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EVIDENCE-BASED REVIEW

Role of physiotherapy in the management of chronic lung diseases: An overview of systematic reviews☆

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Summary
Four Cochrane respiratory reviews of relevance to physiotherapeutic practice are discussed in this overview. Physiotherapists aim to improve ventilation for people with respiratory disease, and approach this using a variety of techniques. As such, the reviews chosen for discussion consider a wide range of interventions commonly used by physiotherapists: breathing exercises, bronchopulmonary hygiene techniques and physical training for peripheral and respiratory muscles. The reviews show that breathing exercises may have beneficial effects on health-related quality of life in asthma, and that inspiratory muscle training (IMT) may improve inspiratory muscle strength. However, the clinical relevance of increased respiratory muscle strength *per se* is unknown, and the longer-term effects of breathing exercises on morbidity have not been considered. One review clearly shows that bronchopulmonary hygiene techniques in chronic obstructive pulmonary disease (COPD) and bronchiectasis increase sputum production. Frequent exacerbation is associated with increased sputum and high bacterial load, suggesting that there may be important therapeutic benefit of improved sputum clearance. Future studies evaluating the long-term effects of bronchopulmonary hygiene techniques on morbidity are recommended. In the third review, the importance of pulmonary rehabilitation in the management of COPD is once again reinforced. Physiotherapists are crucial to the delivery of exercise training programmes, and it is likely that the effects of pulmonary rehabilitation extend to other important outcomes, such as hospital admission and

☆The following Cochrane reviews have been cited in this Evidence-Based Review: Holloway E, Ram FS. Breathing excercises for asthma, Issue 1, 2004; Jones AP, Rowe BH. Bronchopulmonary hygiene physical therapy for chronic obstructive pulmonary disease and bronchiectasis, Issue 2, 2000; Lacasse Y, et al. Pulmonary rehabilitation for chronic obstructive pulmonary disease, Issue 4, 2006; Ram FS, et al. Inspiratory muscle training for asthma, Issue 4, 2003.

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re-admission. On the basis of the evidence provided by these Cochrane reviews, this overview highlights important practice points of relevance to physiotherapy, and recommendations for future studies.

Contents

Introduction

Physiotherapists are recognized as playing an important role in the management of patients with respiratory disease. They use a variety of strategies aimed at reducing the work of breathing, improving ventilation, increasing function and enabling relief of dyspnoea. Chest physical therapy may include positioning to maximize ventilation, management of secretion retention, breathing and whole-body exercises to improve strength and function, and the application of adjuncts designed to maximize lung function. Chest physical therapy is not a new concept; indeed over a century ago deep breathing exercises were promoted in order to 'strengthen the chest, lungs and stomach',[1] and positioning and exercise were proposed as beneficial therapies for the perception of dyspnoea.[2]

However, research concerning the effect of physiotherapeutic interventions is often methodologically weak and insufficiently robust to make clinical recommendations.[3–5] Many studies are small, of short duration and do not adequately define their target population. Furthermore, few studies in physiotherapy use sham treatments. To confuse matters further, there is discussion within the profession as to what constitutes 'conventional chest physical therapy', with commentators advocating a varied approach depending upon the underlying pathological problem.[6] Thus, the formal randomized-controlled trial (RCT) is often considered inappropriate for evaluating physical therapy. Unlike many medical treatments, blinding of participant to treatment group may not be possible, and standardization of technique can be difficult to achieve. Pharmaceutical and commercial sponsorship of clinical trials in much of the world has contributed to the understanding of chronic respiratory disease and its response to pharmaceutical and surgical intervention.[7–9] Physiotherapeutic interventions, while rarely assessed in such sample sizes, have featured in many of these large multicentre studies as part of 'usual care'. This may reflect both the extent to which it has come to be accepted as routine management, and the necessity to establish optimum care.[10] Advances in outcome measurement and the increasing recognition of the value of health-related quality of life treatment of respiratory disease[11] may prove to be more sensitive to physiotherapeutic interventions than measures such as lung function and mortality.

However, a rehabilitative, multidisciplinary intervention is as deserving of formal assessment as any other, and the methodological rigour demanded by organizations such as the Cochrane Collaboration will help to preserve the unique identity of the physiotherapy evidence base. The purpose of this overview then is to consider the evidence from previous robust review documents, predominantly those of the Cochrane Respiratory Review Groups, and to try and illuminate some of the areas that physiotherapists are involved with in the management of respiratory disease.

Systematic review 1: breathing exercises in asthma

Breathing exercises in the management of asthma have been formally evaluated and considered in this systematic review.[12] Seven RCTs were included, in which breathing retraining, lower abdominal breathing, Buteyko technique or yoga that included breathing exercises, were compared with asthma education or waiting list controls.

Effects on lung function

Pooled data from two of the studies[13,14] showed a non-significant decrease in reduced forced expiratory volume in 1 s (FEV_1) in the treatment group compared with control. However, FEV_1 was significantly higher after the treatment period in one small study ($n = 17$) that compared yoga breathing techniques with control.[13] In one study, peak expiratory flow rate significantly improved as a result of breathing exercises,[15] although in another there was no difference in evening or morning values.[14]

Medication usage

Medication usage was recorded in two trials.[16,17] In both, rescue bronchodilator use was reduced in the treatment arm compared with control groups. Of note, beta-2 agonist usage also decreased in the study by Bowler et al.[17] which evaluated the Buteyko Breathing Technique; however, stratification of participants according to high or low usage and recruitment on the basis of high use of rescue medication limit this finding.

Exacerbations

Effects of breathing re-training on exacerbations of asthma were evaluated in two studies with contradictory results. One study showed a positive effect with a reduction of 1.27 attacks per week,[15] whereas no difference was seen between groups in the other.[13]

Health-related quality of life

Health-related, quality-of-life measures, although different, were included in two trials.[17,18] In both, significant improvements were shown in the treatment arm compared with control. In one,[17] numbers needed to treat were identified as two at 1 month and four at 12 months.

Implications for physiotherapists

Clearly, breathing exercises for people with asthma have demonstrable benefits on health-related quality of life. The study by Bowler et al.[17] showed an effect of Buteyko over and above that of abdominal breathing, education and relaxation; the study by Thomas et al.[18] however, indicated that physiotherapy treatment that focused on slowing the breathing pattern achieved good results compared with education alone. Where over-breathing is a component of the manifestation of asthma symptoms, the focus should be on exercises that maximize conscious control of nose breathing, aim to decrease ventilation and 're-establish a more normal and slower pattern of movement'.[19]

Practice point

Breathing exercises, containing an element of hypoventilation, in patients with asthma, result in significant improvements in health-related quality of life.

Systematic review 2: bronchopulmonary hygiene physical therapy for chronic obstructive pulmonary disease and bronchiectasis

Where respiratory patients have difficulty with impaired airway clearance, physical therapists commonly apply techniques to assist clearance of secretions. Although short-term trials show evidence of benefit in cystic fibrosis,[20] the data are controversial in conditions such as bronchiectasis and chronic obstructive pulmonary disease (COPD). In this systematic review, the effects of manual interventions, such as postural drainage, chest percussion, vibration, chest shaking, directed coughing, or forced exhalation technique, were considered on the outcomes of lung function, pulmonary clearance and symptoms.[21] Ninety-nine potential studies were identified, and a total of seven RCTs were included, of which five concerned the evaluation of treatment compared with no treatment. Unfortunately, interventions and patient populations were different, meaning that trials could not be combined statistically.

Pulmonary clearance

Two trials in bronchiectasis evaluated the effect of postural drainage plus percussion[22] and postural drainage plus forced expiration techniques[23] on sputum production and radioisotope clearance. In both studies, physiotherapy treatment improved pulmonary clearance compared with a control group. In chronic bronchitis, postural drainage, cough and exercise also improved airway clearance as measured by radioisotope, whereas postural drainage in isolation was ineffective.[24]

Pulmonary function and oxygenation

Studies investigating effects on pulmonary function and oxygenation did not show benefit in either acute exacerbations of COPD[25] or in chronic COPD.[26]

Methodological limitations

Jones and Rowe[21] acknowledge and highlight significant methodological flaws in study designs, populations and reporting. Few studies evaluated bronchopulmonary hygiene techniques in patients with acute respiratory disease, and those studies that did were of poor methodological quality and did not clearly characterize patients.

In the case of Newton and Bevans[25] 79 patients with an acute exacerbation of COPD were stratified into three groups. The first two were men with $PaO_2 < 8$ kPa, and men with PaO_2 above this. Women then made up a third group. Randomization into control versus physiotherapy was then carried out and data analysed for sub-groups only. This meant that groups were small, with 27 in group 1, 13 in treatment arm and 14 in control arm; 36 in group 2 and only 16 in the third group. No significant differences were found as a result of treatment in these small groups, with the exception of increased sputum production in the last 3 days of hospitalization in men without hypoxaemia as a result of physiotherapy. Results of all group analysis are not shown.

Implications for physiotherapists

This summary clearly shows that bronchopulmonary hygiene techniques in COPD and bronchiectasis increase sputum production. Frequent exacerbation is associated with increased sputum and high bacterial load.[27] In addition, up to half of patients with severe COPD have bronchiectasis on high resolution chest computed tomography.[28] Increased bacterial load in sputum is associated with increased frequency of exacerbation,[29] and physiotherapy aids sputum clearance.[22] Although associations cannot inform us about cause, there may be important therapeutic benefit of improved sputum clearance. In the absence of studies informing us of the long-term effects of bronchopulmonary hygiene techniques on morbidity and mortality, physiotherapists would do well to continue treatment of sputum hypersecretion using the evidence-based approaches described above.

Practice point

Physiotherapy treatment enhances sputum production, whether this is of long-term clinical benefit remains to be seen.

Research priorities

RCTs of bronchopulmonary hygiene techniques are required that evaluate effects on health-related quality of life, exacerbation frequency and hospital admission. Investigation should include long-term follow-up.

Systematic review 3: pulmonary rehabilitation for chronic obstructive pulmonary disease

This recently updated review strongly supports the role of pulmonary rehabilitation in the management of people with COPD.[30] Physical therapists are crucial to the delivery of rehabilitation because of their training in exercise and movement therapies. Trials were considered if an exercise component (with or without education) was compared with usual treatment or a non-exercise control group. An impressive 31 RCTs met the inclusion criteria for this review, and statistically significant improvements were seen for health-related quality of life and functional exercise capacity.

Health-related quality of life

Weighted mean differences (WMD) were calculated from the difference between pre- and post-intervention changes. Thirteen of the studies had measured health-related quality of life, although only the valid measures of St. George's Hospital Respiratory Questionnaire,[31] The Chronic Respiratory Disease Questionnaire (CRQ)[32] and the Transitional Dyspnoea Index[33] were considered. The reviewers compared effect sizes with that of the minimal clinically important difference (MCID) where these have previously been determined. The MCID determines the smallest difference in score that equates to a meaningful clinical change, and have been calculated for the above outcome measures.

Using WMD, the effect size of pulmonary rehabilitation on health-related quality of life was greater than the clinical difference for all domains of the CRQ. Indeed, effects of rehabilitation on the dyspnoea component of CRQ were larger than the MCID of 0.5 units, implying an important clinical benefit of therapy; WMD 1.0 units, 95% CI: 0.8–1.3 units. Data were similarly positive for St. George's Hospital Respiratory Questionnaire, and again the common effect size exceeded the MCID of 4 points.

Maximal exercise tolerance

An important aim of pulmonary rehabilitation is to increase exercise tolerance and functional ability for people limited by their respiratory disease. As evidence shows a close relationship between lower exercise tolerance and admission and readmission to hospital, this is a fundamental clinical aim.[34] Pooled data showed a statistically significant effect of rehabilitation on maximal exercise tolerance using cycle ergometry, mean difference (95% CI) 8.4 W (3.4–13.4). No MCID is available for maximal exercise assessed in this way, although the difference is similar to the increase in exercise capacity seen after ablation of the His bundle in patients with chronic atrial fibrillation, suggesting it may have clinical relevance.[35]

Functional exercise tolerance

Using the six-minute walking distance (6 MWD) as a measure of functional exercise tolerance, mean improvement between control and active groups was 48 m (95% CI 32–65). This mean difference is close to the MCID of 6 MWD identified as around 50 m, although the lower confidence interval marginally falls below MCID confidence intervals of 37–71 m.[36] Clinical significance of the benefits of pulmonary rehabilitation on functional exercise tolerance is therefore not irrefutably proven; however, other evidence highlighting improvement in daily activity performance with rehabilitation does support clinical benefit.[37,38]

The principal reason for performing a meta-analysis is the opportunity to increase the statistical power of individual studies. In the case of this review, results from some individual trials do not reach statistical significance, or are too imprecise to allow useful inference. Data from one community study, for instance, show a small mean difference of only 5 m,[39] and in another small study (consisting of a brief hospital intervention with home follow-up), the mean difference was 0 m.[40] In another small study, a large effect size of rehabilitation was seen (143.6 m); however, the confidence intervals around the mean were large (74.3–212.9), reflecting the very small sample size ($n = 7$).[41] Pooling data from this and other similar studies gave a sample size of 323 participants, and a WMD of 48.5 m with tighter confidence intervals 31.6–65.2 m, reflecting the larger sample size (Fig. 1).

Methodological limitations

Although the review authors conclude that studies comparing rehabilitation with a waiting list or usual care group are no longer of importance, it must be remembered that RCTs concerning effects on hospitalizations and exacerbation are still lacking. Although able to provide evidence of effectiveness on exercise tolerance and quality of life, this review was not able to describe the relationship between appropriate initiation of this intervention, disease severity and hospitalization that has come to be emphasized in clinical guidelines. Owing to the chronic, persistent nature of COPD, a longer-term perspective of rehabilitation is required, especially as the perception of health benefit and depressive co-morbidities may influence adherence to treatment.[42]

Implications for physiotherapists

Pulmonary rehabilitation is a well-proven effective therapy that results in important health benefits for people with COPD. Physiotherapists, trained as they are in the delivery of rehabilitative and physical approaches, should remain at the forefront of delivery of rehabilitation and maximize opportunities for all people with COPD.

Practice point

Pulmonary rehabilitation should be available to people with COPD, with the aim of improving breathlessness, quality of life and exercise tolerance.

Research priorities

Further research would be recommended to identify long-term effects of rehabilitation and strategies to ensure optimization of service delivery.

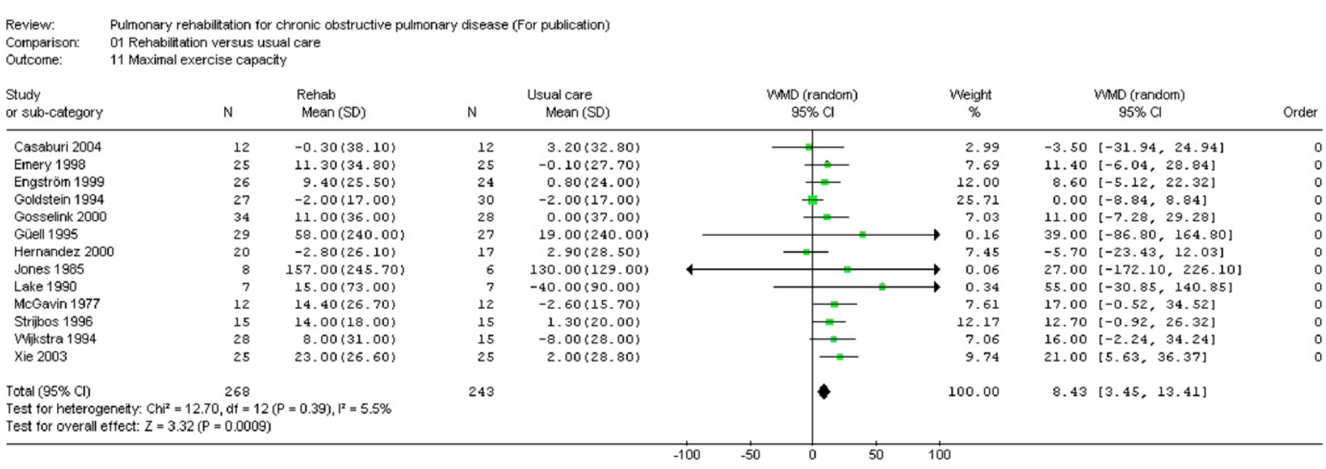

Figure 1 Forest plot of maximal exercise capacity from the Cochrane review by Lacasse et al. The individual trial data are represented by the horizontal lines in relation to the vertical line which represents no statistically significant difference. The width of each horizontal line reflects how precise the difference was for each trial. The weighted average of these estimates is represented by the black diamond at the bottom of the graph, with the numerical value of the widest point of the diamond (point estimate) given to the right, with its associated 95% confidence intervals.

Systematic review 4: inspiratory muscle training for asthma

Generalized muscle weakness is common in patients with respiratory disease, and is known to contribute to reduction in exercise tolerance and dyspnoea. In people with asthma, increased use of steroids, reduced exercise capacity and inflammatory processes may contribute to respiratory muscle weakness. Feasibly, weakness may be a contributory factor towards the sensation of dyspnoea.[43] Alternatively, it has been argued that, in asthma, as work of breathing is increased, inspiratory muscle strength is increased compared with healthy people.[44] Whether alterations in maximal inspiratory and expiratory pressures reflect true weakness, or are rather a feature of dynamic hyperinflation remains controversial. However, empirical evidence of improvement in breathlessness in association with increase in respiratory muscle strength would support the former hypothesis. Devices are now available to assist the training of respiratory muscles, and a number of studies have examined the effect of respiratory muscle training in asthma[45] and COPD.[46] Physical therapists are familiar with the physiological principles of training and the application of respiratory muscle training in people with respiratory disease. In this systematic review, the role of inspiratory muscle training (IMT) in asthma is considered.[47]

Only studies that compared the use of an external resistive training device with sham treatment (or usual care) were considered. Patients had stable asthma according to recognized criteria. Five RCTs[48–51] were included in the review.

Effects of training on maximal inspiratory pressure (cm H_2O)

Four of the above studies were included in this analysis comprising 94 participants. WMD showed a significant effect of IMT on maximal inspiratory pressure compared with control group (20.2 cm H_2O; 95% CI 13.2–27.2). As the studies were heterogeneous, a random-effects model was applied. This did not alter the results, although WMD was smaller and confidence intervals wider.

Effects of training on lung function

Two studies reported on FEV_1 and forced vital capacity.[45,50] However, these outcomes were reported differently: as percent predicted and absolute change. The combined standardized mean difference was not significant for either outcome. One study showed a significant increase in percent forced vital capacity in the treatment group compared with control group (mean difference 15.6%).[45]

Effect of peak expiratory flow rate

Only McConnell et al.[50] reported on this; no significant difference was found in peak expiratory flow rate after training compared with controls.

A number of other outcomes were considered of importance by the reviewer; asthma symptoms, inspiratory muscle endurance, exacerbations, days off work or school and oral corticosteroid usage. Of the five studies reviewed, no data were available for effects of IMT on any of these outcomes. It is of note that four of the included studies were from the same research group.

Methodological limitations

The main outcome of this review is that IMT increases maximal inspiratory pressure compared with control group of no training or sham training only. However, the clinical relevance of this remains difficult to interpret, owing to the fact that measures of lung function show little change and importantly there is neither assessment of symptoms nor evaluation of long-term effects on health-related quality of life or dyspnoea. There remain significant methodological limitations of studies investigating IMT, including small sample size, mixed populations, difficulties with accurately describing intensity, duration and the frequency of training applied. Furthermore, maximal inspiratory pressure is a volitional test and therefore open to criticism.[52] Several different respiratory muscle training devices are available, ranging from sophisticated computerized systems to simple hand-held resistive devices. In addition, the relative benefits of strength versus endurance training, inspiratory versus expiratory training and effect in patients of differing severity are unknown.

Implications for physiotherapists

Although the routine use of IMT cannot yet be recommended, where the therapist considers that respiratory muscle weakness is of primary importance in the manifestation of symptoms, a trial of respiratory muscle training may be undertaken.

Practice point

IMT improves maximal inspiratory strength; however, the clinical relevance of this is at present unclear.

Research priorities

- Long-term randomized, double-blinded, controlled trials are required that evaluate the effect of IMT on quality of life, dyspnoea and exacerbations in people with asthma.
- The effect of IMT requires assessment using non-volitional tests of respiratory muscle strength in people with asthma.

Conclusions

In this article, we provide an evidence-based overview of four Cochrane reviews of relevance to physiotherapeutic practice. The reviews chosen include a broad range of treatments commonly used by physiotherapists: breathing exercises; bronchopulmonary hygiene techniques; and physical training for peripheral and respiratory muscles. These reviews reflect the varied nature of physiotherapy practice. Physiotherapists aim to improve ventilation for people with respiratory disease and, as shown above, they may approach this using a variety of techniques. The reviews show that breathing exercises can have beneficial effects on health-related quality of life in asthma, that IMT improves inspiratory muscle strength and that bronchopulmonary techniques aid clearance of sputum. However, the clinical relevance of these treatments and long-term effects on morbidity are as yet unknown.

The unequivocal importance of pulmonary rehabilitation in the management of COPD is once again reinforced. Recent data from a cohort study demonstrate a protective effect of physical activity on mortality and hospital admissions in COPD.[53] It is likely that the effects of pulmonary rehabilitation will extend to other important outcomes, such as hospital admission and re-admission.[54]

The process of pre-defining clinical questions, extensive literature searches and critical appraisal that characterizes Cochrane reviews has provided physiotherapists and other clinicians with carefully assembled summaries of evidence of the effects of interventions in the management of respiratory disease. To varying degrees, these reviews serve as the basis for informing the practice and provision of physiotherapy services to patients with chronic respiratory disease. They also highlight crucial areas of research that require further exploration. Unfortunately, Cochrane reviews rarely answer questions of equal importance, which is that if we can show something works, what is it that facilitates successful roll-out at service level? This is particularly relevant for the delivery of pulmonary rehabilitation. Often these questions require an empirically rigorous basis provided by systematic reviews, before we can progress and ask other important questions. In time, the findings of such qualitative studies should feed into the evidence-gathering process. The observations that can be made from cohort and other observational or qualitative studies have the potential to provide guidance to the design of intervention studies, making such studies, and the reviews that assess them, of increasing relevance to the daily practice of physiotherapy.

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