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Comprehensive Pulmonary Rehabilitation for Chronic Obstructive Pulmonary Disease

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Abstract

Chronic obstructive pulmonary disease (COPD) is one of the leading causes of mortality, disability, and a rise in healthcare costs worldwide. Patients experience a progressive deterioration from an early stage up to the end-stage of COPD, which is characterized by airflow limitation and a severely limited and declining performance status. In the advanced stage, patients with COPD occasionally develop chronic respiratory failure, need long-term oxygen therapy, and suffer from non-respiratory comorbidities which are currently known as being due to systemic manifestations. Recent clinical guidelines for COPD suggest that management is divided into two different modalities: pharmacological and non-pharmacological interventions, and that these two should equally apply in the long-term management of COPD. However, such a grouping in therapy occasionally causes a misunderstanding in daily practice, because these two modalities have to work closely together, particularly in terms of self-management.

Here in, we have described the current concepts, problems, and perspectives of comprehensive pulmonary rehabilitation in COPD patients, mainly based on experiences in Japan.

Introduction

A major cause of chronic obstructive pulmonary disease (COPD) is a long-term smoking. Thus, COPD is one of the lifestyle-related diseases, which is increasing in prevalence, and its incidence tends to increase in old age, consequently becoming a major public health problem among elderly populations worldwide (Pauwels & Rabe, 2004). Patients with COPD are characterized by airflow limitation, and a severely limited and declining

performance status with chronic respiratory failure at a more advanced stage; furthermore, they present various comorbidities due to systemic inflammation, as currently described in the guidelines (Global Initiative for Chronic Obstructive Lung Disease, 2007; ATS/ERS, n.d.).

According to the recent clinical guidelines (Global Initiative for Chronic Obstructive Lung Disease, 2007), COPD is defined as:

> a preventable and treatable disease with some significant extra-pulmonary effects that may contribute to the severity in individual patients. Its pulmonary component is characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lung to noxious particles or gases.

COPD is the fifth largest cause of morbidity and mortality worldwide, and represents a substantial economic and social burden (Global Initiative for Chronic Obstructive Lung Disease, 2007). Patients with COPD experience progressive dyspnea during daily activities up to end-stage COPD, when they may have chronic respiratory failure, characterized by severe airflow limitation, and a strictly limited and declining performance status; thus, showing deterioration of the health status in both the general and disease-specific quality of life (QOL). The QOL of COPD patients is increasingly being accepted as one of the most important health outcomes to consider in managing the disease, which means that QOL improvement is considered a major goal of COPD management in the guidelines, such as those of the Japan Respiratory Society (JRS, 2004), the American Thoracic Society (ATS) / the European Respiratory Society (ERS) (ATS/ERS, n.d.), and GOLD guidelines (Global Initiative for Chronic Obstructive Lung Disease, 2007), not just survival prolongation. According to such guidelines for COPD, two different therapeutic modalities, which include pharmacological and non-pharmacological interventions, should be applied in the long-term management of COPD. For the pharmacological treatment, an anti-cholinergic regimen, beta-agonists, and occasionally inhaled corticosteroids are generally used in some combinations. On the other hand, non-pharmacological treatment, which includes pulmonary rehabilitation, is emphasized as well. However, in a grouping of therapy, such as pharmacological and non-pharmacological treatment, causes occasional misunderstandings in daily practice, since these treatments should be considered as a communion with nature of long-term management in COPD. Moreover, it is also likely to confuse the stage of COPD when pulmonary rehabilitation should start; for example, the ATS guidelines (ATS/ERS, n.d.) suggest that pulmonary rehabilitation should be applied gradually or step-by-step (Fig.1). Pulmonary rehabilitation, alternative non-pharmacological therapy, and pharmacological therapy have to work closely together, which may result in a more successful outcome (Casaburi R & Porszasz J, 2006); one clinical study has shown that a better outcome of pulmonary rehabilitation can be obtained by applying therapies together using tiotropium (Casaburi R et al., 2005). An analysis of pooled data from a number of trials demonstrated that pulmonary rehabilitation improved the endurance time during a constant work-rate task by an average of 87%, peak work-rate by an average of 18%, and

peak oxygen uptake by 11% compared with pre-rehabilitation levels (Troosters T et al., 2005).

Comprehensive pulmonary rehabilitation

The goals of pulmonary rehabilitation programs are to reduce symptoms, improve activity and daily function, and restore the highest level of independent function possible in patients with respiratory disease (Nici L et al., 2006).

The ATS and ERS have recently adopted (Nici L et al., 2006) the following definition of pulmonary rehabilitation:

> Pulmonary rehabilitation is an evidence-based, multidisciplinary, and comprehensive intervention for patients with chronic respiratory disease who are symptomatic and often have decreased daily life activities. Integrated into the individualized treatment of the patients, pulmonary rehabilitation is designed to reduce symptoms, optimize functional status, increase participation, and reduce health-care costs through stabilizing or reversing systemic manifestations of the disease.

We previously reported the results of a survey as part of a pulmonary rehabilitation program (PRP) in North America and Europe, and presented the first report of the results of a survey of PRP in Tokyo (Kida K et al., 1998). PRPs were available at 56% of hospitals in North America and 74% in Europe, but at only 20% of hospitals in Tokyo. Most PRPs were conducted in an outpatient setting in North America (98%), whereas both inpatient and outpatient programs were available in Europe (55% inpatient and 65% outpatient programs). The types of lung disease referred to in the PRP were mainly COPD in both North America and Europe, although these accounted for only 34% of referrals in Tokyo; however, referrals for sequelae of primary tuberculosis ($p=0.028$) and bronchiectasis ($p=0.021$) were more common in Europe, similar to the situation in Tokyo. The following PRP items were available at significantly higher rates in North America than in Europe (Table 1): family education, psychological support, nutritional instruction, treadmill, ergobicycle or ergometer, walking training, and increasing the activities of daily living; whereas most of these items were unavailable in Tokyo. From these data, we conclude that PRPs in North America are more multi-dimensionally oriented. Target diseases differ among North America, Europe, and Tokyo, however. PRPs in Tokyo differed from those in either North America or Europe and were poorly organized. Problems arising in PRPs in the three regions include the lack of trained personnel and insufficient reimbursement. Based on a comparison between Tokyo and Western countries regarding comprehensive pulmonary rehabilitation, in 1996, we proposed our concept which is summarized in Fig. 2. Since then, situations regarding pulmonary rehabilitation are re-assessed, leading to re-structuring in Japan; the statement of pulmonary rehabilitation was reported by the Japan Respiratory Care and Rehabilitation Society and related academic societies (2002). Since April of 2006, pulmonary rehabilitation has been reimbursed by public medical insurance in Japan. According to the statement, two manuals are published, one is for exercise (JRS/JSRCRM, 2003) and the other is for patient education (JRS/JSRCRM, 2007). These manuals are aimed to

raise standard skills for health-care professionals involved in the long-term management of chronic respiratory disease patients, particularly in those with COPD, and it is planned to translate these into English. The manuals primarily comprise the following three parts: 1) assessment, 2) program composition, and 3) outcome measures.

In the assessment, both patients and their families should be assessed regarding both medical and social aspects. The program consists of the following seven aspects: 1) general education for lung disease and smoking cessation, 2) pharmacotherapy which includes inhalation of the β2 agonist and/or anti-cholinergic regimens, inhaled corticosteroid, or theophylline, 3) instruction on nutrition since blue bloater patients (obese type) with COPD need to reduce body weight, while pink puffer patients (lean type) need to gain weight, 4) detailed instructions in the use of long-term oxygen therapy, 5) physiotherapy, crucial to improve activities of daily living, 6) excise, and finally, 7) instruction or advice on improving social activities. All these should be encouraged or supported as psychosocial aspects by family members or care givers.

When both the initial assessment and subsequent program function well, a better outcome can be anticipated, as shown in Fig. 2. Namely, a better quality of life and level of daily activity would be expected in such COPD patients receiving long-term oxygen therapy due to chronic respiratory failure. Accordingly, we performed comprehensive pulmonary rehabilitation for elderly COPD patients on hospitalization, and parts of the data have been published (Katsura H et al., 2004).

Evidence of pulmonary rehabilitation

There is already a considerable body of evidence to support the clinical importance of pulmonary rehabilitation in COPD patients. Table 2 shows the ranking of evidence according to the current report of the Joint ACCP/AACVPR Evidence-Based Clinical Practice Guidelines (Ries AL et al., 2007).

Prescribing regular exercise training

It should be noted that regular exercise training is a major way to avoid a reduction in activities of daily living (ADL). There are two types of opinion regarding methods of daily exercise training: one is low frequency and high intensity (Casaburi R et al., 1991), and the other is high frequency and low intensity (Normandin EA et al., 2002). The two opinions are not contradictory, and are considered to mutually supplement each other. In exercise training at medical institutions supervised by specialists or health care professionals, the high-intensity exercise may result in a better outcome, although it involves a high-level risk and may involve hospitalization, which is also not cost effective. On the other hand, regular exercise based on the patients' home lifestyle comprises low-intensity exercise and is much safer.

Recently, the American College of Physicians (ACP) guidelines (Qaseem A et al., 2007) recommended that Clinicians should consider prescribing pulmonary rehabilitation in symptomatic individuals with COPD who have an FEV1 less than 50% predicted. (Grade: Weak recommendation, moderate-quality evidence) which contrasts with the

ATS/ERS guidelines, in which pulmonary rehabilitation may be started from an earlier stage.

However, many problems were raised, which included patients who showed poor adherence to daily exercise, and exercise training prescribed by non-specialist physicians (Estabrooks PA et al., 2003). The reasons included the fact that non-specialists: 1) do not have information on the type and intensity of exercise for each COPD patient, 2) do not know how to continue exercise in each patient, and 3) do not have access to appropriate medical staff who engage in such training in a busy daily practice. The pulmonary rehabilitation manual, which was published in 2003 and edited by the Japan Respiratory Care and Rehabilitation Society (JRS/JSRCRM, 2003), indicates that the exercise training prescription for COPD patients should be based on the four components of FITT: the frequency (F), intensity (I), type (T), and duration (=time) (T).

Beyond pulmonary rehabilitation

Education in comprehensive pulmonary rehabilitation is a very important item. According to recent clinical practice guidelines for pulmonary rehabilitation (Ries AL et al., 2007), education should be an integral component of pulmonary rehabilitation. It is stated that education should include information on collaborative self-management, and the prevention and treatment of exacerbations and high priority, such as grading of recommendation 1B. Previously, clinical studies in this regard reached different conclusions; one by the group of Bourbeau (Bourbeau J et al., 2006) showed that self-management-based education was very effective and had a better outcome, but Monninkhof et al. (2004) did not support such a hypothesis.

The most important component of a self-management approach is instruction in the prevention and early treatment of COPD exacerbation, since the exacerbation of COPD led to a high mortality rate and was costly (Groenewegen KH et al., 2003; Almagro P et al., 2002; Miravitlles M et al., 2002; Connors AF Jr et al., 1996; Andersson F et al., 2002). According to our report from Japan (Motegi T, 2006), the mean total expenditure for the management of exacerbations ranged from US $1,550-7,658 (US $1 = 110 yen). The early treatment of COPD exacerbation hastens recovery and reduces the health care burden. Patient education is included with an important recommendation in the current clinical practice guidelines for COPD (Troosters T et al., 2005; Nici L et al., 2006; Ries AL et al., 2007), but there is limited evidence on the education effect. The teaching of self-management skills is insufficient to bring about a change in behavior such as smoking cessation; patients should learn to integrate skills, which include inhalation techniques, daily exercise, and/or nutrition, in his/her everyday life. Self-efficacy will play a role in determining which activities or situations a person will perform or avoid. In a chronic disease such as COPD, it is important to work at promoting patients' confidence in following a self-care regimen by increasing their self-efficacy (Bourbeau J et al., 2004), which should be based on how each patient maintains information they need in long-term management. However, currently, Hyland and Jones propose the application of a simple questionnaire to assess information needs (Hyland ME et al., 2006), termed LINQ (the lung information needs questionnaire). It is already available in Japanese

(Kida K, 2006), and is becoming a very important and promising tool to assess the information needs of each COPD patient.

Team approach and collaborations between medical institutions

A system for close medical consultation between a major referral hospital and small medical offices should be established (Fig. 3). The referral hospital ought to be responsible for screening the candidate patients and for initial education. Cases with a stable condition might be referred back to local general physicians or a small hospital located close to the patients' homes, while patients in an unstable condition might receive care from the referred hospital in consultation with general physicians or small community clinics. Long-term oxygen therapy is effective when conducted and organized by a medical team consisting of a physician, nurse, case-worker, dietitian, pharmacist, and physical therapist for each patient. To deliver optimal care and promote the highest quality of life, local organization is of the utmost importance. Thus, a concept for comprehensive pulmonary rehabilitation should be applied properly to facilitate long-term oxygen therapy in terms of safe and efficient therapy in cases of advanced COPD with chronic respiratory failure.

Conclusions

Theoretically, pulmonary rehabilitation should be considered as applicable in all stages for COPD patients who have respiratory symptoms. The overwhelming evidence currently available is clearly sufficient for regulatory authorities to conclude that there is a sound basis for reimbursement for pulmonary rehabilitation. Recent clinical guidelines for COPD suggest that the two different therapeutic modalities, pharmacological and non-pharmacological interventions, should both apply in the long-term management of COPD. However, such therapy occasionally causes misunderstandings in daily practice, and so both areas have to work closely together.

Figures and Tables

Figure 1

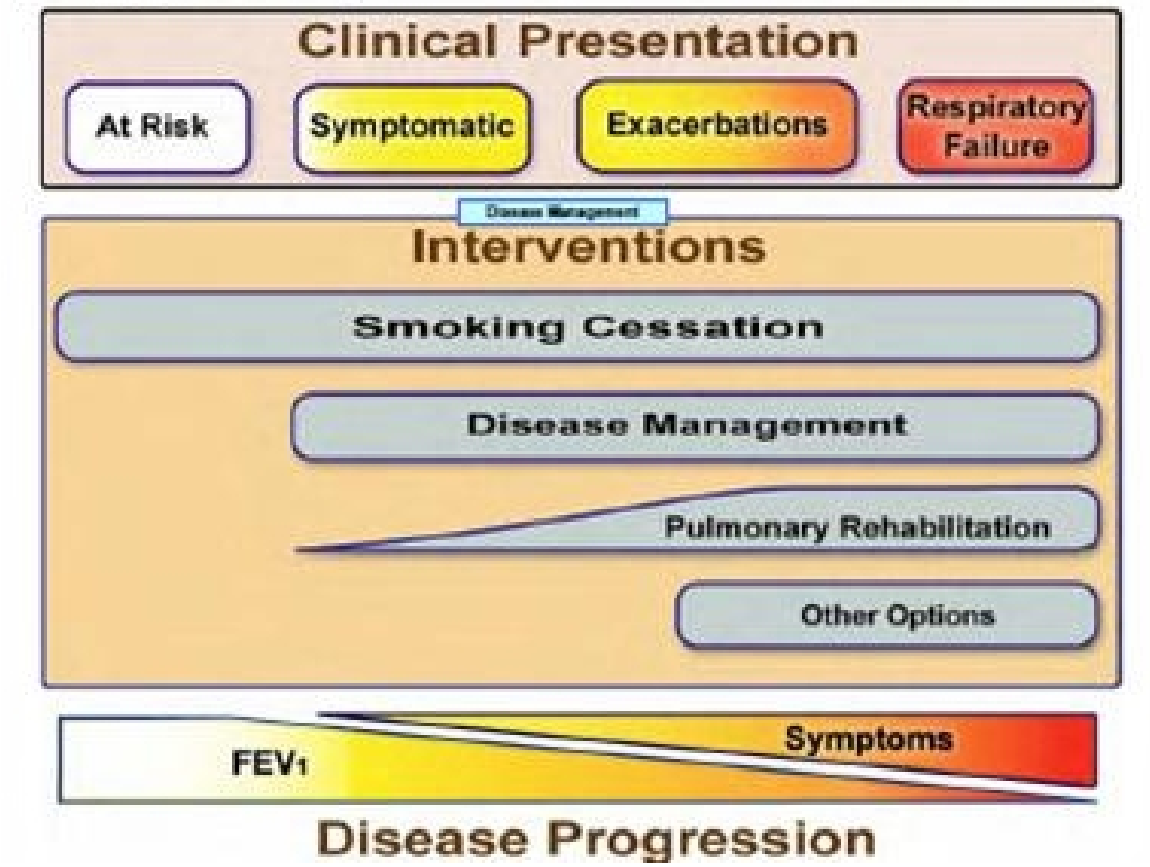
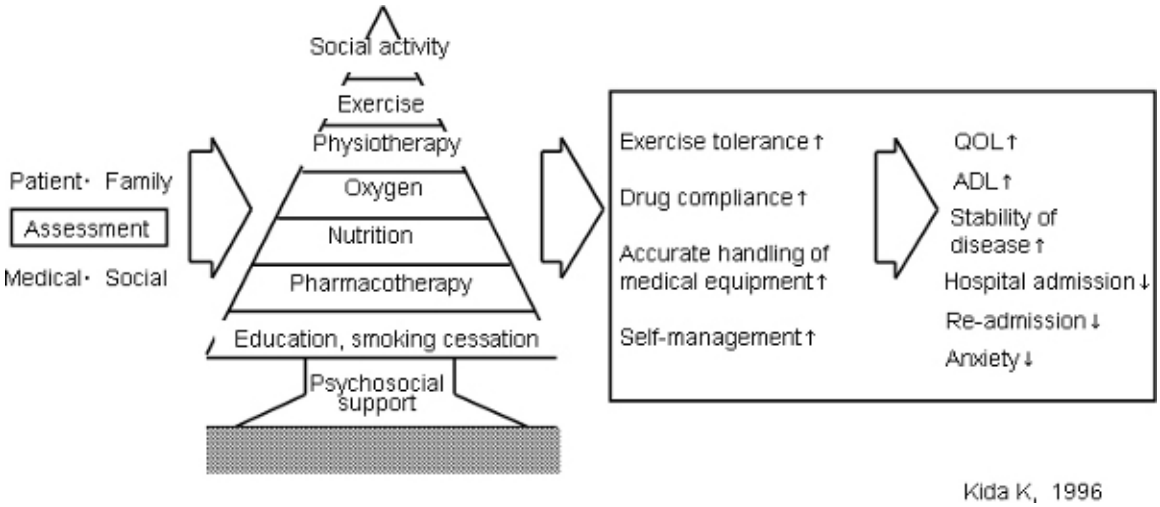


Figure 2



Kida K, 1996

Figure 3

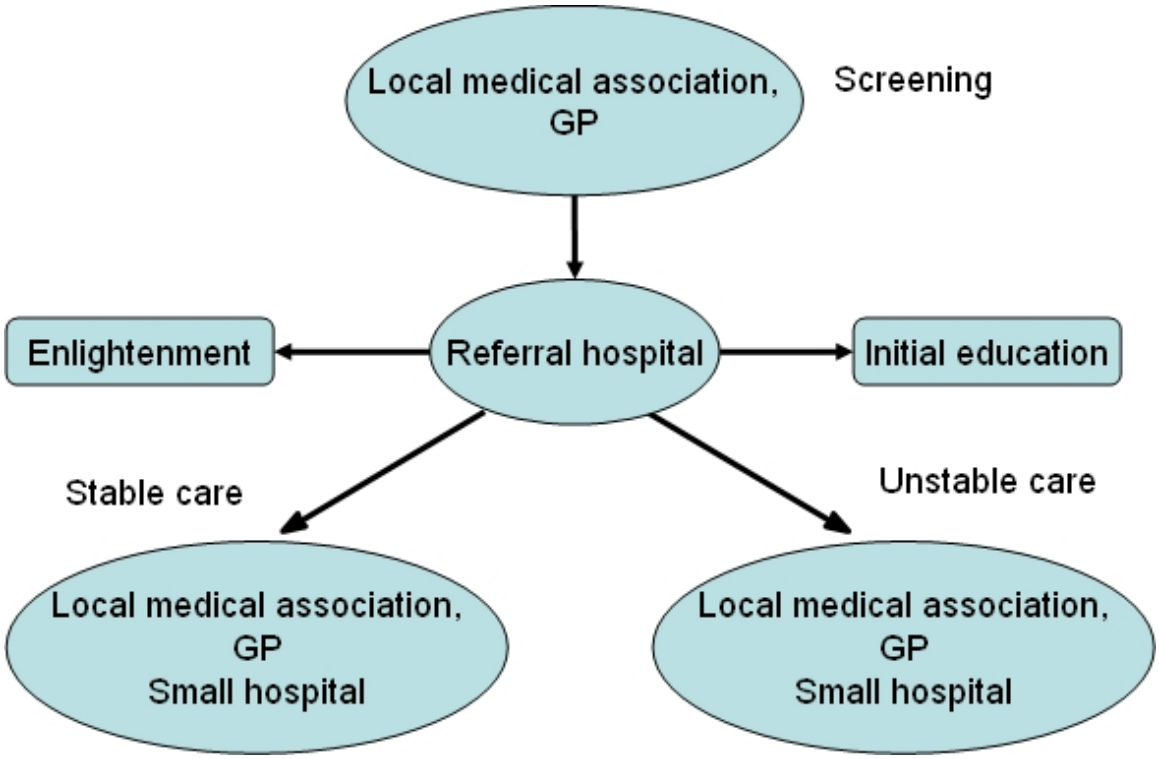

Local medical association, GP
Screening
Enlightenment
Referral hospital
Initial education
Stable care
Unstable care
Local medical association, GP Small hospital
Local medical association, GP Small hospital

Table 1 :Comparison of Pulmonary Rehabilitation Program Contents in North America, Europe, and Tokyo

Content Item	North America (n=50)%	Europe (n=51)%	Tokyo (n=202)%	North America vs Europe	North America vs Tokyo	Europe vs Tokyo
Education on pulmonary disease	98	86	20	P<0.05	P<0.0001	P<0.0001
Medication	92	90	20	NS	P<0.0001	P<0.0001
Breathing retraining	90	80	47	NS	P<0.0001	P<0.0001
Oxygen	86	78	84	NS	NS	NS
Walking	86	61	39	P<0.005	P<0.0001	P<0.005
ADLs	84	28	20	P=0.000	P<0.0001	NS
Nutrition	84	55	36	P<0.005	P<0.0001	P<0.05
Upper and lower extremity exercise	82	61	24	P<0.05	P<0.0001	P<0.0001
Relaxation	78	65	13	NS	P<0.0001	P<0.0001
Psychosocial support	78	59	1	P<0.05	P<0.0001	P<0.0001
Family education	76	33	20	P=0.000	P<0.0001	P<0.05
Pulmonary hygiene	74	59	42	NS	P<0.0001	P<0.05
Bicycle ergonometer	72	45	6	P<0.01	P<0.0001	P<0.0001
Smoking cessation	70	69	66	NS	NS	NS
Treadmill	68	33	6	P<0.01	P<0.0001	P<0.0001
Respiratory muscle training	58	49	47	NS	NS	NS

ADL: activity of daily living. NS: Not significant. (Casaburi R & Porszasz J, 2006)

Table 2: Strength of Evidence

Strong Recommendation

High (Grade A)

- A program of exercise training for the ambulatory muscles is recommended as a mandatory component of PR for patients with COPD.
- PR improves the symptom of dyspnea in patients with COPD.
- PR improves the health-related quality of life in patients with COPD.
- Six to 12 weeks of PR leads to benefits regarding several outcomes that decline gradually over 12 to 18 months.
- Both low- and high-intensity exercise training lead to clinical benefits in patients with COPD.
- The addition of a strength training component to a PR program increases muscle strength and muscle mass.
- Unsupported endurance training of the upper extremities is beneficial in patients with COPD and should be included in PR programs.

Moderate (Grade B)

- Lower-extremity exercise training at a higher exercise intensity produces greater physiologic benefits than lower-intensity training in patients with COPD.
- The scientific evidence does not support the routine use of inspiratory muscle training as an essential component of PR.
- Education should be an integral component of PR. Education should include information on collaborative self-management and the prevention and treatment of exacerbations.
- PR is beneficial for some patients with chronic respiratory diseases other than COPD.

Low (Grade C)

- Some benefits, such as in the health-related quality of life, remain above controls at 12 to 18 months.
- Supplemental oxygen should be used during rehabilitative exercise training in patients with severe exercise-induced hypoxemia.

Weak recommendation

Moderate (Grade B)

- PR reduces the number of hospital days and other measures of health-care utilization in patients with COPD.

- There are psychosocial benefits derived from comprehensive PR programs in patients with COPD.

- As an adjunct to exercise training in selected patients with severe COPD, noninvasive ventilation produces modest additional improvements in exercise performance.

Low (Grade C)

- PR is cost-effective in patients with COPD.

- Longer PR programs (12 weeks) produce greater sustained benefits than shorter programs.

- Maintenance strategies following PR have a modest effect on long-term outcomes.

- Current scientific evidence does not support the routine use of anabolic agents in PR for patients with COPD.

- There is minimal evidence to support the benefits of psychosocial interventions as a single therapeutic modality.

- Administering supplemental oxygen during high-intensity exercise programs in patients without exercise-induced hypoxemia may improve gains in exercise endurance.

No recommendation

- There is insufficient evidence to determine if PR improves survival in patients with COPD.

- Although no recommendation is provided since scientific evidence is lacking, current practices and expert opinions support the inclusion of psychosocial interventions as a component of comprehensive PR programs for patients with COPD.

- There is insufficient evidence to support the routine use of nutritional supplementation in PR of patients with COPD.

- Although no recommendation is provided since scientific evidence is lacking, current practices and expert opinions suggest that PR for patients with chronic respiratory diseases other than COPD should be modified to include treatment strategies specific to individual diseases and patients in addition to treatment strategies common to both COPD and non-COPD patients.

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