaches are necessary in patients with the most severe asthma, principles of rehabilitation described in this article are useful for almost all patients. These principles are perhaps most useful early in a patient's course when the setting of appropriate expectations is important in minimizing restrictions from both disease and its treatment. Once a patient has developed restrictions, prompt institution of rehabilitation is essential to prevent significant disability, which can be avoided or even reversed. Once rehabilitation has been instituted, progress with rehabilitation goals should be monitored in visits to the physician so that communication with the appropriate health care professional can be established to readjust therapy. Physician interest in the process of rehabilitation can stimulate motivation of the patient.

REFERENCES

- Blackburn H, Jacobs DR. Physical activity and the risk of coronary heart disease. *N Engl J Med* 1988;319:1217-9.
- Morton AR, Fitch KD, Hahn AG. Physical activity and the asthmatic. *Phy Sports Med* 1981;9:51-64.
- Orenstein DM, Reed ME, Grogan FT, Crawford LV. Exercise conditioning in children with asthma. *J Pediatr* 1985;106:556-60.
- Fitch KD, Morton AR, Blanksby BA. Effects of swimming training on children with asthma. *Arch Dis Child* 1976;51:190-4.
- Fitch KD. Sport, physical activity and the asthmatic. In: Oseid S, Edwards A, eds. *The asthmatic child in play and sport*. London: Pitman Books, 1983:246-58.
- Ludwick SK, Jones JW, Jones TK, Fukuhara JT, Strunk RC. Normalization of cardiopulmonary endurance in severely asthmatic children after bicycle ergometry therapy. *J Pediatr* 1986;109:446-51.
- Clark CJ, Cochrane LM. Assessment of work performance in asthma for determination of cardiorespiratory fitness and training capacity. *Thorax* 1988;43:745-9.
- Strunk RC, Rubin D, Kelly L, Sherman B, Fukuhara J. Determination of fitness in children with asthma: use of standardized tests for functional endurance, body fat composition, flexibility, and abdominal strength. *Am J Dis Child* 1988;142:940-4.
- Strunk RC, Mrazek DA, Fukuhara JT, Masterson J, Ludwick SK, LaBrecque JF. Cardiovascular fitness in children with asthma correlates with psychological functioning of the child. *Pediatrics* 1989;84:460-4.
- Pierson WE, Voy RO. Exercise-induced bronchospasm in the XXIII summer Olympic games. *N Engl J Allergy Proc* 1988;9:209-13.
- Kendall M. Reflections on physical training programmes for the asthmatic child. In: Oseid S, Edwards A, eds. *The Asthmatic Child in Play and Sport*. London: Pitman Books, 1983:372-9.
- McFadden ER, Lenner KAM, Strohl KP. Postexertional airways rewarming and thermally induced asthma: new insights into pathophysiology and possible pathogenesis. *J Clin Invest* 1986;78:18-25.
- Edmunds AT, Tooley M, Godfrey S. The refractory period after exercise-induced asthma: its duration and relation to the severity of exercise. *Am Rev Respir Dis* 1978;117:247-54.
- Nickerson BG, Bautista DB, Namey MA, Richards W, Keens TG. Distance running improves fitness in asthmatic children without pulmonary complications or changes in exercise-induced bronchospasm. *Pediatrics* 1983;71:147-52.
- Fitch KD, Blitvich JD, Morton AR. The effect of running training on exercise-induced asthma. *Ann Allergy* 1986;57:90-4.
- Itkin IH, Nacman M. The effect of exercise on the hospitalized asthmatic patient. *J ALLERGY* 1966;37:253-63.
- Oseid S, Haaland K. Exercise studies on asthmatic children before and after regular physical training. *Swim Med* 1978;4:32-41.
- Svenonius E, Kautto R, Arborelius M. Improvement after training of children with exercise-induced asthma. *Acta Paediatr Scand* 1983;72:23-30.
- Arborelius M, Svenonius E. Decrease of exercise-induced asthma after physical training. *Eur J Respir Dis [Suppl]* 1984;136:25-31.
- Schnall RP, Ford P, Gillam I, Landau LI. Swimming and dry land exercises in children with asthma. *Aust Paediatr J* 1982;18:23-7.
- Holzer FJ, Schnall R, Landau LI. The effect of a home exercise programme in children with cystic fibrosis and asthma. *Aust Paediatr J* 1984;20:297-302.
- American College of Sports Medicine. Guidelines for graded exercise testing and exercise prescription. 2nd ed. Philadelphia: Lea and Febiger, 1980.
- Strick L. Breathing and physical fitness exercises for asthmatic children. *Pediatr Clin North Am* 1969;16:31-42.
- Fine BT, Cox EP, Green LH. Respiratory and physical exercise in the treatment of bronchial asthma. *Ann Allergy* 1953;11:275.
- Livingstone J, Gillespie M. The value of breathing exercises in asthma. *Lancet* 1935;2:705-8.
- Committee on Children with Disabilities and Committee on Sports Medicine. The asthmatic child's participation in sports and physical education. *Pediatrics* 1984;74:155-6.
- Larson EB, Bruce RA. Health benefits of exercise in an aging society. *Arch Intern Med* 1987;147:353-6.
- Sander N, Miller D. Breathing buddies manual. Parents of Asthmatic/Allergic Children, Inc. Ft. Collins, Colo.
- Wolf SI, Lampl KL. Pulmonary rehabilitation: the use of aerobic dance as a therapeutic exercise for asthmatic patients. *Ann Allergy* 1988;61:357-60.

30. Parcel GS, Gilman SC, Nader PR, Bunce H. A comparison of absentee rates of elementary school children with asthma and nonasthmatic school mates. *Pediatrics* 1979;64:878-81.
31. Mitchell RG, Dawson B. Educational and social characteristics of children with asthma. *Arch Dis Child* 1973;48:467-71.
32. Creer TL, Yoches C. The modification of an inappropriate behavioral pattern in asthmatic children. *J Chronic Dis* 1971;24:507-13.
33. American Academy of Pediatrics Committee on Children with Handicaps. The asthmatic child and his participation in sports and physical education. *Pediatrics* 1970;45:150-1.
34. Freudenberg N, Feldman CH, Clark NM. The impact of bronchial asthma on school attendance and performance. *J Sch Health* 1980;50:522-6.
35. Gutstadt LB, Gillette JW, Mrazek DA, Fukuhara JT, LaBrecque JF, Strunk RC. Determinants of school performance in children with chronic asthma. *Am J Dis Child* 1989;143:471-5.
36. Rackemann FM, Edwards MC. Asthma in children: a follow-up study of 688 patients after an interval of twenty years. *N Engl J Med* 1952;246:815-23.
37. McNicol KN, Williams HB. Spectrum of asthma in children. I. Clinical and physiological components. *Br Med J* 1973;4:7-11.
38. Ronnimann S, Burrows B. A prospective study of the natural history of asthma: remission and relapse rates. *Chest* 1986;90:480-4.
39. Sparrow D, Bossé R, Rosner B, et al. The effect of occupational exposure on pulmonary function: a longitudinal evaluation of fire fighters and nonfire fighters. *Am Rev Respir Dis* 1982;125:319-22.
40. Grammer LC, Patterson R, Zeiss CR. Guidelines for the immunologic evaluation of occupational lung disease: report of the Subcommittee on Immunologic Evaluations of Occupational Immunologic Lung Disease. *J ALLERGY CLIN IMMUNOL* 1989;84:805-14.
41. Norrish M, Tooley M, Godfrey S. Clinical, physiological, and psychological study of asthmatic children attending a hospital clinic. *Arch Dis Child* 1977;52:912-7.
42. Mrazek D. Asthma: psychiatric considerations, evaluation, and management. In: Middleton E, Reed CE, Ellis EF, Adkinson NF, Yuninger JW, eds. *Allergy: principles and practice*. St. Louis: CV Mosby, 1988:1176-96.