The role of physiotherapy in the management of COPD

Christine Mikelsons*

Physiotherapy Department, Royal Free Hospital, Pond Street, London NW3 2QG, UK

Keywords:
Positioning
Breathing exercises
Airway clearance therapies
Early pulmonary rehabilitation
Non-invasive ventilation

Summary
Chronic obstructive pulmonary disease (COPD) is characterised by intractable dyspnoea, reduced functional capacity and episodes of acute exacerbation. Physiotherapy plays a key role in multidisciplinary interventions. The evidence in relation to airway clearance, pulmonary rehabilitation, inspiratory muscle training and non-invasive ventilation is now robust whilst further evidence is required for other interventions in order to clarify where application, skills and training should be focused. The challenge is to translate sound clinical evidence-based practice into novel models of service with resultant improvements in care for patients with COPD.

© 2007 Elsevier Ltd. All rights reserved.

Introduction
Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality, with the expectation that prevalence will increase rather than decrease in the coming years.1 Patients with COPD complain primarily of incapacitating dyspnoea and reduced functional capacity. The role of physiotherapy in the management of COPD includes addressing issues relating to reducing work of breathing, promoting airway clearance, improving mobility and promoting rehabilitation and contributing to the provision of effective non-invasive ventilation services. The key to successful management of these complex patients is two fold: the accurate assessment of the patient to identify clear goals of treatment and team work, which underpins a thorough knowledge of the individual patient. The way in which various physiotherapy treatment techniques are used will depend on the changing clinical presentation of each patient and physiotherapy should be tailored to meeting different needs according to whether patients are in an acute exacerbation of COPD or in a stable phase. Variations in the application of techniques will be pointed out, and may involve a change in performance of the technique or in the regime of treatment. Concordance between patients and clinical staff in determining a treatment plan for patients should be a main aim of treatment in order to optimise and promote self-management.

Positioning
Dyspnoea is a common feature of COPD and can incapacitate patients both functionally due to their inability to perform activities of daily living and psychologically as they become anxious and depressed about their breathlessness. Many patients adopt a forward lean position to relieve breathlessness and this is a useful, simple tool, which can be taught to patients to self-manage intractable dyspnoea, both in a stable phase of the disease and during an acute exacerbation. Assessment should however be made in each case to gauge the likely effectiveness for individuals. Early evidence supports the use of this position to relieve breathlessness,2 reduce the work of breathing3 and to reverse paradoxical abdominal wall movement.4 It is thought that the forward lean position facilitates diaphragmatic function by lengthening the shortened diaphragm by the movement of the abdominal contents thereby optimising the length tension relationship.5 In patients who find this position beneficial, other positions of ease can be taught in standing such as
leaning against a window sill, wall, or shopping trolley whilst outside to enable patients to maximise their potential of getting out of their homes. A more recent study by Probst showed an increase in ventilatory capacity in patients with severe COPD using a frame or rollator providing arm support. This is an important aspect in facilitating the early rehabilitation of patients with COPD in an acute exacerbation, as it is known that those hospitalised in the previous year had a lower activity level at 1 month post-discharge compared to those not hospitalised and were more likely to be admitted in the following year. Early rehabilitation will be returned to later in more depth.

### Breathing exercises

**Diaphragmatic breathing, breathing control and pursed lip breathing**

The aims of using diaphragmatic breathing (DB), breathing control and pursed lip breathing (PLB) are to relieve breathlessness and promote relaxation. DB involves encouraging patients to move the abdominal wall predominantly during inspiration with reduction of rib cage movement and inhale slowly and deeply, in order to improve chest wall movement and the distribution of ventilation, decrease the work of breathing and improve exercise capacity. However, studies by Gosselink et al., Vitacca et al. and others have found that DB in severe COPD patients may increase asynchronous and paradoxical breathing movements, increase the work of breathing, enhance the oxygen cost and reduce the mechanical efficiency of breathing and therefore do not support its use. Breathing control is described as tidal breathing at normal tidal volume and rate, using the lower chest with relaxation of the upper chest and shoulders and may facilitate relaxation when used with positions of ease such as forward lean sitting. It is of note that it has been shown that fatigue of the diaphragm may develop earlier when using slow, deep breathing. It is clear that further research is required to identify clearly the benefits of breathing exercises in breathless patients with COPD and treatments should be closely monitored for variations in response and modified accordingly. PLB involves the patient breathing in through the nose and out through the mouth against a resistance created by pursing the lips, which helps to prevent airway collapse. It has been shown that PLB performed during exertion can lead to a reduction in respiratory rate and increased recovery rate compared with spontaneous breathing, but no differences in dyspnoea or exercise tolerance were found. PLB during exertion may therefore be a useful addition to the breathless patients’ regime and may be taught as a strategy to reduce respiratory rate in patients with COPD.

### Airway clearance techniques

**Active cycle of breathing techniques (ACBT), forced expiration technique (FET), autogenic drainage (AD), positive expiratory pressure adjuncts (PEP), intermittent positive pressure breathing (IPPB)**

Airway clearance techniques include a variety of techniques such as the active cycle of breathing technique (ACBT), forced expiration technique (FET), postural drainage (PD), autogenic drainage (AD), positive expiratory pressure (PEP) adjuncts and intermittent positive pressure breathing (IPPB). The key indicator for determining use of any airway clearance technique is the presence of sputum that the patient is unable to expectorate independently which may occur during an acute exacerbation. This will be a key indicator for a patient in the self-management of their disease and patients should be taught modifications of their airway clearance regime during an acute exacerbation. ACBT consists of tidal breathing, thoracic expansion exercises and forced expiration techniques which can be performed in postural drainage positions or in sitting and can be done successfully either independently or with an assistant. It is easily taught to patients and does not require any special equipment to perform. Autogenic drainage is a sequence of breathing exercises which consist of three phases of controlled expirations during tidal breathing called ‘unstick’, ‘collecting’ and ‘evacuating’. Evidence from the literature identifies that both ACBT and AD show equal improvements in lung function when sputum clearance in patients with COPD is compared, however it is not known whether there is a significant difference between the two techniques. In a comparison of AD and ACBT in patients with COPD, Savci et al. identified improvements in pulmonary function, arterial blood gases, exercise tolerance and dyspnoea scores using both techniques. However, differences between the benefits of ACBT and AD were noted with positive effects seen in SpO2 using ACBT and in PEFR and PaCO2 using AD. The use of FET has also been demonstrated to be effective in sputum clearance in COPD, with FET and PD being more effective than cough alone.

Positive expiratory pressure adjuncts to aid sputum clearance include the PEP mask (Astra Meditec Ltd., UK), Flutter (Scandipharm Intl, UK), Cornet (Pari Respiratory Equipment, Midlothian, VA) and Acapella™ (Smiths Medical, UK). The

### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB</td>
<td>Diaphragmatic breathing</td>
</tr>
<tr>
<td>PLB</td>
<td>Pursed lip breathing</td>
</tr>
<tr>
<td>ACTB</td>
<td>Active cycle of breathing techniques</td>
</tr>
<tr>
<td>FET</td>
<td>Forced expiration techniques</td>
</tr>
<tr>
<td>AD</td>
<td>Autogenic drainage</td>
</tr>
<tr>
<td>PEP</td>
<td>Positive expiratory pressure</td>
</tr>
<tr>
<td>IPPB</td>
<td>Intermittent positive pressure breathing</td>
</tr>
<tr>
<td>PD</td>
<td>Postural drainage</td>
</tr>
<tr>
<td>IMT</td>
<td>Inspiratory muscle training</td>
</tr>
</tbody>
</table>
Flutter, Cornet and Acapella also incorporate an oscillatory element, which provides expiratory vibration, aiding sputum movement into larger airways. When compared to conventional chest physiotherapy (PD, percussion, chest shaking, huffing and directed coughing), these devices have been shown to be as effective as each other.15,19,20 The Flutter has been shown to produce significant improvements in sputum removal in a small group of COPD patients using it during an acute exacerbation, compared with PD, during the first hour after treatment.19 Patients’ preferences may be a key feature in deciding on the use of such devices where convenience in performing sputum clearance may be the most important factor.15

Given the evidence, decisions about which techniques patients are advised to use independently should be informed by which patients find most helpful and easiest to incorporate into their daily lives. In addition, regimes should take account of daily routine, whether patients work, and so what kind of constraints this places on the individual. Patients should be informed about appropriate changes to make to their routine in response to changes in their clinical condition, which may involve increasing the time spent and repetitions of treatments in the presence of increased sputum volumes. During acute exacerbations of COPD, patients may benefit from the assistance of a physiotherapist, who can then tailor treatments and the use of adjuncts to the patients needs taking into account how quickly the patient is tiring during treatment, how much bronchospasm the patient has and how often treatments are indicated.

It is worth noting that what is meant by 'chest physiotherapy' varies internationally which makes comparison of the effectiveness of interventions difficult when examining the literature. In the United States, 'chest physical therapy' consists of percussion, postural drainage and chest vibrations whereas in the UK 'conventional chest physiotherapy' may include the ACBT in combination with postural drainage and manual techniques such as shaking or vibrations. In addition, much of the evidence relating to airway clearance techniques has been performed in patients with cystic fibrosis rather than in COPD, underlining the importance of an understanding of evidence when translating it into clinical practice.

The use of IPPB has largely been replaced by the advent of non-invasive ventilation, which is well described in the literature in the treatment of acute exacerbations of COPD.21 However, two early studies into the use of IPPB demonstrated increased tidal volumes when used in acute respiratory failure22 and decreased work of breathing,23 and may be indicated in patients with exacerbations of COPD who have retained secretions which they are unable to clear independently due to fatigue and/or increased work of breathing.24 Its use can effectively achieve multiple goals of treatment simultaneously for patients who are fatigued, by delivering bronchodilators in a position of ease or by supporting an increase in tidal volume enabling efficient sputum clearance. Other techniques of airway clearance such as intrapulmonary percussive devices and high frequency chest wall oscillation vests have largely been tested in patients with cystic fibrosis and have not been extensively tested for use in the COPD group.

Rehabilitation for patients with COPD

Early rehabilitation following an exacerbation, early rehabilitation in the intensive therapy unit (ITU), inspiratory muscle training (IMT)

Large bodies of evidence now support the use of pulmonary rehabilitation in the treatment of patients with COPD, with many randomised controlled trials describing its potential benefits including: improved exercise capacity, increased quality of life, enhanced patients’ sense of control over their condition, improved emotional function, improved dyspnoea and fatigue, increased functional outcomes, reduced length of hospital stay and number of hospitalizations, reduction in primary care consultations and survival benefit.25,26 Although evidence suggests that no change in FEV1 occurs as a result of pulmonary rehabilitation,27 important changes in self-efficacy (for example in functional capacity and confidence in coping with the disease) have been demonstrated on completion of a programme.

The evidence supporting the benefit of pulmonary rehabilitation for patients with COPD is robust (level 1) and has been reviewed in a Cochrane review,25 which included 31 randomised controlled trials. Both the NICE Guideline28 and the Cochrane Review of pulmonary rehabilitation25 strongly support the inclusion of pulmonary rehabilitation for patients with COPD. An economic evaluation undertaken by Griffiths et al.29 demonstrated that pulmonary rehabilitation was cost saving and increased quality of life and the challenge currently being faced is the provision of pulmonary rehabilitation programmes equitably across the UK. In addition maintenance programmes need to address the plateau effect seen in improvements in functional ability, at 1 year.

Pulmonary rehabilitation is a multidisciplinary programme, which aims to optimise COPD patients’ functional capacity and empower management and coping strategies. Guidelines for pulmonary rehabilitation are well-documented with the suggested optimal programme length being 6–8 weeks and consisting of graded exercises, disease education, psychological and social intervention.30 Physiotherapists play a key part in the assessment, exercise and education components. Patients are encouraged to discuss clear aims in attending a programme as part of an assessment and to identify appropriate agreed goals. Patients referred to pulmonary rehabilitation must have had their medical therapy optimised, be in a stable state of their disease and be capable of participating in a group class.30 Motivation to attend, participate and make necessary lifestyle changes will affect outcomes for patients and should be discussed in a preliminary assessment. Criteria for acceptance of patients on to a programme may include their ability to attend for the period of the programme and their ability to get to and from sessions as attrition rates are known to be high with transport being a major factor in hindering attendance. Programmes may require attendance on a fixed term or rolling basis, with the latter optimising the best use of resources where attrition rates are high. Patients requiring oxygen to exercise should not be excluded from programmes and assessment for ambulatory oxygen can be performed as part of attendance.
at pulmonary rehabilitation. In addition, exclusion criteria should be considered and any co-morbidities taken into account (e.g. unstable angina, recent myocardial infarct). Exercise programmes usually consist of a variety of upper and lower limb exercises, often performed on an interval basis, with training intensity set at 60–70% of VO₂ peak. During exercise patients are encouraged to monitor their levels of performance and breathlessness. Patients are encouraged to continue to exercise once they get home, so programmes should include functional activities and exercises which are easily reproduced in the home setting.

Pulmonary rehabilitation is effective in both the primary and secondary care settings. Basic protocols should be in place, which will outline procedures for the care and safety of patients. The benefit of pulmonary rehabilitation in the community is that patients may be seen closer to home. In the acute setting it may be easier to manage more severe patients who require oxygen to exercise. In addition, in some areas there is local provision of classes in non-clinical settings (e.g. gyms), supervised by trainers taught to manage patients with breathlessness, which enable patients to continue to exercise in a safe environment independently.

Recent research has identified the potential benefit of early rehabilitation following an exacerbation of COPD. In a meta-analysis by Puhan et al. 6 trials were identified including a total of 230 patients: using pooled results from these studies, early pulmonary rehabilitation was identified as improving exercise capacity and improving the patients’ scores for quality of life questionnaires, reducing the risk of hospital admission and reducing mortality. Although evidence suggests that early rehabilitation is effective, further research is required to identify the type and timing of such interventions as studies in Puhan et al.’s meta-analysis had a wide range of regimes including a rehabilitation programme begun within 4–8 days as an inpatient, an outpatient based programme started within 10 days of discharge, a supervised home programme and an inpatient programme started within 3–5 days of admission for patients many of whom had required intubation. However, a study by Pitta et al. of the physical activity of 17 patients hospitalised with an exacerbation of COPD supports the recommendations for early rehabilitation. Measures of levels of activity, 6 min walking distance, muscle force, pulmonary function and arterial blood gases at the beginning and end of the period of hospitalisation and 1 month after discharge were taken. Those patients hospitalised in the previous year had a lower activity level at 1 month post-discharge compared to those not hospitalised and were more likely to be readmitted in the following year, underlining the spiral of decline in activity which repeated acute exacerbations can reinforce. In support of this, Garcia-Aymerich et al. have also reported that regular physical activity reduces hospital admission and mortality in COPD. In addition, resistance training for patients during an exacerbation of COPD has been identified as an important aspect of rehabilitation in patients who are admitted to hospital and Probst et al. have demonstrated maintenance of quadriceps muscle force in patients given a once a day programme of bilateral leg extensions.

Evidence relating to the early rehabilitation of patients admitted to an ITU for intubation and ventilation as a result of an exacerbation of COPD, has demonstrated its benefits. These reports are supported by early small studies performed in the 1980s. In a randomised controlled study, Nava described the benefits of an early rehabilitation programme for COPD patients admitted to a respiratory ITU, 74% of whom were intubated, consisting of four stages which patients progressed through as and when they were able, including passive mobilisations, progressive walking, respiratory and lower skeletal muscle training and treadmill walking. Significant improvements were found in the rehabilitation group in walking distance, maximal inspiratory pressure and visual analogue score for dyspnoea with a reduced total length of ITU stay. It is important that safety aspects are considered before mobilising critically ill patients and these are comprehensively outlined by Stiller and Phillips (2003). A physiotherapy assessment of all body systems will identify key priorities for treatment, which may include airway clearance in the presence of sputum, and in addition, will determine the type and level of physical activity appropriate given the clinical picture of the patient. Studies have reported that early activity is both safe and feasible and may help to prevent the sequelae of critical illness and ventilation. This is of major importance in the treatment of these patients who may have musculoskeletal weakness as a feature of their disease which is worsened during an exacerbation, especially when muscle fibre atrophy is known to progress at the rate of 3–4%/day in critically ill patients ventilated in ITU.

The use of inspiratory muscle training (IMT) in patients with COPD has been described in the literature with positive outcomes, both in intubated patients to facilitate weaning from ventilation and in spontaneously breathing patients. IMT has been shown to produce benefits in exercise tolerance, inspiratory muscle endurance and strength, breathlessness and quality of life. The use of IMT in an exercise programme has been shown to increase maximal inspiratory pressure, perception of breathlessness and health-related quality of life. High-intensity IMT has been shown to produce useful reductions in dyspnoea and fatigue. Usually training takes place over 6 to 9 weeks using 30 to 60% of maximal inspiratory pressure. In a small study of 10 patients with COPD, Martin et al. described the use of IMT to facilitate ventilator weaning with patients performing four sets of six breaths through an IMT, set to an intensity of 6–8 on a scale of 10. Weaning was achieved in 9 out of 10 patients after a mean period of use of 44 days.

Non-invasive ventilation (NIV)

Guidelines for the provision of non-invasive ventilation services identify the need for competent and skilled healthcare professionals to be involved in the provision of the service and respiratory physiotherapists are ideally placed to make a valuable contribution to these services. Many of these core skills and competencies are taught at undergraduate level. Physiotherapy programmes include respiratory anatomy and physiology, assessment, ventilation, NIV, oxygen as well as pulmonary rehabilitation, holistic care of patients including knowledge of COPD and an understanding
of the psychological impact of chronic respiratory disease. Physiotherapists are also selected for undergraduate programmes for their problem solving skills and their ability to communicate effectively and have many valuable attributes to contribute to the care of patients with COPD. Many services offering non-invasive ventilation either have respiratory physiotherapists as a key member of the team or in a leadership role in the provision of the service. Extended scope physiotherapy practitioners may also be ideally placed to offer additional skills such as earlobe blood gases to complement the provision of such services and physiotherapists are ideally placed to offer training and education to multidisciplinary staff.

**Conclusion**

The role of respiratory physiotherapy in the management of COPD spans all aspects of the care of these patients in both the primary and acute care settings. Evidence now supports the use of pulmonary rehabilitation, non-invasive ventilation, airway clearance and IMT but there is clearly a need for further research in order to clarify where skills and training should be focused, particularly in relation to other interventions, in order to optimise benefit and outcomes for our patients. In addition, there is a need to provide sound clinical evidence in support of the integration of seamless care across the primary/secondary care interface, which will enable the translation of evidence-based practice into novel models of service and result in better care for patients.

**REFERENCES**


