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Research article

The general essential objectives of medical rehabilitation in the management of chronic dyspnea – a systematic review

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Abstract: Dyspnea is defined by an increased laboured breathing, due to interactions of motor, sensory and metabolic nerve impulses, with increased airway resistance, caused by hypox-emia or hypercapnia. Chronic dyspnea presents various causes, respiratory disease, car-diovascular disease, skeletal disease, anaemia, obesity or even physical deconditioning, a condition that persists for more than 4–8 weeks. As for the rehabilitation program, it in-volves the patient's re-education, the actual physical recovery, change in risk factors and psychological counselling, all leading to the definite improvement of the physical and mental condition, with positive consequences on the quality of life. The rehabilitation pro-gramme applied to increase exercise tolerance in patients with chronic dyspnea can be performed safely; it will also result in an increase in the quality of life of patients. There is a need to develop a strategy for a long-term approach to patients with chronic dyspnea, involving a multidisciplinary team for the constant follow-up of these patients using easily reproducible, feasible and low-cost methods. Rehabilitation therapy in patients with chronic dyspnea uses a set of therapeutic measures, with the aim of restoring greater physical and mental capacity than before the programme.

Keywords: pulmonary rehabilitation, chronic dyspnea, physical therapy in dyspnea

1. Introduction

Cardiopulmonary rehabilitation includes a multidisciplinary program and its main objective is to prevent the patient's physical deconditioning beyond the limit imposed by the basic suffering [1]. It includes several medical disciplines, which tailor the therapy according to the individual needs of each patient, setting up long-term objectives, using therapeutic methods aimed at increasing physical capacity, regaining autonomy as well

as social and professional reinsertion, thus achieving an increase in the patients' quality of life [2, 3].

1.1. Definition and etiology.

dyspnea is a pathophysiological condition, which manifests itself through an increased respiratory effort, a distinct sensation in terms of quality, but which varies in intensity. The mechanism is the interaction of motor, sensory and metabolic nerve impulses, which lead to a dysfunction of the motor cortex, due to hypoxemia or hypercapnia [4, 5]. The dyspneic patient, who presents a dyspneic disease, persistent over 4-8 weeks, falls under the concept of chronic dyspnea [6].

Shortness of breath is commonly seen in patients with cardiopulmonary disease. The history provides information about the etiology of this clinical manifestation. Cardiac causes are ischaemic heart disease, congestive heart failure, valvular heart disease and arrhythmias. Pulmonary vascular diseases, restrictive and obstructive dysfunction diseases may also be accompanied by dyspnea. Other causes of dyspnea have also been identified (figure 1)[7-9]. Chronic dyspnea may have different origins, pulmonary, cardiac or other such as anaemia, lack of physical condition, anxiety. Often, several reasons are behind it.

dyspnea is the symptom that generates, in addition to biological reactivity, also a psychological reactivity, experienced differently by patients. Anxiety and depression are quite common manifestations among patients with chronic cardiovascular and respiratory diseases, manifested via dyspnea [10].

As for the quality of life, experiencing this symptom - chronic dyspnea, causes a reduction in the quality of life due to the discomfort created by it, disability, and inability to work, with the consequence of some psycho-social problems, to which the patient must adapt [11].

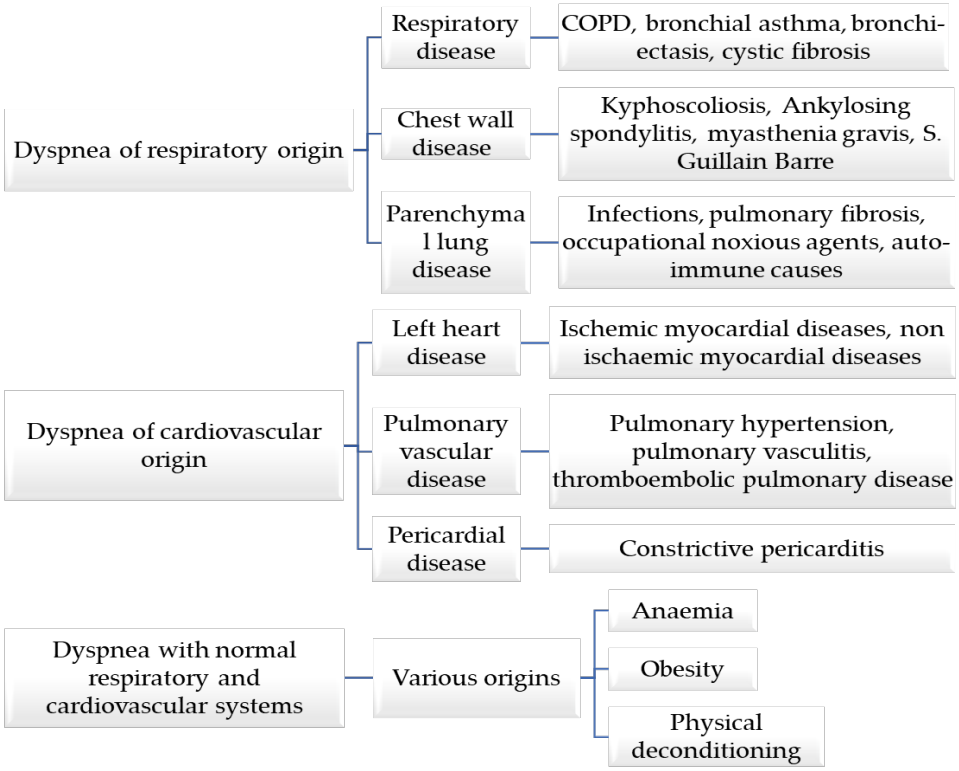

Figure 1. Etiology of dyspnea.

Asthma, heart failure, ischaemic heart disease, chronic obstructive pulmonary disease (COPD), pneumonia and psychogenic disorders are thought to account for 90% of dyspnea cases.

1.2. Physiopathological mechanisms in the onset of dyspnea

Alveolar ventilation is dependent on inspiratory and expiratory function (which promotes the elimination of secretions, through coughing, sneezing). With ageing comes inspiratory dysfunction [12]. The association of chronic heart failure accentuates this dysfunction. The consequences of inspiratory dysfunction are shown in Figure 2.

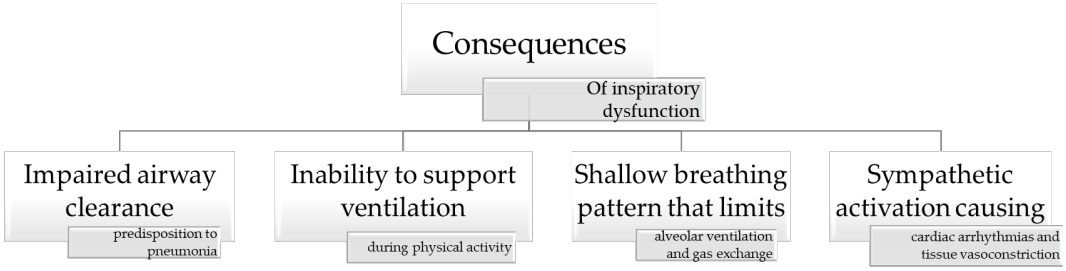

Figure 2. The consequences of inspiratory dysfunction.

The activity of the diaphragm (having the function of an inspiratory muscle) depends on neuromuscular integrity; aging and heart failure cause changes in the quantity and quality of contractile proteins, accelerated fiber atrophy and changes in fiber type distribution. These changes in skeletal muscle cause decreased physical performance [13].

Dyspnea of respiratory cause is characterized by skeletal muscle dysfunction. There is a change in the structure, strength, and endurance of muscle fibres. The proportion of type I fibres (responsible for slow contraction and increased resistance to fatigue) and type IIx fibres (responsible for fast contraction and low resistance to fatigue) is affected [14].

Resting pulmonary hyperinflation is a predictor of exertional dyspnea [15].

1.3. Assessment of dyspnea as a symptom

The methods commonly used to assess dyspnea are shown in Figure 3.

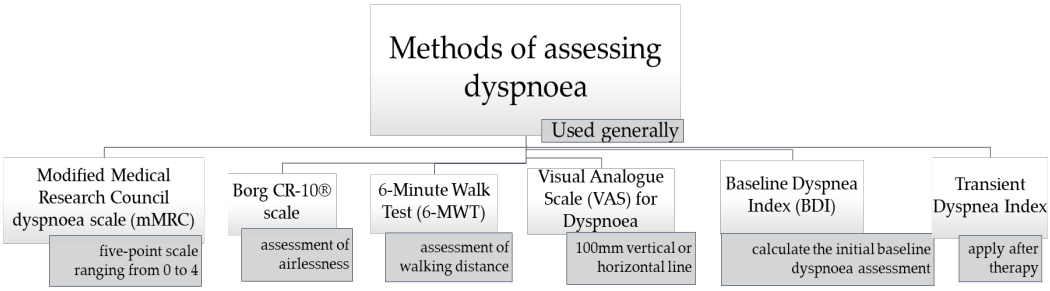

Figure 3. Methods for assessing dyspnea.

The Medical Research Council Modified dyspnea Scale (mMRC) classifies dyspnea into 5 grades, from 0-4 [14].

Assessing the quality of feeling dyspnea can be made according to different classifications [16] figure 4.

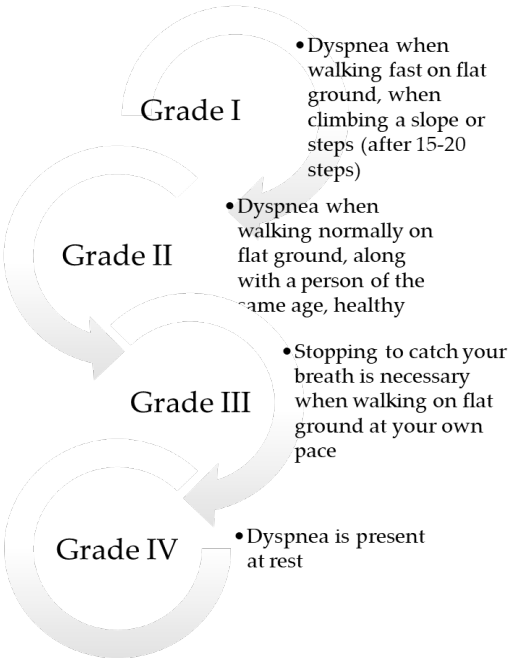

Figure 4. Clinical differentiation of chronic dyspnea according to WHO.

Dyspnea evaluation according to Borg Scale, which is a subjective method of assessing the intensity of physical activity, quantifies the physical exertion by tracking its frequency, duration and intensity; can be used during submaximal effort (6 min walk test) [17]. Frequency and duration are objective parts, meanwhile intensity is a subjective part that takes into consideration the subject in question and the subject's perception of the physical exertion perceived, Table 1 [18].

Visual analogue scale (VAS) (100 mm horizontal or vertical line) and numerical rating scale (NRS - scale from 0-10) can be used to assess dyspnea [14]. Other scales used are the Baseline Dyspnea Index (for initial assessment of dyspnea) and the Transient Dyspnea Index (used after the pulmonary rehabilitation program).

Table 1. Modified Borg Scale

Value	Subject's perception of the physical exertion perceived
0	No symptoms
0.5	Extremely slight, barely noticeable
1	Very slight
2	Slight
3	Moderate
4	Somewhat severe
5-6	Severe
7-8	Very severe
9	Extremely severe
10	Maximal

1.4. Evaluation of effort capacity in patients with dyspnea

1.4.1. Spirometry

Spirometry is a basic respiratory functional exploration that provides data on lung flows and volumes and the function of the respiratory muscles, used to diagnose obstructive and restrictive ventilatory disorders, to characterize disease severity and to monitor the response to treatment [19, 20].

1.4.2. Cardiopulmonary exercise testing (CPET)

CPET (the gold standard) which determines the maximum oxygen consumption (max. VO2) during physical activity, CO2 production and heart rate, is a complex exploration that evaluates the respiratory and cardiovascular function, as well as the peripheral muscle activity [21]. It is the most specific evaluation method for assessing functional capacity [22]. It analyses the gas exchange during physical activity of increasing intensity, until symptoms limit the test or the maximum level is reached. In fact, the test determines normal or reduced maximal exercise capacity. For people without cardiorespiratory disease, the rate of decline in VO2max (US) is estimated to be 10% [14]. This test directs the diagnosis towards the organ or system in charge with the patient's symptoms and it has a high sensitivity in detecting subclinical conditions. CPET is carried out on a treadmill or a cycle ergometer [23]. The effort can be incremental (in the ramp), maximum incremental on the treadmill and with a speed.

Indications for cardiopulmonary testing: assessment of dyspnea, detection of exercise-induced bronchoconstriction, detection of exercise desaturation, assessment of response to exercise, prognosis on life expectancy, determination of the disability, assessment of cardiopulmonary fitness, assessment of response to therapy [24].

1.4.3. Six-minute walk test

The 6-minute walk test (6 is a method of testing and quantifying the physical condition of patients with cardiopulmonary diseases, including the assessment of their prognosis and therapeutic response, with a high degree of patient tolerance [25]. The test is objective, simple, reproducible, low cost, well tolerated by patients, adjustable to patient comorbidities. It reflects the functional capacity for submaximal exercise in daily life [26]. The test assesses functional capacity overall, but it does not provide specific information about the multiple systems involved in this exercise, nor does it assess the patient's stress [27]. Other assessment methods are the ISWT (incremental shuttle walking test), external ritmate and ESWT (endurance shuttle walking test).

The severity of dyspnea is closely related to cardiopulmonary reserve.

2. Methods

The objective of this work was to identify the rehabilitation methods used in chronic dyspnea and the effects obtained. We have searched randomised controlled trials, observational studies, systematic reviews, and meta-analyses published in English in PubMed database using the keywords: chronic dyspnea, physical therapy in dyspnea, cardio-pulmonary rehabilitation. The medical literature includes numerous evaluation

and approaches of this disease, also has emphasized the necessity for additional research to find efficient rehabilitation treatment for people with chronic dyspnea. Studies that have looked at the effects of different types of exercise-on-exercise tolerance (including dyspnea) in patients with pulmonary, cardiac or cardiopulmonary disease have been considered.

3. Results

The term pulmonary rehabilitation, introduced in 1960, represents a non-pharmacological, patient-centered therapeutic intervention through the choice of training type; the goal is to achieve increased exercise tolerance, increased quality of life, reduced dyspnea and anxiety [28]. The recovery of chronic dyspnea of cardiopulmonary etiology aims to optimize the physical, mental and social condition of the patients, as well as to slow down or stop the progression of the disease, with the improvement of the psychosocial and professional status [21]. Chronic obstructive pulmonary disease (COPD) is associated with disabling dyspnea, skeletal muscle dysfunction and significant morbidity and mortality. Current guidelines recommend pulmonary rehabilitation (PR) to improve chronic dyspnea, functional capacity and quality of life. The 3 guidelines have been published by the American College of Sports Medicine, the American Thoracic Society/European Respiratory Society and the American Association of Cardiovascular and Pulmonary Rehabilitation [29]. The exercise capacity of patients with chronic dyspnea is usually reduced, both due to the suffering itself as well as to the lack of activity of these patients, therefore physical training increases the exercise capacity of patients with chronic dyspnea and it does not involve further alteration of the cardiopulmonary function [30]. Progressiveness in the application of physical activity is mandatory, thus the results obtained at the previous exercise test will be considered [31]. The individualization of the treatment will be carried out according to the patients' age, gender and comorbidities [2].

3.1. The fundamental stages of cardiopulmonary rehabilitation

The fundamental stages of cardiopulmonary rehabilitation involve assessing patients, determining the etiology of chronic dyspnea, identification of risk factors and establishment of the rehabilitation plan (figure 5).

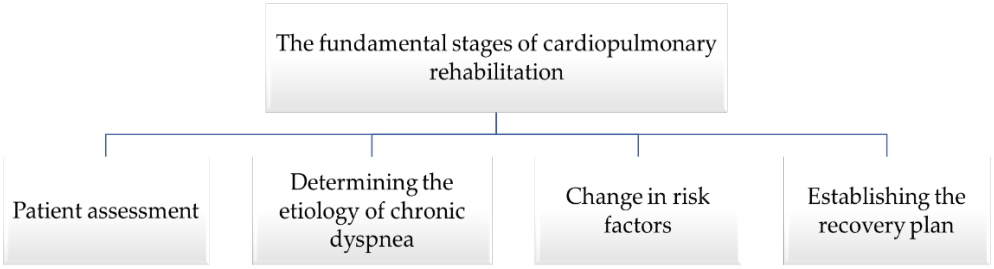

Figure 5. The fundamental stages of cardiopulmonary rehabilitation.

3.2.1. Patient assessment

During the medical history, the patient is asked to describe what they feel, the breathing discomfort, how it occurs and the effects of certain positions on the dyspnea. At this stage, emphasis is placed on cardiopulmonary risk factors, information on comorbidities is sought, as well as the presence of possible physical disabilities. The severity of dyspnea is assessed using the Borg scale classification.

3.2.2. Determining the etiology of chronic dyspnea

The general physical examination will exclude acute pathologies, or possible osteoarticular or neurological deficits that would prevent physical training. At this stage, heart rate and blood pressure will be determined, which are important factors in the dosage of exercise. Electrocardiogram, echocardiography to determine ventricular function, presence or absence of valvular heart disease or valvular dysfunction, spirometry, laboratory tests are performed. To assess exercise capacity, the patient undergoes an exercise test. Nutrition status, cognitive function and the patient's integration into psycho-social life are also assessed.

3.2.3. Change in risk factors

Quit smoking – smoking is one of the most important risk factors, therefore all smokers should be encouraged to quit smoking for good. Sudden stop rather than tapering is recommended. Behavioral tips or psychological counselling are used. Passive smoking is also avoided [32].

Lipid management - the main goal is to achieve low values of LDL cholesterol below 100 mg/dL, HDL cholesterol above 150 mg/dL and total cholesterol below 200 mg/dL. Patients with altered lipid values are advised to manage nutrition and body weight, but, if needed, medicines will be added for optimal lipid management [33-35].

Management of arterial hypertension – in hypertensive patients, therapy and compliance are evaluated, optimal BP is at 120/80 mmHg. For patients with SBP above 130 mmHg or DBP above 85 mmHg, lifestyle changes, periodic exercise, weight control, moderate sodium restriction, quit smoking, along with adherence to drug therapy are initiated [36].

Obesity – BMI and waist circumference are measured, with ideal values for BMI of 21-25 kg/m2, and waist below 89 cm in men and below 78 cm in women. For patients with altered values, it is recommended a diet that sets out reduced calory intake [37], such as increased expenditure through an exercise program. The initial goal is a loss of approximately 10% of the body mass, compared to the initial value [38].

Evaluation of the psycho-social factors – such as depression, anxiety, low socio-economic status, stress at work, alcohol misuse or other toxic substances. The method used will involve using behavioral methods, such as group or individual counselling. In special cases, family members can also be counselled. Self-help strategies and the ability to get effective social support will be taught.

Depression – it is important to identify the signs and the management of depression [39, 40], this being a condition associated with worsening symptoms, frequent hospitalizations and requires individual or group education to help the patient adapt to his/her illness. In the case of signs of depression, the help of a specialist psychiatrist and psychologist will be sought for diagnosis and subsequent treatment [41, 42].

3.2. Tips on diet or food education

It is recommended to evaluate diet, eating habits; low fat foods (30-35% of daily energy intake, of which 10% monounsaturated acids), high fibre intake 30 g/day, low intake of industrialized sugar. Salt intake should not exceed 6 g/day. Calorie intake should be in relation to daily energy intake to avoid weight gain and maintain a BMI of 18.5-24.9 kg/m2. Abdominal circumference is very important, so if it exceeds 89 cm in women and

103 cm in men, lifestyle measures should be taken and metabolic syndrome management should be considered. In overweight/obese patients, the target is weight loss by reducing body mass by 5-10%, changing diet and associated risk factors [43]. In patients with heart failure, weight gain is usually due to fluid retention; weight loss is not recommended in these patients, as some of them may have reduced muscle mass [44].

3.3. Actual medical rehabilitation

Cardiopulmonary rehabilitation is an important part of the treatment of patients with congestive heart failure or COPD, with a role in improving physical status; its role in improving psycho-social status is also recognized [45]. Chronic heart failure (HF), through pathophysiological changes, causes multiorgan damage, including pulmonary damage. In HF the blood circulation in the respiratory mucosa is reduced [46]. Lung damage is responsible for dyspnea and reduced exercise tolerance. Studies show that there is no correlation between impaired function (expressed by cardiac volumes and ejection fraction] and exercise tolerance [47].

Training aims to train skeletal muscles; aerobic or resistance exercise increases blood flow (by increasing capillary density), mitochondria volume, muscle fibre size, decreases lactic acidosis and vascular resilience. The reduction in lactic acidosis during submaximal exercise is responsible for the decrease in dyspnea. Physical training also reduces pulmonary hyperflation (with improvement of arterial oxygen levels required by skeletal muscles) and regulates neurohumoral excitation. All these effects will lead to increased exercise tolerance in patients with cardio-pulmonary disease [45].

Cardiopulmonary rehabilitation aims at improving the physical and mental performance, by using programs that involve medical evaluation, physical therapy, intervention on risk factors, patient education on a healthy lifestyle, but also psychological counselling. It is an intervention based on thorough patient assessment followed by patient-tailored therapies that include exercise, education, and behavior change designed to improve long-term adherence to health-enhancing behaviours [3]. It is recommended that the recovery intervention be multidimensional, individualized and patient-centered, with a holistic approach to achieve the goals (figure 4).

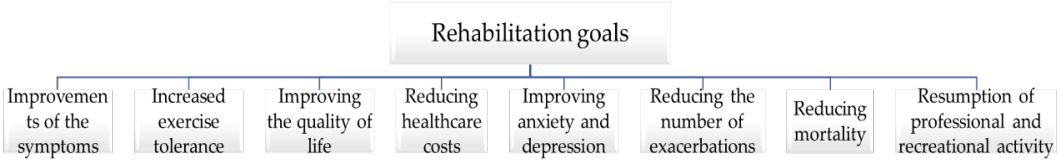

Figure 4. Rehabilitation goals.

Cardiopulmonary rehabilitation follows three main phases, thus phase I is carried out during hospitalization, in hospital conditions, to ensure the capacity for self-care and independence when walking. Phase II takes place in a specialized rehabilitation facility and aims at achieving maximal exercise capacity, while phase III at the patient's home, the importance of modifying risk factors and lifestyle, managing psychosocial and family factors, and stress training again [2, 29].

Patient's education is the basis of his adherence to the medical procedure; the more clearly the information is conveyed, the better the results. Personalized goals will be pursued for each patient. These educational measures are important both for increasing treatment compliance and for secondary prevention of cardiovascular diseases [48].

Physical therapy has the role of increasing cardiovascular and pulmonary functional capacity. This aims at: corrective gymnastics, respiratory rehabilitation, relaxation, posture, balanced stress training, cough education, speech education, occupational therapy [49].

The choice of individualized physical exercise is important, because choosing inappropriately with the patients' current possibilities can have unfortunate consequences on the rehabilitation process.

The amount of stress will depend on the type of exercise, the intensity and the duration of the exercise. When choosing physical exercises, one will consider the social and logistical particularities and the patient's preferences for better treatment compliance. The intensity of the physical activity will consider heart rate (HR) 70-75% of the maximum HR or 110-120 beats/minute under treatment with beta-blockers, as well as Borg scale 12-14 points [50].

Physical maintenance activity is characterized by moderate aerobic activity at least 30-60 minutes daily or 3-4 times a week, the dosage of exercise being done gradually, included in the patient's daily schedule [51]. Training takes into account the patient's age, his/her habits, the presence of comorbidities, preferences and intended goals, but individual psycho-social barriers are also considered. Training is recommended for approximately 150 minutes per week at a submaximal stress, starting at 50% of the maximum heart rate, gradually increasing to 70% of the maximum heart rate obtained at the dosed exercise test performed before training. Caloric energy intake will be approximately 1000-2000 kcal per week. The patient will be supervised during training by monitoring the heart rate and the blood pressure [52].

Physical activity is interrupted when dyspnea, angina worsens, excessive fatigue, tachycardia, greatly increased blood pressure values, low glycaemic values below 80 mg/dL or above 250 mg/dL [26].

The rehabilitation program will take place in a space suitable for physical exercises, equipped with appropriate equipment as well as medical equipment to provide emergency medical assistance.

Informative rehabilitation programs are set up, consisting of tips given to patients and the recommendation for home exercise without supervision, or formal programs where rehabilitation is carried out under the supervision of the medical team [53].

Tabel 2. Recommended interventions for lung rehabilitation.

Type of exercise	Tool	Time	Intensity	Schedule
Aerobic	Bike, treadmill	30–40 minutes per session	Progressive, Symptom-limited	4–12 weeks, 2–5 weekly supervised sessions
Resistance	Resistance exercises (weights, elastic bands, etc.) from different starting positions	5-20 minute, per session	Progressive, Symptom-limited	4–12 weeks, 2–5 weekly supervised sessions

At an exercise capacity of more than 5 METS, the patient can resume routine physical activity, otherwise the patient may start with 50% of the maximum exercise capacity. Physical activity is gradually initiated with activities of moderate intensity, walking, climbing stairs, cycling, household chores [54].

Recommended are bicycle training, resistance training (relieves hyper-inflation and exertion dyspepsia, heart rate [14], training in water exercise, Tai Chi (systematic callisthenic exercise, of moderate intensity), yoga, etc. [21]. For patients with respiratory pathology, it is very important to train the arm muscles; you can use the Arm Bike [14].

Exercises with resistance are recommended to address several joints, to tone all muscle groups and also prevent the installation of muscle imbalances [55, 56]. The American Thoracic Society/European Respiratory Society recommends endurance training duration of 20-60 minutes per session, with an exercise intensity >60% of

maximum intensity, 3-5 times per week, perceived exertion level on the Borg scale 4-8 [2, 57]. When initiating strength training (in the untrained) it is recommended to repeat resistance exercises of 8-12 times maximal resistance (MR), 2-3 times a week; the increase should be gradual by 2-10% after reassessment of effort capacity [58]. Combining the 2 types of training brings superior benefits.

Neuromuscular electrical stimulation (NMES), using low-frequency current, medium-frequency current, monopolar, bipolar, etc., brings benefits in increasing exercise capacity in patients with various frame diseases, including respiratory and heart failure. The electrodes are applied to the quadriceps, hip and calf muscles, frequency is 50 Hz, pulse duration: 350-400 μs, duration 30-60 min/day, 6-8 weeks in respiratory diseases and 8-10 weeks in cardiac diseases. The effects relate to the preservation of strength and muscle mass through neuronal adaptation. This increases walking distance and effort tolerance [59]. The results of the rehabilitation programme are summarised in Table 3.

Table 3. Summarises the results obtained through the implementation of the rehabilitation programme.

study/number of patients	Pathology	Assessment of dyspnea	rehabilitation programme	duration of application	results
M. Beaumont, 2017/ 150, **[60]**	COPD	Multidimensional dyspnea Profile and 6MWD test, quality of life	PRP+IMT versus PRP	4 weeks	Significant increase in inspiratory volume in the PRP+IMT group, with no significant differences in dyspnea
A. Acheche, 2020/42, **[61]**	COPD	Time up and go, Berg Balance Scale, 6MWD test and maximum voluntary contraction	Neuromuscular electrical stimulation associated with endurance training (ET) and resistance training (RT)	72 sessions	Improves balance in COPD patients.
A. Martín-Salvador, 2015/44 **[62]**	acquired pneumonia, acute exacerbations of COPD	Dyspnea level and quadriceps muscle strength	Standard medical therapy (oxygen therapy and pharmacotherapy) versus standard treatment and a physical therapy intervention (breathing exercises, electrostimulation, elastic band exercises and relaxation).	during hospitalization	skeletal muscle level gains
M. Beaumont, 2015/34, **[63]**	COPD with inspiratory volume in normal range	Borg scale, 6MWD test	PRP+IMT versus PRP	3 weeks	Improvement of dyspnea, No significant differences
P. Bernocchi, 2016/ a group that followed a rehabilitation programme versus conventional care, ratio 1:1,	COPD and CHF combined	6MWD test, dyspnea and fatigue at rest, oxygenation, physical activity profile (PASE questionnaire), and QoL (Minnesota and CAT questionnaires)	"Light training" (15-25 min of exercise with a mini-ergometer, 3 times/week; 30 min of calisthenic exercise 3 times/week; free walking twice a week) versus "hard training" (30-45 min with mini-ergometer, incremental load (0 - 60 W)/ 3 - 7 days a week;	4-6 months	It has proven the effectiveness of methods for monitoring health, dyspnea, including tele-medicine.

[64]			30-40 min weight training (0.5 kg)/ 3-7 days per week; walking 2 - 7 days a week.		
L. Dowman et al., 2021, /356 (16 studies), **[65]**	Pulmonary diseases	6MWD test, quality of life tests, degree of dyspnea, heart rate	PRP	3-48 weeks	Increases walking distance, work capacity, improves quality of life; No adverse reactions. Effect of pulmonary rehabilitation on maximum heart rate was uncertain.
M.Kerti, et al., 2018/ 327, **[66]**	COPD	6MWT	PRP	4 weeks, 20-30 minutes/ 2 times a day; Breathing exercises and endurance exercises	Test improvement 6MWT, averaging 60 m, Increased stress tolerance.
Maureen Davey et al., 2014 / 92, **[67]**	COPD, ischemic heart disease, HF	6MWT	PRP	8 weeks, 3 times/week	Walking distance increased, average 55.7 m, incremental walking, dyspnea and quality of life improved.
K. Miki et al., 2017/36, **[68]**	COPD	CPT Test	Maximum training, 4 times/week	4 weeks	Increases exercise tolerance, saves O2 requirements, no cardiac workload
B. Vainshelboim, 2017/32, **[69]**	Idiopathic pulmonary fibrosis	Echocardiography, CPT test		12 weeks/ 2 sessions per week	They showed a significant correlation with improvement in functional capacity, dyspnea and quality of life.
M. Davey, et al., 2014/272 **[67]**	chronic respiratory diseases (N=193) and heart failure (N=79)	incremental shuttle walking test; endurance shuttle walking test; quadriceps strength; the anxiety and depression test improved	PRP, personalised exercises: aerobic and resistance exercises	2 sessions of 30 minutes (minimum)/ week, 6 weeks	An increase in walking distance, endurance, and quadriceps strength was observed. The anxiety and depression test also improved.
S. Adamopoulos et al., 2014/43 **[70]**	HF	Work capacity, lung function, inspiratory muscle strength and work capacity, quality of life, FEVS and VS diameter, dyspnea, C-reactive protein and NT-proBNP.	inspiratory muscle training combined with aerobic training	3 sessions of 45 minutes (minimum)/week, 12 weeks	Combination therapy with aerobic training provides additional benefits in functional and serum biomarkers in patients with moderate CHF.

V. Cavalheri et al., 2019/450 **[71]**	Lung cancer and lung resection	6MWD test; VO2peak	combined aerobic and resistance training; combined aerobic and inspiratory muscle training; combined aerobic, resistance, inspiratory muscle training and balance training	4-20 weeks, 2-5 day/week	Physical training increases the effort capacity and muscle strength of the quadriceps, decreasing dyspnea.
L. Peñailillo et al., 2022/66, **[72]**	COPD	Spirometry, Medical Research Council dyspnea scale, 6MWD test, BMI, the St. George´s Respiratory Questionnaire for COPD, Maximal voluntary isometric contractions strength, VO2peak, Muscle biopsy	eccentric (ECC), concentric (CONC) and combined eccentric/concentric (ECC/CONC) cycling training	12 weeks	Combination of eccentric and concentric exercises will lead to improvement of clinical aspects in COPD.
I. S. Silva et al., 2013/113, **[73]**	Bronchial asthma and HF		inspiratory muscle training with either an external resistive device or a threshold load in people with asthma.	10-30 minutes/day, 3-25 weeks	Inspiratory muscle training causes diaphragm toning (in patients with HF) and changes the proportion of type I fibres and the size of type II fibres (in the external intercostal muscles in patients with COPD).
Z. Louvaris et al., 2021/18, **[74]**	COPD	lung function, functional capacity (6MWD) and respiratory muscle strength assessment and a symptom-limited cardiopulmonary exercise test on a cycle ergometer	High-intensity training of skeletal muscles	Three visits, 48 hours apart	High-intensity training of skeletal muscles results in reduced perfusion of extradiaphragmatic respiratory muscles, which causes increased dyspnea despite increased cardiac output.

Legend: PRP − rehabilitation programme, HF – heart failure, COPD − chronic obstructive pulmonary disease, 6MWD − 6MWD test.

Contraindications for physical rehabilitation

The main contraindications for rehabilitation therapy in patients with dyspnea are as follows: heart failure with signs of exacerbation, unstable angina, arrhythmias, pulmonary hypertension, severe arterial hypertension, pericardial effusion, symptomatic valvular heart disease, obstructive cardiomyopathy, acute infections, bronchial asthma exacerbation or COPD, haemoptysis, dementia, toxic substance abuse, motor disabilities that do not allow physical activity [75].

4. Discussion and future direction

The results presented above demonstrate that physical training has the role of reducing chronic dyspnea and fatigue; besides these clinical signs, studies show positive effects on the psycho-social state, especially in that patients feel they can control dyspnea [76]. Pulmonary rehabilitation exercises aimed at reducing chronic dyspnea consist of training the inspiratory, expiratory and diaphragm muscles.

Various rehabilitation programs were studied which aimed to train inspiratory muscles and skeletal muscles. It is very important to note the importance of the level of training. Intensive training aimed at skeletal muscles can increase dyspnea by reducing perfusion in the respiratory muscles. The superiority of the results obtained (occurrence of dyspnea, 6 min walk test, quality of life questionnaire) has been proven in the case of the association of specific training on inspiratory muscles applied for 4 weeks [60]. Another study followed the minimum duration and intensity of effort (40% of average maximum inspiratory pressure - PImax); from this study it appears that 3 weeks of training would be too little and the intensity of effort is too low [63].

Multicenter study, published in 2022 (N=66) evaluated, comparatively, the benefits of concentric cycling/eccentric cycling/eccentric cycling paired concentric cycling training, performed 3 times/week, 12 weeks, with duration (up to 40 min/training) and progressive intensity (rated perceived exertion, between 6-20). In the case of concentric exertion, the workload was up to 70% of VOpeak, maximum perceived exertion was considered up to 14 (Borg scale = somewhat hard). And in the second case training was performed up to the perceived exertion value of 14 on the Borg scale. In the third case the training time was half for each type of effort [72].

Inspiratory muscles in patients with bronchial asthma are shortened (resulting in a reduced contraction capacity); toning them also results in diaphragm training, both in healthy patients and in those with HF. Increasing the force of contraction of the inspiratory muscles (IM) with the apparatus will compensate for the hyperinflation characteristic of this pathology [73].

Three types of devices are available for inspiratory muscle training (IMT): threshold, resistive load and voluntary isocapnic hyperpnea devices. Threshold devices allow airflow during inspiration after reaching an inspiratory pressure, while resistive load devices are characterised by progestive resistance to inspiration. Voluntary isocapnic hyperpnea devices by increasing ventilation cause an increase in respiratory rate [77]. By training the inspiratory muscles, an increase in the speed of contraction of the diaphragm is obtained and, implicitly, a change in breathing times; the duration of inspiration decreases and the duration of expiration increases, without affecting Plmax [63]. MI training with external resistive device or threshold load, lasting 10-30 minutes, 3-25 weeks, in people with asthma does not show conclusive benefits supports a systematic review published in 2013 (N=113) [73].

Based on the assessment of exercise capacity, a recommendation can be made as to what activities the patient can do in the third phase of recovery, which lasts a lifetime. Table 4 shows the activities and the corresponding energy consumption.

At an exercise capacity of more than 5 METS, the patient can resume routine physical activity, otherwise the patient may start with 50% of the maximum exercise capacity. Physical activity is gradually initiated with activities of moderate intensity, walking, climbing stairs, cycling, household chores [54].

It is important to deepen the idea of developing a training program that addresses the patient with chronic dyspnea, regardless of the cause of the dyspnea. This program will contain endurance and endurance exercises, associated with an active lifestyle (daily walks and daily activities). It is important to determine their training frequency, intensity and duration.

Table 4. MET – measurement unit of energy level, energy spent that uses 3.5-4 mL of oxygen per kilogram body weight in one minute.

met Energy	Household chores	Works activities	Sports-recreational exercises
1 met	Reading TV Hand sewing	-	Sitting
1.5 met	Drawing, Handicraft Partially wash	-	Painting
1.5-2 met	Shaving, Piano,guitar Small activities in the kitchen	Typewriter, Adding machine, Sitting at the desk	Walking on flat ground Fishing
2 met	Shower-bath	Travelling, airplane	Gymnastics
2.5 met	Washing items, Small car repairs, Hair styling	Car driving Attending meetings	Cycle ergometer, Walking on flat ground at 3km/h, Dancing, Horse riding
2-3 met	Cleaning the window Raking	Convenience store clerk	-
3 met	Hot bath, Ironing Climbing stairs	Car repairs	Walking 4-5km/h Slow cycling
3.5-4 met	Fixing the garden, Carrying items, Vacuuming	Car assembling, Welding, Upholstery	Swimming, Golf
4-5 met	Sweeping, Climbing stairs Carrying 8-10kg	Carpentry, Masonry	Tennis, Badminton Gardening, Rowing boat
5-6 met	Wood choping	Raking, digging the ground	Cycling 10-15km Tennis, Skying
6-7 met	Rug beating	Pneumatic tools Work at the oven	Skating, Climbing at the Mountain, Jogging
7-8 met	-	Digging ditches	Rowing boat, Jump rope Skying
8-9 met	Carrying weights on the stairs Carrying items over 30-40 kg Snow shovelling	Hard physical work Steel industry worker	Rowing, Fencing, Handball Skying 6km/h, Jogging 10km/h
9-10 met	-	-	Cycling 20 km/h

The various barriers identified that limit patients from pursuing a cardiopulmonary rehabilitation program have prompted the National Heart, Lung, and Blood Institute (NHLBI) to find solutions to increase adherence to treatment. A Funding Opportunity Announcement (FOA) has been developed to support Phase II clinical trials; one of the objectives is to examine strategies to reduce differences in participation in cardiopulmonary rehabilitation programs related to age, gender, race, or ethnicity. Disparities were identified between women versus men related to referral, enrollment and completion of rehabilitation programs [78].

Another objective is to evaluate the effectiveness of the recovery programme, assessing exercise capacity, CV and pulmonary risk factors and quality of life. The importance of

telemedicine and a patient-centred home exercise programme is highlighted [78, 79].

Future strategies must understand these barriers, eliminate them to increase adherence to rehabilitation programs [80].

5. Conclusion

The rehabilitation program applied to increase exercise tolerance in patients with chronic dyspnea can be performed safely; it will also have the effect of increasing the quality of life of patients. It is necessary to elaborate a long-term approach strategy for the patients with chronic dyspnea, with the involvement of a multidisciplinary team for constant follow-up of these patients through easily reproducible, feasible and low-cost methods. The rehabilitation therapy at patients with chronic dyspnea, is using a set of therapeutic measures, due to restore higher physical and mental capacity as that before the program. Physical inactivity, limited by the symptomatology, leads to physical and mental degradation, regardless to the severity of the disease.

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