REVIEW

Results of Physiotherapy Treatments in Exacerbations of Chronic Obstructive Pulmonary Disease: A Systematic Review

Irene Torres-Sánchez, MSc, PT; Roberto Cruz-Ramírez, PT; Irene Cabrera-Martos, PhD, PT; Ana Díaz-Pelegrina, MSc, OT; Marie Carmen Valenza, PhD, PT

ABSTRACT

Purpose: The objective of this study was to review clinical trials of the effectiveness of physiotherapy compared with standard care, focused mainly on the functional status of patients hospitalized for acute exacerbation of chronic obstructive pulmonary disease (AECOPD). ***Methods:*** Search strategies were developed for each of the databases (PubMed, Scopus, and Web of Science). The study eligibility criteria were as follows: (1) The objective was to assess the effect and efficacy of physiotherapy compared with standard care (which included only medical and pharmacological treatment); (2) adults subjects had AECOPD; (3) one of the outcome measures was functional status, defined as an individual's ability to perform the normal daily activities required to meet basic needs, fulfill usual roles, and maintain health and well-being; (4) it was a clinical trial; (5) it was written in English; (6) it was published between January 2009 and February 2016; and (7) the full-text article was available. ***Results:*** The review revealed that for patients hospitalized for AECOPD, exercise, neuromuscular electrical stimulation, breathing exercises, and chest therapy significantly improved their functional status compared with standard care. ***Conclusions:*** A variety of physiotherapy modalities have been shown to improve functional status compared with standard care among patients hospitalized for AECOPD; other outcome measures also showed improvements.

Key Words: chronic obstructive pulmonary disease; hospitalization; cardiorespiratory physiotherapy; rehabilitation; systematic review.

RÉSUMÉ

Objectif : recenser les essais cliniques sur l'efficacité de la physiothérapie par rapport aux soins conventionnels pour évaluer l'état fonctionnel des patients hospitalisés pour exacerbations aiguës de la maladie pulmonaire obstructive chronique (EAMPOC). ***Méthodologie :*** des stratégies de recherche ont été mises au point pour chaque banque de données (PubMed, Scopus et Web of Science). Critères d'admissibilité des études : (1) l'étude vise à évaluer l'effet et l'efficacité de la physiothérapie par rapport aux soins conventionnels (traitement médical et médicamenteux seulement); (2) les sujets adultes souffrent d'EAMPOC; (3) un des résultats mesurés est l'état fonctionnel, défini comme la faculté d'une personne à accomplir les activités quotidiennes nécessaires pour répondre à ses besoins fondamentaux, assumer ses rôles habituels et maintenir sa santé et son bien-être; (4) il s'agit d'un essai clinique; (5) l'article est rédigé en anglais; (6) l'étude a été publiée entre janvier 2009 et février 2016; (7) le texte intégral de l'article est disponible. ***Résultats :*** le recensement révèle que l'exercice, la stimulation électrique neuromusculaire, les exercices de respiration et la physiothérapie respiratoire améliorent de façon significative l'état fonctionnel de patients hospitalisés pour EAMPOC par rapport aux soins conventionnels. ***Conclusions :*** divers soins de physiothérapie ont prouvé leur efficacité pour améliorer l'état fonctionnel de patients hospitalisés pour EAMPOC davantage que les seuls soins conventionnels. D'autres mesures de résultats ont également montré des améliorations.

Chronic obstructive pulmonary disease (COPD) is one of the leading causes of disability and mortality around the world; it is expected to become the third leading cause of death and the fifth leading cause of disability-adjusted life years in 2020.[1] Patients with COPD experience recurrent acute exacerbations at an annual rate

From the Department of Physical Therapy, School of Health Sciences, University of Granada, Granada, Spain.

Correspondence to: Marie Carmen Valenza, Departamento de Fisioterapia, Universidad de Granada, Facultad de Ciencias de la Salud, Av. de la Ilustración, 60, 18016 Granada, Spain; cvalenza@ugr.es.

Competing interests: None declared.

The authors received financial support from the Professional Association of Physiotherapists of Andalusia (Colegio Profesional de Fisioterapeutas de Andalucía), Spain (SG/0300/13CO); the Spanish Society of Pulmonology and Thoracic Surgery (Sociedad Española de Neumología y Cirugía Torácica, or SEPAR); the Spanish Lung Foundation (Fundación Respira; Beca Becario SEPAR 2013, Proyecto061/2013); and the University of Granada (Beca-Contrato FPU 2014, Plan propio de investigación, Universidad de Granada). It was financed jointly by Fundación Progreso y Salud and Boehringer Ingelheim España, SA (project code PI-0370-2014).

This work is part of a doctoral dissertation (ITS) within the framework of the PhD program in clinical medicine and public health at the University of Granada.

Physiotherapy Canada **2017; 69(2);122–132; doi:10.3138/ptc.2015-78**

Table 1 Search Strategy: Terms and Key Words

Query	MeSH and keywords
Chronic obstructive pulmonary disease and/or COPD	(''pulmonary disease, chronic obstructive'' [MeSH Terms] OR (''pulmonary'' [All Fields] AND ''disease'' [All Fields] AND ''chronic'' [All Fields] AND ''obstructive'' [All Fields] OR ''chronic obstructive pulmonary disease'' [All Fields] OR ''copd'' [All Fields]) AND (''exacerbation'' OR ''disease progression'' [MeSH Terms])
Physiotherapy treatment	(''physiotherapy'' [All Fields] OR ''Physical therapy'' [All Fields] OR ''Rehabilitation'' [All Fields] [MeSH Terms]) OR (''Physical therapy modality'' OR ''Physical therapy speciality'' OR ''physical therapy techniques'' [All Fields] [MeSH Terms]) AND (''effect'' [MeSH Terms] OR ''effectiveness'' [All Fields])
Limits	(''humans'' [MeSH Terms] AND English [lang] AND ''adult'' [MeSH Terms] AND 2009:2016 [dp] AND ''all relevant journal names'' [jour] AND ''journal article'' [pt])

MeSH = Medical Subject Headings.

that ranges from 0.5 to 3.5 exacerbations per patient.[2,3] Recurrent acute exacerbation of COPD (AECOPD) contributes significantly to the burden of the disease and is a leading cause of hospital admissions worldwide: Of COPD patients, 35% have at least one admission a year, and as many as 40% of admitted patients have two or more readmissions a year.[4] Exacerbations imply a worsening of symptoms and a reduction in lung function that, in a small proportion of patients, may not be recovered.[5]

In addition to the usual symptoms of an exacerbation (worsening cough, shortness of breath, etc.), patients who are admitted to hospital may exhibit impairment in functional status.[6] Systemic factors such as inflammation, malnutrition, medication, inactivity, age, hypoxemia, and smoking have long been recognized to exert strong effects on skeletal muscle performance in patients with COPD.[7] Among the main consequences of AECOPD, the following have a direct impact on patients' health: increase in mortality,[8] impairment of health-related quality of life,[9] faster decline in lung function,[10] marked reduction in physical activity level,[11] and worsening of peripheral muscle weakness.[12]

According to the Global Initiative for Chronic Obstructive Lung Disease guidelines,[13] standard medical therapy in patients hospitalized for AECOPD includes pharmacological treatment such as steroids, bronchodilators, and antibiotics. Many physiotherapy techniques are applied to patients admitted to hospital for AECOPD, aiming to restore or maintain function to prevent or avoid further impairment, but there is no consensus about the best physiotherapy modality or about the effectiveness of such treatment.[14] Physiotherapy treatment in these patients involves using techniques or strategies aimed at improving lung volume or facilitating the removal of airway secretions. Common physiotherapy techniques include percussion, vibration, postural drainage, active cycle of breathing, positive expiratory pressure (PEP), neuromuscular electrical stimulation (NMES), thoracic expansion exercises, and walking programmes.[15]

The Canadian Thoracic Society guidelines[16] describe how pulmonary rehabilitation (PR) significantly improves dyspnea, exercise endurance, quality of life, and risk of hospitalization after AECOPD. However, evidence about the effects, feasibility, and benefits of physiotherapy techniques in patients with AECOPD is lacking. Therefore, the objective of this study was to review clinical trials that had studied the effectiveness of physiotherapy compared with standard care, focused mainly on the functional status of patients hospitalized for AECOPD.

METHODS

We conducted and reported our review following the guidelines of the Centre for Reviews and Dissemination at the University of York, York, United Kingdom, and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses and taking into account the recent tutorial published in the *Brazilian Journal of Physical Therapy,* which guides authors on how systematic reviews should be conducted and reported.[17]

Information sources and search

We developed search strategies for each of the databases used: PubMed, Scopus, and Web of Science. These strategies maximized the retrieval of articles using a combination of Medical Subject Headings and free-text terms, described in Table 1.

Selecting the studies

Two authors worked independently as reviewers to evaluate the titles and abstracts of all identified articles and ordered the full text of any article that was deemed eligible by either of them. They then evaluated the full text of all retrieved articles, made a decision about inclusion or exclusion, and discussed their decisions. All the authors then resolved any questions or discrepancies through consensus, taking the inclusion and exclusion criteria into account.

Eligibility criteria

Articles were included if they met the following criteria: (1) the objective of the study was to assess the effect and efficacy of physiotherapy compared with standard care (which included only medical and pharmacological treatment); (2) the adults subjects had had AECOPD; (3) one of the outcome measures was functional status,

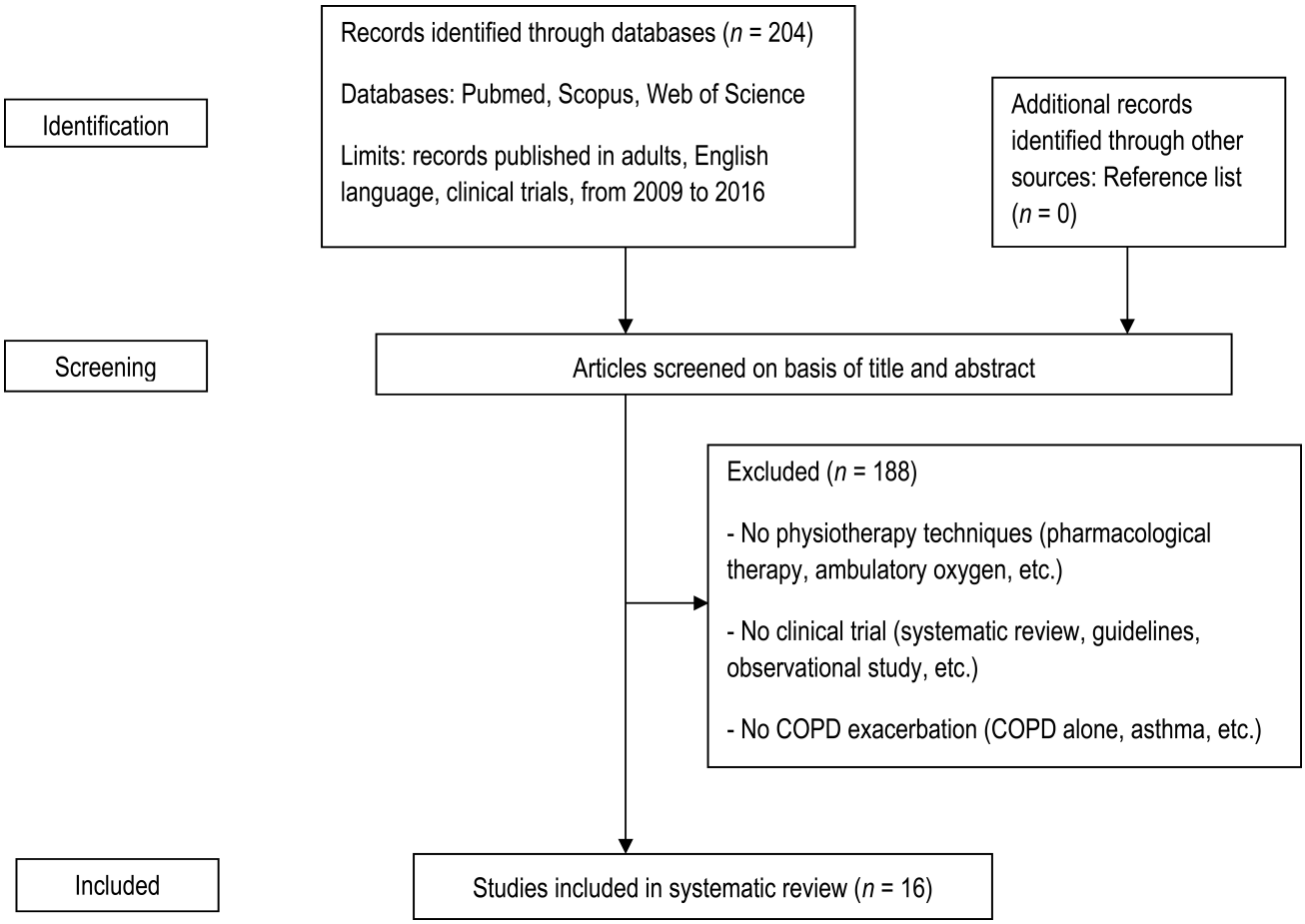

Figure 1 Flow diagram of study selection. COPD = chronic obstructive pulmonary disease.

defined as an individual's ability to perform the normal daily activities required to meet basic needs, fulfill usual roles, and maintain health and well-being;[18,19] (4) the study was a clinical trial; (5) it was written in English; (6) it was published between January 2009 and February 2016; and (7) the full-text article was available.

Data collection

From the retrieved articles, two authors performed the data extraction, which included author and year (country), design, gender, mean age, severity of forced expiratory volume in 1 second percentage predicted (FEV1%), studied parameters, exclusion criteria, and quality scale. In addition, they collected the treatment modality and information about the intervention, such as description, frequency, session duration, treatment duration, and significant results.

Quality assessment

Two authors independently appraised the quality of each study using the scale developed by Downs and Black.[20] This instrument is a validated scoring scale that has been used to determine the quality of both randomized and non-randomized clinical trials and has been highlighted by the Cochrane Collaboration as a useful tool for assessing the risk of bias.[21]

We then categorized our assessment of the quality of each study using 27 items grouped into five sub-scales: reporting, external and internal validities, bias, confounding, and power. The highest total score was 32; scores are expressed as rates, with higher scores representing a better methodology and 1.00 being the highest possible rating. As suggested by some reviews,[22] ratings of less than 0.50 were considered weak, ratings of 0.50–0.69 were considered fair, ratings of 0.70–0.79 were considered good, and ratings of 0.80–1.00 were considered very good.

Summary measures and synthesis of results

Characteristics of the included studies were summarized. The type of treatment and interventions were analyzed, summarizing the modality, description, frequency, session duration, and treatment duration.

RESULTS

The database searches yielded 183 potentially relevant citations. After checking for duplicates and determining eligibility, 16 studies involving physiotherapy treatment in patients with AECOPD were included in this review (see Figure 1).

Table 2 Characteristics of Included Studies

First author, year, country; score on quality scale	Design	No. of participants (male/female)	Age, Mean (SD), y	Severity, FEV1%	Studied parameters	Exclusion criteria
Torres-Sánchez,[23] 2016, Spain; 27	RCT	49 (47/2)	Intervention group, 72.36 (8.91), control group, 73.7 (7.10)	Intervention group, 39; control group, 41	Lower and upper limb strength, exercise capacity, dyspnea, EQ-5D, HADS	Patients with other organ failure, cancer, or inability to cooperate; BMI lower than 30 kg/cm^2
Liao,[24] 2015, Taiwan; 26	RCT	61 (37/24)	Experimental group, median age 68; control group, median age 70	No information; peak expiratory flow = 140 L (range 50–300)	Dyspnea, cough, exercise tolerance (6MWT), sputum expectoration	Systolic blood pressure < 90 mmHg, SpO2 < 90%, and unstable psychological status; hemoptysis, pneumothorax, pulmonary edema, and use of a respirator
He,[25] 2015, China; 20	RCT	94 (83/11)	PR group, 69.2 (1.53); control group, 73.9 (1.84)	PR group, 38 (3.04); control group, 39 (5.07)	Spirometry, dyspnea, 6MWT, limitation in daily activities	Severe orthopaedic or neurological disorders limiting exercise performance, unstable cardiac disease, inability to understand or complete questionnaires
Borges,[26] 2014, Brazil; 27	RCT	29 (18/11)	Control group, 67.8 (9.0); PR group, 64.1 (12.5)	Control group, 39.1 (15.5); PR group, 41.7 (13.6)	6MWT, HRQOL, muscle strength, systemic inflammatory markers, level of PADL	Patients transferred to ICU before 2nd day of hospitalization, patients exhibiting changes in mental status, worsening of hypoxemia (PaO_2)
Osadnik,[27] 2014, Australia; 26	RCT	90 (58/32)	Control group, 67.8 (11.6); PEP group, 69.5 (9.8)	Control group, 44.2 (20.2); PEP group, 37.3 (19.7)	Self-reported symptoms (BCSS), QOL (SGRQ), BODE Index	A respiratory condition deemed more significant than COPD, established airway clearance routines, patient's breathing through an artificial airway, or PEP therapy contraindicated
Valenza,[28] 2014, Spain; 24	RCT	46 (46/0)	Intervention group, 76 (5.5); control group, 74.43 (7.6)	No information	HADS, SGRQ, dyspnea (MRC scale), EQ-5D, Hand Grip Strength Test, Respiratory Muscle Strength Test	Other organ failure, cancer, or inability to cooperate
Kurzaj,[29] 2013, Poland; 13	RCT	30 (12/18)	Experimental group, 57 (5.7); control group, 55 (4.2)	Experimental group, 45.2 (19.0); control group, 40.2 (13.0)	BODE Index variables	No information
Tang,[30] 2012, Australia; 24	RCT	32 (13/19)	Control group, 78 (8.8); low-intensity exercise group, 68 (10.1); moderate- to high-intensity exercise group, 73.6 (10)	Control group, 46.8 (20.4); low-intensity exercise group, 45.1 (18.6); moderate- to high-intensity exercise group, 46.1 (18.3)	Exercise tolerance (3MWT), lung function (FEV1%), perceived level of improvement in lung symptoms, activity status (Barthel Index), and muscle strength (manual muscle tester)	Medically unwell, non-English-speaking, cognitively impaired/non-ambulatory, discharged before recruitment
Cross,[31] 2012, United Kingdom; 25	RCT	522 (298/224)	MCP arm group, 69.08 (9.58); no-MCP arm group, 69.58 (9.51)	No information	SGQR, BCSS, EuroQol index; and EQ visual analogue scale; no. of days spent in hospital	Any contraindication for use of MCP techniques (osteoporosis, hemoptysis, bronchial hyper-reactivity, etc.)
Ides,[32] 2012, Belgium; 10	CCT	5 (2/3)	No information	5 participants, 39.49 (23.62)	Lung function (spirometry and body plethysmography), inspiratory and expiratory muscle strength, diffusion capacity, arterial blood gas sampling, dyspnea (Borg Scale)	No information

Table 2 Continued

First author, year, country; score on quality scale	Design	No. of participants (male/female)	Age, Mean (SD), y	Severity, FEV1%	Studied parameters	Exclusion criteria
Giavedoni,[33] 2012, Scotland; 16	RCT	11 (5/6)	11 participants, 72.2 (3.1)	11 participants, 41.3 (5.6)	QMVC	In need of respiratory support or admission to ICU, any condition that precluded a reliable muscle strength measurement, engaged in any PR program at time of admission, any hospital admission or AECOPD in previous 3 mo
Meglic,[34] 2011, Slovenia; 21	CCT	19 (15/4)	19 patients, 71 (6)	19 patients, 29 (11)	Dyspnea (MRC scale), HRQOL (SGRQ and FACIT)	Contraindications for NMES
Cross,[35] 2010, United Kingdom; 26	RCT	527 (298/224)	MCP arm group, 69.08 (9.85); no-MCP arm group, 69.58 (9.51)	No information	QOL (SGRQ) and QALY	COPD diagnosis not established, not admitted for COPD exacerbation, no sputum, clinical exclusion suspected, too unwell to consent, other reasons (consent declined, no physiotherapist available, had already seen physiotherapist)
Troosters,[36] 2010, Belgium; 26	RCT	36 (27/9)	Control group, 69 (7); training group, 67 (8)	Control group, 50 (18); training group, 40 (12)	QF, dyspnea (MRC scale), exercise tolerance (6MWT), myostatin, myogenin–MyoD ratio (muscle biopsy)	No information
Babu,[37] 2010, India; 27	RCT	38 (27/11)	Experimental group, 65 (15.9); control group, 58 (13.3)	No information	Peak expiratory flow rate, sustained maximal inspiratory rate, dyspnea (Borg Scale), 6MWT	Pulmonary embolism, pulmonary edema, acute myocardial infarction, acute heart failure
Kodric,[38] 2009, Italy; 20	RCT	59 (41/18)	Control group, 71.3 (8.4); ELTGOL group, 69.1 (8.3)	Control group, 52.3 (18.7); ELTGOL group, 55.6 (27.6)	Spirometry (FEV1% and FEV1/FVC), dyspnea (MRC scale and Borg Scale), QOL (SGRQ)	Positive bronchodilator reversibility test or any other chest disease likely to bias results

Note: Studies are listed by year, beginning with the most recent. The quality scale used was the scale developed by Downs and Black[20] (score out of 32).
FEV1% = forced expiratory volume in 1 s percentage predicted; RCT = randomized controlled trial; EQ-5D = EuroQol–5 Dimension (questionnaire developed by the EuroQol Group); HADS = Hospital Anxiety and Depression Scale; BMI = body mass index; 6MWT = 6-minute walk test; mmHG = millimetres of mercury; SpO2 = arterial oxygen saturation; PR = pulmonary rehabilitation; HRQOL = health-related quality of life; PADL = physical activity in daily life; ICU = intensive care unit; PaO_2 = partial pressure of oxygen; PEP = positive expiratory pressure; BCSS = Breathlessness, Cough and Sputum Scale; QOL = quality of life; SGRQ = Saint George's Respiratory Questionnaire; BODE = body mass index, airflow obstruction, dyspnea and exercise capacity; COPD = chronic obstructive pulmonary disease; MRC = Medical Research Council (of the United Kingdom); 3MWT = 3-minute walk test; MCP = manual chest physiotherapy; EuroQol = EuroQol Group; EQ = EuroQol; CCT = controlled clinical trial; QMVC = quadriceps maximal isometric voluntary contraction; AECOPD = acute exacerbation of chronic obstructive pulmonary disease; FACIT = functional assessment of chronic illness therapy; NMES = neuromuscular electrical stimulation; QALY = quality-adjusted life year; QF = quadriceps force; MyoD = protein that plays a major role in regulating muscle differentiation; ELTGOL = expiration with glottis open in the lateral posture; FVC = forced vital capacity.

Table 3 Type of Treatment and Interventions of Included Studies

		Intervention		
Author, year, country	Treatment modality	Description	Frequency/session duration/treatment duration	Significant results
Torres-Sánchez,[23] 2016, Spain	Breathing program and physical exercise	Programme included 15 min of deep breathing exercises and 20–30 min of limb exercises.	Twice per day/30–45 min/during hospitalization	Improvement in strength, exercise capacity, psychological distress. Beneficial effect of physical treatment on QOL measures and dyspnea.
Liao,[24] 2015, Taiwan	Breathing program and physical exercise	Disease awareness, sputum clearance treatments, pursed-lip breathing training, upper limb exercise with deep breathing, walk training, assigned pulmonary rehabilitation program coordinator	Twice per day/10 min per session/4 days	Reduced AECOPD symptoms (such as dyspnea and cough), increased exercise tolerance and sputum expectoration.
He,[25] 2015, China	Breathing program and physical exercise	Exercise training, relaxation, breathing retraining and education	Twice per day/30 min/during hospitalization	Significant improvements in 6MWT, resting SpO2, and exercise Borg dyspnea score; for PR group, greater improvement in total CRQ-SAS score and lower CAT score.
Borges,[26] 2014, Brazil	Physical exercise	Weight-lifting exercises for 6 muscle groups in upper and lower limbs (2 sets of 8 repetitions each); initial load was set at 80% of 1-repetition maximum load	Exercise training started on 3rd day of hospitalization; every patient completed a minimum of 3 sessions. Sessions were performed every morning with free weights in 2 sets of 8 repetitions	PR group improved strength in lower limb muscles and 6MWT during and 30 d after hospitalization ($p < 0.05$), also improved QOL after hospitalization. Blood levels of inflammatory markers reduced only after hospitalization.
Osadnik,[27] 2014, Australia	Instrumental chest therapy	Usual care and PEP	Twice per day/20 min/at discharge or 24 h without sputum expectoration	No significant between-group differences over time in BCSS score or SGRQ total score at 9 wk. Dyspnea improved more rapidly in PEP group over first 8 wk, but these benefits were not observed at 6 mo. Exacerbations and hospitalizations did not differ between groups.
Valenza,[28] 2014, Spain	Breathing program	Controlled breathing program (relaxation exercises, pursed-lips breathing, active expiration)	Twice per day/30 min/during hospitalization	Significantly improved dyspnea, anxiety, and mobility. All measured variables improved in intervention group.
Kurzaj,[29] 2013, Poland	Manual chest therapy	Massage treatment: stroking, grinding, vibration, kneading	Once per day/30 min/a period of a few successive days	Significant improvement in BODE index in experimental group, whereas this ratio changed slightly in control group. FEV1% and MRC parameters changed significantly only in experimental group.
Tang,[30] 2012, Australia	Physical exercise	Standard physical therapy and exercise sessions (walking, hip abductors, lunges, stimulated lifting, chess press) with a low-intensity exercise group (40% maximum intensity) and a moderate- to high-intensity exercise group (70% maximum intensity)	Twice per day/15 min/during hospitalization	Exercise groups improved significantly in walking distance; however, no significant between-group differences observed.
Cross,[31] 2012, United Kingdom	Manual chest therapy	MCP and ACBT	At discretion of physiotherapist/at discretion of physiotherapist/during hospitalization	No significant differences in SGRQ. No significant differences found in any secondary outcome measures.
Ides,[32] 2012, Belgium	Instrumental chest therapy	IPV treatment	No information	No significant changes in lung function or arterial blood gases measured 1 hr after end of IPV session. Local changes in airway resistance.

Table 3 Continued

Giavedoni,[33] 2012, Scotland	Electrostimulation therapy	NMES	Once per day/30 min/14 sessions	Mean quadriceps muscle strength decreased in control legs, but increased in stimulated legs. ΔQMVC between groups was statistically significant ($p < 0.05$).
Meglic,[34] 2011, Slovenia	Electrostimulation therapy	NMES	Twice per day/25 min/six days per week during hospitalization	Significant decrease in score of dyspnea. HRQOL improved during hospitalization: SGRQ and FACIT scores decreased significantly.
Cross,[35] 2010, United Kingdom	Manual chest therapy	MCP and ACBT	At discretion of physiotherapist/at discretion of physiotherapist/during hospitalization	No significant difference at 6 mo post-randomization in total SGRQ score, SGRQ symptom score, SGRQ activity score, or SGRQ impact score. Compared with no MCP, using MCP was associated with a slight loss in QOL but lower health service costs.
Troosters,[36] 2010, elgium	Physical exercise	Usual care and quadriceps resistance training (knee extension while seated on a chair)	Once per day/not specified/7 d	Enhanced quadriceps force observed at discharge ($p = 0.05$) and at 1-mo follow-up in patients who trained. 6MWT improved after discharge only in group that received resistance training. Myostatin was lower, and myogenin/MyoD ratio tended to be higher, in training group.
Babu,[37] 2010, India	Not specified	Regular physical therapy and on-call physical therapy (required by patient outside business hours)	Once per day, more often if required/not specified/ during hospitalization	Peak expiratory flow rate and 6MWT showed a significant difference.
Kodric,[38] 2009, Italy	Manual chest therapy	Chest physiotherapy (ELTGOL)	Twice per day/30 min/7 d	At time of hospital discharge, only Borg score was significantly improved in ELTGOL group; after 6 mo, no significant difference in other variables measured. ELTGOL group had numerically fewer exacerbations and less need for hospitalizations, although differences were not statistically significant.

Note: Studies are listed by year, beginning with the most recent.
QOL = quality of life; AECOPD = acute exacerbation of chronic obstructive pulmonary disease; 6MWT = 6-minute walk test; SpO2 = arterial oxygen saturation; PR = pulmonary rehabilitation; CRQ-SAS = Chronic Respiratory Disease Questionnaire Self-Administered Standardized; CAT = COPD Assessment Test; PEP = positive expiratory pressure; BCSS = Breathlessness, Cough and Sputum Scale; SGRQ = Saint George's Respiratory Questionnaire; BODE = body mass index, airflow obstruction, dyspnea, and exercise capacity; FEV1% = forced expiratory volume in 1 s percentage predicted; MRC = Medical Research Council dyspnea scale; MCP = manual chest therapy; ACBT = active cycle of breathing technique; IPV = intrapulmonary percussive ventilation; NMES = neuromuscular electrical stimulation; NMES: neuro muscular electrical stimulation; ΔQMVC = change in quadriceps maximal voluntary contraction; HRQOL = health-related quality of life; FACIT = functional assessment of chronic illness therapy; MyoD = protein that plays a major role in regulating muscle differentiation; ELTGOL = expiration with glottis open in the lateral posture.

Study quality appraisal

Quality assessments showed an average score of 22.38 (range 10–27, out of a total score of 32). Only 3 of 16 articles had a score less than 20. On the basis of the quality assessment instrument, studies received an average rating of 0.70, which was considered good.

Study characteristics

The characteristics of the studies are shown in Table 2. The number of patients included in all the studies was 1,648, and the severity of their COPD ranged from 29% to 55.6% in FEV1%. The more frequent variables included to assess the patients were dyspnea, respiratory function, quality of life, and variables related to functional status.

Treatment modalities

Physiotherapy modalities explored in the trials included exercise sessions with aerobic or resistance exercise,[26,30,36] expiration with glottis open in lateral posture (ELTGOL),[38] PEP,[27] intrapulmonary percussive ventilation,[32] NMES,[33,34] manual chest therapy and active cycle of breathing techniques,[29,31,35] a controlled breathing program,[28] and either standard physical therapy[37] (not specified) or combined training, including breathing techniques and exercise.[23–25] Table 3 shows the full details on treatment and interventions for each study.

The authors divided the different treatment modalities into several groups: seven studies included chest physical therapy,[22,27,29,31,32,35,38] one study used breathing techniques,[28] three studies included physical exercise,[26,30,36] two studies used electrostimulation,[33,34] three studies included a combination of treatment modalities,[23–25] and one study included standard physical therapy (not specified).[37]

DISCUSSION

The studies included in this review showed a broad range of treatments commonly used by physiotherapists: chest physical therapy, breathing techniques, exercise, electrostimulation, and a combination of treatment modalities These studies reflect the varied nature of physiotherapy practice.[39]

The data provided in the Results section (Table 3) suggest that physiotherapy interventions are significantly beneficial in AECOPD during hospitalization. In all of the included articles, physiotherapy was shown to significantly improve common outcome variables such as dyspnea,[22,32,38] quality of life, walking distance,[22,28,30] strength,[33] and functional status.

Chest physical therapy

Several studies explored the effects of chest therapy on exacerbations, with contradictory results. Cross and colleagues[31,35] and Osadnik and colleagues[27] showed no difference between groups in outcomes, whereas other studies were associated with a positive effect on dyspnea, FEV1%, and exacerbations at 6 months.[22] The main reason for this disparity is likely to be the different modalities of techniques and outcomes; however, all the articles included measures of functional status.

None of the reviewed studies on chest therapy showed any difference in quality of life. By contrast, all the studies on chest therapy showed significant results in dyspnea perception[22,32,38] when measured. Only the study by Kodric and colleagues[38] found that the ELTGOL technique, used twice a day, resulted in significant improvements in the frequency of future exacerbations; no other study found these differences at follow-up. The differences may be due to the compliance developed by subjects when they learned the technique at the hospital.[40–42]

Breathing techniques

Previous studies have reported that hyperinflation, respiratory instability, upper chest pain, and asynchronous breathing patterns can be associated with symptomatic dysfunctional breathing[43] in AECOPD. Breathing training was used only in the study by Valenza and colleagues,[28] and it results in significant changes in dyspnea, quality of life, and anxiety. This is in line with the results of previous studies on pulmonary conditions experienced by stable COPD patients[44] or asthma patients,[45] who showed favourable respiratory changes. However, more studies are needed to confirm that breathing training is really effective in improving other outcome variables, such as pulmonary function, exercise capacity, and symptoms in patients with AECOPD.

Exercise

AECOPD patients who performed physical exercise showed significant improvements, with positive effects found in the study by Troosters and colleagues[36] on walking distance and improvements in muscle strength found in the study by Tang and colleagues.[30] Enhanced quadriceps force was observed at discharge ($p = 0.05$) and at 1-month follow-up in patients who trained. The 6-minute walk test (6MWT) improved after discharge only in the group that had received resistance training. In addition, myostatin was lower, and the myogenin–MyoD ratio tended to be higher in the training group (MyoD is a protein that plays a major role in regulating muscle differentiation).[36] Furthermore, the study by Borges and Carvalho[26] showed that resistance training during hospitalization improved these outcomes without altering the levels of systemic inflammation.

Electrostimulation

The study by Giavedoni and colleagues[33] using NMES showed results similar to those using physical exercise. PR programmes during AECOPD are difficult to implement because of patients' clinical condition, and strategies that avoid respiratory system stress are needed. In answer to that need, high-frequency NMES has been successfully used as a localized training modality in severely disabled patients who are unable to follow formal PR or tolerate higher training intensities.[46,47]

It has been convincingly demonstrated that exercise training and NMES are key constituents of rehabilitation in patients with stable disease.[48] Nevertheless, no evidence for this has been found in patients with AECOPD, in whom muscle deterioration is most marked. Electrostimulation and physical exercise have been shown to be effective and to lead to positive results in AECOPD in some separate outcomes. Compared with standard care (only medical and pharmacological treatment), these treatments proved to be effective in counteracting the deleterious effects of AECOPD on peripheral muscle force. Functional capacity and physical independence were also improved.

Combination of treatment modalities

Recent studies[23–25] have combined different modalities of physical therapy, such as controlled breathing exercises and limb exercises. The study by Torres-Sánchez and colleagues[23] achieved beneficial effects for physical functioning and perceived variables such as psychological distress, QOL measures, and dyspnea. In the same line, the study by Liao and colleagues[24] improved the symptoms experienced during an exacerbation. The study by He and colleagues[25] found that 6MWT, resting arterial oxygen saturation, and exercise Borg dyspnea score were all significantly improved in the PR group. In addition, the PR group showed greater improvement in quality of life and the impact of the disease. In general, functional status improved with the treatment. Hence, it seems clear that future studies should combine different types of interventions and evaluate their results.

Other previous reviews

Chest therapy was discussed in another review[49] that focused on airway-clearance objectives. That review revealed that breathing exercises had beneficial effects on health-related quality of life, training in inspiratory muscle techniques improved inspiratory muscle strength, and chest therapy aided clearance of sputum. In that systematic review,[49] focused on various respiratory diseases, the effects of manual interventions (e.g., postural drainage, chest percussion, vibration, chest shaking, directed coughing, and forced-exhalation techniques) had controversial results. The present review focused only on studies of patients with AECOPD; moreover, it considered not only chest therapy with airway-clearance objectives but also all the different modalities of respiratory physiotherapy performed with AECOPD patients.

In the present review, manual chest therapy resulted in significant improvements in dyspnea and quality of life. Chest physiotherapy techniques included vibrations, deep diaphragmatic breathing, percussions, postural drainage in different positions, incentive spirometry, oscillating PEP using Flutter, ELTGOL, intermittent positive pressure ventilation, PEP using a PEP mask, and walking programmes. Physical exercise and NMES studies showed the greatest improvement in physical status, dyspnea, and walking distance.

The review of Tang and colleagues[30] concluded that chest physiotherapy techniques benefited patients with COPD who require assistance with sputum clearance, and walking programmes may have greater benefits for patients admitted with AECOPD. Chest physiotherapy techniques other than percussion are safe to administer to this patient population.[49] The recent study by Osadnik and colleagues[50] revealed that airway clearance techniques were safe for individuals with COPD and conferred small beneficial effects on some clinical outcomes. It suggested that these techniques should be considered in both acute and stable disease. However, the clinical relevance of these treatments and long-term effects on morbidity are as yet unknown.

One of the limitations of our review was that including so many different physiotherapy modalities was related to a great variety of outcomes, which could make it difficult to compare the results obtained. However, in all the studies included in this review, one of the variables assessed was functional status; it allowed us to compare the results of the included articles and draw conclusions.

CONCLUSIONS

COPD is one of the leading causes of death, and AECOPD contributes significantly to the high health care costs associated with managing COPD. The different physiotherapy modalities we analyzed in our review—chest physical therapy, breathing exercises, exercise, and NMES—significantly improved functional status—defined as an individual's ability to perform the normal daily activities required to meet basic needs, fulfill usual roles, and maintain health and well-being—compared with standard care (which included only medical and pharmacological treatment) in patients hospitalized for AECOPD. Functional status improvements included increases in quadriceps strength and improvements in exercise capacity and mobility. Symptoms (dyspnea, cough, or sputum expectoration), quality of life, psychological distress, and impact of the disease also showed significant improvements. In addition, many studies showed the beneficial effects of NMES and chest therapy on COPD in both primary and secondary prevention. The beneficial effects of physiotherapy treatments on readmissions, dyspnea, and quality of life were likely to be multifactorial and appeared to be mostly improved by physical exercise.

However, the benefits of breathing techniques, walking programmes, and strength training on AECOPD are still unclear. Further studies are needed to properly assess the role of physiotherapy in this setting and to combine different physiotherapy modalities.

KEY MESSAGES

What is already known on this topic

AECOPD is an important cause of loss of function in patients with COPD. It implies a worsening of symptoms and a reduction in lung function that may not be recovered. After exacerbation, it takes a considerable time for COPD patients to recover to baseline functional status, which is defined as an individual's ability to perform the normal daily activities required to meet basic needs, fulfill usual roles, and maintain health and well-being.

What this study adds

Physiotherapy interventions proved to be effective in counteracting the deleterious effects of AECOPD on functional status. Peripheral muscle force and physical performance were also improved.

REFERENCES

1. Murray CJL, Lopez AD. Alternative projections of mortality and disability by cause 1990–2020: Global Burden of Disease Study. Lancet. 1997;349(9064):1498–504. http://dx.doi.org/10.1016/S0140-6736(96)07492-2. Medline:9167458
2. Seemungal TA, Hurst JR, Wedzicha JA. Exacerbation rate, health status and mortality in COPD—a review of potential interventions. Int J Chron Obstruct Pulmon Dis. 2009;4:203–23. http://dx.doi.org/10.2147/COPD.S3385. Medline:19554195
3. Chenna PR, Mannino DM. Outcomes of severe COPD exacerbations requiring hospitalization. Semin Respir Crit Care Med. 2010;31(3):286–94. http://dx.doi.org/10.1055/s-0030-1254069. Medline:20496298
4. Izquierdo JL, Barcina C, Jiménez J, et al. Study of the burden on patients with chronic obstructive pulmonary disease. Int J Clin Pract. 2009;63(1):87–97. http://dx.doi.org/10.1111/j.1742-1241.2008.01936.x. Medline:19125996
5. Seemungal TAR, Donaldson GC, Bhowmik A, et al. Time course and recovery of exacerbations in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2000;161(5):1608–13. http://dx.doi.org/10.1164/ajrccm.161.5.9908022. Medline:10806163
6. Groenewegen KH, Schols AM, Wouters EF. Mortality and mortality-related factors after hospitalization for acute exacerbation of COPD. Chest. 2003;124(2):459–67. http://dx.doi.org/10.1378/chest.124.2.459. Medline:12907529
7. Seemungal TA, Donaldson GC, Paul EA, et al. Effect of exacerbation on quality of life in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 1998;157(5 pt 1):1418–22. http://dx.doi.org/10.1164/ajrccm.157.5.9709032. Medline:9603117
8. Soler-Cataluña JJ, Martínez-García MA, Román Sánchez P, et al. Severe acute exacerbations and mortality in patients with chronic obstructive pulmonary disease. Thorax. 2005;60(11):925–31. http://dx.doi.org/10.1136/thx.2005.040527. Medline:16055622
9. Miravitlles M, Ferrer M, Pont A, et al; IMPAC Study Group. Effect of exacerbations on quality of life in patients with chronic obstructive pulmonary disease: a 2 year follow up study. Thorax. 2004;59(5):387–95. http://dx.doi.org/10.1136/thx.2003.008730. Medline:15115864
10. Donaldson GC, Seemungal TA, Bhowmik A, et al. Relationship between exacerbation frequency and lung function decline in chronic obstructive pulmonary disease. Thorax. 2002;57(10):847–52. http://dx.doi.org/10.1136/thorax.57.10.847. Medline:12324669
11. Pitta F, Troosters T, Probst VS, et al. Physical activity and hospitalization for exacerbation of COPD. Chest. 2006;129(3):536–44. http://dx.doi.org/10.1378/chest.129.3.536. Medline:16537849
12. Spruit MA, Gosselink R, Troosters T, et al. Muscle force during an acute exacerbation in hospitalised patients with COPD and its relationship with CXCL8 and IGF-I. Thorax. 2003;58(9):752–6. http://dx.doi.org/10.1136/thorax.58.9.752. Medline:12947130
13. Global Initiative for Chronic Obstructive Lung Disease. Global strategy for diagnosis, management and prevention of chronic obstructive pulmonary disease. Bethesda (MD): National Heart, Lung and Blood Institute; 2001.
14. Yohannes AM, Connolly MJ. A national survey: percussion, vibration, shaking and active cycle breathing techniques used in patients with acute exacerbations of chronic obstructive pulmonary disease. Physiotherapy. 2007;93(2):110–3. http://dx.doi.org/10.1016/j.physio.2006.07.003.
15. Pryor JA, Webber BA, Bethune DD, et al. Physiotherapy techniques. 2nd ed. London: Churchill Livingstone; 2008.
16. O'Donnell DE, Hernandez P, Kaplan A, et al. Canadian Thoracic Society recommendations for management of chronic obstructive pulmonary disease—2008 update—highlights for primary care. Can Respir J. 2008;15(suppl A):1A–8A. Medline:18292855
17. Mancini MC, Cardoso JR, Sampaio RF, et al. Tutorial for writing systematic reviews for the Brazilian Journal of Physical Therapy (BJPT). Braz J Phys Ther. 2014;18(6):471–80. http://dx.doi.org/10.1590/bjpt-rbf.2014.0077. Medline:25590440
18. Leidy NK. Functional status and the forward progress of merry-go-rounds: toward a coherent analytical framework. Nurs Res. 1994;43(4):196–202. http://dx.doi.org/10.1097/00006199-199407000-00002. Medline:8047422
19. Wilson IB, Cleary PD. Linking clinical variables with health-related quality of life. A conceptual model of patient outcomes. JAMA. 1995;273(1):59–65. http://dx.doi.org/10.1001/jama.1995.03520250075037. Medline:7996652
20. Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. J Epidemiol Community Health. 1998;52(6):377–84. http://dx.doi.org/10.1136/jech.52.6.377. Medline:9764259
21. Higgins JPT, Green S, editors. Cochrane handbook for systematic reviews of intervention. Version 5.1.0. New York: Wiley; 2011.
22. Salgado TM, Moles R, Benrimoj SI, et al. Pharmacists' interventions in the management of patients with chronic kidney disease: a systematic review. Nephrol Dial Transplant. 2012;27(1):276–92. http://dx.doi.org/10.1093/ndt/gfr287. Medline:21719712
23. Torres-Sánchez I, Valenza MC, Sáez-Roca G, et al. Results of a multimodal program during hospitalization in obese COPD exacerbated patients. COPD. 2016;13(1):19–25. http://dx.doi.org/10.3109/15412555.2015.1043428. Medline:26418629
24. Liao LY, Chen KM, Chung WS, et al. Efficacy of a respiratory rehabilitation exercise training package in hospitalized elderly patients with acute exacerbation of COPD: a randomized control trial. Int J Chron Obstruct Pulmon Dis. 2015;10:1703–9. Medline:26345529
25. He M, Yu S, Wang L, et al. Efficiency and safety of pulmonary rehabilitation in acute exacerbation of chronic obstructive pulmonary disease. Med Sci Monit. 2015;21:806–12.
26. Borges RC, Carvalho CR. Impact of resistance training in chronic obstructive pulmonary disease patients during periods of acute exacerbation. Arch Phys Med Rehabil. 2014;95(9):1638–45. http://dx.doi.org/10.1016/j.apmr.2014.05.007. Medline:24879965
27. Osadnik CR, McDonald CF, Miller BR, et al. The effect of positive expiratory pressure (PEP) therapy on symptoms, quality of life and incidence of re-exacerbation in patients with acute exacerbations of chronic obstructive pulmonary disease: a multicentre, randomised controlled trial. Thorax. 2014;69(2):137–43. http://dx.doi.org/10.1136/thoraxjnl-2013-203425. Medline:24005444
28. Valenza MC, Valenza-Peña G, Torres-Sánchez I, et al. Effectiveness of controlled breathing techniques on anxiety and depression in hospitalized patients with COPD: a randomized clinical Trial. Respir Care. 2014;59(2):209–15. http://dx.doi.org/10.4187/respcare.02565. Medline:23882107

29. Kurzaj M, Wierzejski W, Dor A, et al. The impact of specialized physiotherapy methods on BODE index in COPD patients during hospitalization. Adv Clin Exp Med. 2013;22(5):721–30. Medline:24285458
30. Tang CY, Blackstock FC, Clarence M, et al. Early rehabilitation exercise program for inpatients during an acute exacerbation of chronic obstructive pulmonary disease: a randomized controlled trial. J Cardiopulm Rehabil Prev. 2012;32(3):163–9. http://dx.doi.org/10.1097/HCR.0b013e318252f0b2. Medline:22561417
31. Cross JL, Elender F, Barton G, et al. Evaluation of the effectiveness of manual chest physiotherapy techniques on quality of life at six months post exacerbation of COPD (MATREX): a randomised controlled equivalence trial. BMC Pulm Med. 2012;12(1):33. http://dx.doi.org/10.1186/1471-2466-12-33. Medline:22748085
32. Ides K, Vos W, De Backer L, et al. Acute effects of intrapulmonary percussive ventilation in COPD patients assessed by using conventional outcome parameters and a novel computational fluid dynamics technique. Int J Chron Obstruct Pulmon Dis. 2012;2012(7):667–71. http://dx.doi.org/10.2147/COPD.S29847. Medline:23055715
33. Giavedoni S, Deans A, McCaughey P, et al. Neuromuscular electrical stimulation prevents muscle function deterioration in exacerbated COPD: a pilot study. Respir Med. 2012;106(10):1429–34. http://dx.doi.org/10.1016/j.rmed.2012.05.005. Medline:22726566
34. Meglic U, Sorli J, Kosnik M, et al. Feasibility of transcutaneous electrical muscle stimulation in acute exacerbation of COPD. Wien Klin Wochenschr. 2011;123(11–12):384–7. http://dx.doi.org/10.1007/s00508-011-1587-2. Medline:21607562
35. Cross J, Elender F, Barton G, et al; MATREX Research Group. A randomised controlled equivalence trial to determine the effectiveness and cost-utility of manual chest physiotherapy techniques in the management of exacerbations of chronic obstructive pulmonary disease (MATREX). Health Technol Assess. 2010;14(23):1–147, iii–iv. http://dx.doi.org/10.3310/hta14230. Medline:20487638
36. Troosters T, Probst VS, Crul T, et al. Resistance training prevents deterioration in quadriceps muscle function during acute exacerbations of chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2010;181(10):1072–7. http://dx.doi.org/10.1164/rccm.200908-1203OC. Medline:20133927
37. Babu AS, Noone MS, Haneef M, et al. The effects of ''on-call/out of hours'' physical therapy in acute exacerbations of chronic obstructive pulmonary disease: a randomized controlled trial. Clin Rehabil. 2010;24(9):802–9. http://dx.doi.org/10.1177/0269215510367558. Medline:20543018
38. Kodric M, Garuti G, Colomban M, et al. The effectiveness of a bronchial drainage technique (ELTGOL) in COPD exacerbations. Respirology. 2009;14(3):424–8. http://dx.doi.org/10.1111/j.1440-1843.2008.01466.x. Medline:19192230
39. Pitta F, Probst VS, Langer D, et al. A practical guide for physical therapy treatment of patients with Chronic Obstructive Pulmonary Disease (COPD): combining scientific evidence and clinical practice. Rev Bras Fisioter. 2009;13(3).
40. Bourbeau J, Nault D, Dang-Tan T. Self-management and behaviour modification in COPD. Patient Educ Couns. 2004;52(3):271–7. http://dx.doi.org/10.1016/S0738-3991(03)00102-2. Medline:14998597
41. Jones RCM, Hyland ME, Hanney K, et al. A qualitative study of compliance with medication and lifestyle modification in chronic obstructive pulmonary disease (COPD). Prim Care Respir J. 2004;13(3):149–54. http://dx.doi.org/10.1016/j.pcrj.2004.05.006. Medline:16701658
42. Rau JL. Practical problems with aerosol therapy in COPD. Respir Care. 2006;51(2):158–72. Medline:16441960
43. Han JN, Stegen K, Simkens K, et al. Unsteadiness of breathing in patients with hyperventilation syndrome and anxiety disorders. Eur Respir J. 1997;10(1):167–76. http://dx.doi.org/10.1183/09031936.97.10010167. Medline:9032511
44. Pomidori L, Campigotto F, Amatya TM, et al. Efficacy and tolerability of yoga breathing in patients with chronic obstructive pulmonary disease: a pilot study. J Cardiopulm Rehabil Prev. 2009;29(2):133–7. http://dx.doi.org/10.1097/HCR.0b013e31819a0227. Medline:19305239
45. Thomas M, McKinley RK, Mellor S, et al. Breathing exercises for asthma: a randomised controlled trial. Thorax. 2009;64(1):55–61. http://dx.doi.org/10.1136/thx.2008.100867. Medline:19052047
46. Neder JA, Sword D, Ward SA, et al. Home based neuromuscular electrical stimulation as a new rehabilitative strategy for severely disabled patients with chronic obstructive pulmonary disease (COPD). Thorax. 2002;57(4):333–7. http://dx.doi.org/10.1136/thorax.57.4.333. Medline:11923552
47. Vivodtzev I, Pépin JL, Vottero G, et al. Improvement in quadriceps strength and dyspnea in daily tasks after 1 month of electrical stimulation in severely deconditioned and malnourished COPD. Chest. 2006;129(6):1540–8. http://dx.doi.org/10.1378/chest.129.6.1540. Medline:16778272
48. Rabe KF, Hurd S, Anzueto A, et al; Global Initiative for Chronic Obstructive Lung Disease. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. Am J Respir Crit Care Med. 2007;176(6):532–55. http://dx.doi.org/10.1164/rccm.200703-456SO. Medline:17507545
49. Tang CY, Taylor NF, Blackstock FC. Chest physiotherapy for patients admitted to hospital with an acute exacerbation of chronic obstructive pulmonary disease (COPD): a systematic review. Physiotherapy. 2010;96(1):1–13. http://dx.doi.org/10.1016/j.physio.2009.06.008. Medline:20113757
50. Osadnik CR, McDonald CF, Jones AP, et al. Airway clearance techniques for chronic obstructive pulmonary disease. Cochrane Database Syst Rev. 2012; (3):CD008328. Medline:22419331