Treatment of Dyspnea in COPD*
A Controlled Clinical Trial of Dyspnea Management Strategies

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We conducted a randomized clinical trial to evaluate a limited pulmonary rehabilitation program focused on coping strategies for shortness of breath but without exercise training. Eighty-nine patients with COPD were randomly assigned to either a 6-week treatment or general health education control groups. Treatment consisted of instruction and practice in techniques of progressive muscle relaxation, breathing retraining, pacing, self-talk, and panic control. Tests of 6-min walk distance, quality of well-being, and psychological function as well as six dyspnea measures were administered at baseline, posttreatment, and 6 months after the intervention. Baseline pulmonary function tests also were obtained. At the end of the 6-week treatment, there were no significant differences between the treatment and control groups on any outcome measure. At the 6-month follow-up, a significant group difference was seen only on one variable, Mahler's transition dyspnea index. The results of this evaluation suggest that a treatment program of dyspnea management strategies, without structured exercise training or other components of a comprehensive pulmonary rehabilitation program, is not sufficient to produce significant improvement in dyspnea, exercise tolerance, health-related quality of well-being, anxiety, or depression. (Chest 1995; 107:724-29)

**COPD** is a major health problem and leading cause of morbidity and mortality in the United States. Dyspnea, one of the disabling symptoms of COPD, is an uncomfortable, subjective sensation of breathlessness. It encompasses not only the perception of breathlessness, but also the individual's reaction to the sensation. The mechanisms of dyspnea are not clearly understood, and there is no universal theory that completely explains its physiologic basis.

Pulmonary rehabilitation provides an important treatment option for patients with shortness of breath related to COPD. Comprehensive pulmonary rehabilitation programs generally include components of education, instruction in self-care techniques, exercise training, and psychosocial group support. Such programs include but are not limited to symptom-control treatment strategies. Previous research studies have focused on the effectiveness of comprehensive pulmonary rehabilitation or of individual strategies, but none has evaluated a specific multi-component program directed specifically at control of dyspnea. Since dyspnea is the symptom most associated with dysfunction for patients with COPD, a reasonable hypothesis is that treatment of dyspnea will result in improved functional outcomes. The purpose of this study was to evaluate the effectiveness of a treatment program utilizing various coping strategies for dyspnea management in patients with COPD.

**METHODS**

**Subjects**

Patients were recruited from local newspaper advertisements, community physicians and clinics, and the local Better Breathers Clubs of the American Lung Association. We screened 497 persons for the study. Criteria for participation in the randomized clinical trial were (1) diagnosis of COPD, (2) patient's report that she or he felt limited in physical functioning secondary to dyspnea, and (3) no participation in a pulmonary rehabilitation program during the previous 2 years. An initial power analysis indicated that 84 subjects would be required in the clinical trial to detect a moderate treatment effect with power of 0.80 and an alpha level of 0.05. Ninety-eight eligible subjects agreed to be

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ATS=American Thoracic Society; BDI=baseline dyspnea index; Borg-Hx=Borg average rating for past week; Borg-6MW=Borg rating following 6-min walk; CESD=Center for Epidemiologic Studies’ Depression; 6MW=6-min walk; OCD=oxygen cost diagram; PMR=progressive muscle relaxation; QWB=quality of well-being; SOBQ=shortness of breath questionnaire; STAI=state-trait anxiety inventory; TDI=transition dyspnea index; VAS=visual analog scale; VAS-Hx=VAS average rating for past week; VAS-6MW=VAS following 6-min walk

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randomized into the clinical trial. An additional 45 subjects completed the baseline assessment but did not enter the treatment study either because they were unable to commit the necessary time or were not limited by self-reported dyspnea. We used available medical records and pulmonary function test evidence of expiratory obstruction to confirm the diagnosis of COPD in all subjects. All subjects completed a baseline assessment in which measures of dyspnea, function, and psychological status were obtained.

**Study Groups**

Study subjects were randomly assigned into either a treatment or an education-control group.

**Treatment Group:** The treatment groups were facilitated jointly by a graduate student in psychology and a clinical nurse with more than 9 years of experience working in the field of pulmonary rehabilitation. The intervention consisted of 6 weekly sessions during which various strategies for coping with shortness of breath were presented. Class size varied between four and eight participants who completed the 6 weekly sessions together. During the sessions, one or more of the following strategies was presented followed by a question-and-answer period: pulmonary anatomy and physiology; description of COPD; a dyspnea model; progressive muscle relaxation; diaphragmatic and pursed-lip breathing; pacing and energy-saving techniques; self-talk and panic control; and stress management. Subjects also practiced the strategies at activity stations, which were set up to mimic various activities of daily living. The activity stations included showering, vacuuming, window washing, folding laundry, packing and unpacking groceries, and stair stepping.

The topics covered included some general background information about lung disease in addition to techniques specific to dyspnea management. Topic outlines are described as follows:

(1) Pulmonary anatomy and physiology: A basic description of the respiratory system including the diaphragm and the mechanics of gas exchange utilizing visual material such as posters.

(2) Description of COPD: Discussion of the cause, pathophysiology, diagnosis, symptoms and treatment of asthma, chronic bronchitis, and emphysema. Posters illustrating and comparing normal and diseased anatomy were utilized.

(3) Dyspnea-function model: Discussion of the role of dyspnea in functional limitations. Shortness of breath is associated with discomfort, frustration, and sometimes panic, which lead to a gradual decrease in activities. This causes physical deconditioning which increases the likelihood of dyspnea during exertion, leading to a vicious cycle of dyspnea and inactivity (Fig 1).

(4) Progressive muscle relaxation: Progressive muscle relaxation (PMR) involves systematically tensing and relaxing specific muscle groups with a goal of increasing awareness of the distinction between muscle tension and relaxation; PMR was introduced during the first session and practiced at each subsequent session. Patients were given cassette tapes to use during daily home practice.

(5) Breathing techniques: A review of the anatomy of the respiratory system, highlighting the location and function of the diaphragm, was followed by instruction in diaphragmatic and pursed-lip breathing techniques. To reinforce the therapist’s instruction, the videotape, “Learning to Breathe Better.” (Encyclopedia Britannica, Training Edge, Palatine, Ill) also was utilized. A practice session followed, and patients were asked to practice daily during rest and exercise.

(6) Pacing and energy-saving techniques: Methods for energy conservation and work simplification were presented with emphasis on planning, prioritizing, and pacing. Participants were instructed to coordinate breathing with activities. For example, patients were instructed to exhale during the strenuous part of an activity and were reminded not to hold their breath when exerting.

(7) Self-talk and panic control: Discussion of the role of thoughts ie, self-talk, in managing panic associated with dyspnea. For example, when short of breath, thoughts such as, “I can’t breathe. I’m going to die,” exacerbate panic, while thoughts such as, “I can handle this, I just need to sit quietly and use breathing techniques,” reduce panic and help to manage dyspnea.

(8) Stress management: Discussion of the role of stress and emotional factors in shortness of breath. Patients were encouraged to identify external and internal causes of stress and physiological and behavioral responses. A number of coping strategies were discussed: controlling the situation, opening up to others, pacing oneself, regular exercise, and relaxation.

**Control Group:** The control group consisted of 6 weekly general health education lectures on topics not directly related to lung disease. Lectures were presented by professionals specializing in each subject without specific directions for behavior change or dyspnea management. The series included exercise, general medications, durable power of attorney, nutrition, Alzheimer’s disease, and medical insurance.

Although group support was not planned formally in the study design, it occurred spontaneously in both the treatment and the control groups. In the control group, the subjects talked together before and after each lecture, and a supportive environment developed during the 6 weeks. In the treatment group, the researchers facilitated the discussion periods which often became support sessions, since strategies taught the prior week were reviewed.

**Outcome Measures**

A 2-h assessment was obtained at baseline, after the 6-week intervention, and 6 months later; it included measures of dyspnea, exercise tolerance, health-related quality of well-being, anxiety, and depression. The reliability and validity of the dyspnea measures used in this study were evaluated in the assessment phase of the study and are described in detail elsewhere in another forthcoming study.

**Dyspnea Measures**

There is considerable disagreement about the appropriate methodology for measuring dyspnea. In order to ensure that this construct was adequately captured, we applied six different measures of shortness of breath and four more general health outcome measures. Brief descriptions of these measures follow.

**Baseline and Transition Dyspnea Indexes:** Mahler and colleagues developed a two-part (baseline and transition), interviewer-administered dyspnea index used to rate dyspnea according to three categories: functional impairment attributed to dyspnea, magnitude of task that produces dyspnea, and magnitude of...

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**FIGURE 1. Dyspnea model.**

1) Education about COPD & Dyspnea
2) Relaxation
3) Breathing Techniques
4) Pacing & Energy Saving
5) Self-Talk & Panic Control
6) Stress Management

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**TREATMENT STRATEGIES**

1) Education about COPD & Dyspnea
2) Relaxation
3) Breathing Techniques
4) Pacing & Energy Saving
5) Self-Talk & Panic Control
6) Stress Management
of effort exerted to produce dyspnea. The baseline dyspnea index (BDI) is used to rate the severity of dyspnea at a single point in time; the transition dyspnea index (TDI) is used to assess changes from that baseline.6

American Thoracic Society Dyspnea Scale: The American Thoracic Society (ATS) dyspnea scale is a self-reporting respiratory questionnaire consisting of five yes-no questions which ask whether the respondent becomes breathless during various levels of exertion. Based on the responses to these questions, the subject's dyspnea is rated in terms of one of five grades of severity.7

Oxygen Cost Diagram: The oxygen cost diagram (OCD) is a 10-cm line along which activities are written at intervals which correspond to the metabolic equivalents (or oxygen cost) required to perform them. Patients are asked to make a mark on the line indicating the point above which their breathlessness would not allow them to go.8

University of California, San Diego, Shortness of Breath Questionnaire: The shortness of breath questionnaire (SOBQ) was developed and has been used extensively in the Pulmonary Rehabilitation Program at the University of California, San Diego.9 A modified version of the SOBQ was used in the current study. The modification clarified and expanded the dyspnea rating scale of the original instrument. The modified questionnaire asks patients to indicate how frequently they experience shortness of breath on a 7-point scale (0 = never, 1 = sometimes, 2 = half of the time, 3 = most of the time, 4 = all of the time, 5 = activity given up due to dyspnea, NA = activity not performed, unrelated to dyspnea) during 21 different activities of daily living associated with varying levels of exertion. Three additional questions about limitations due to shortness of breath, fear of harm from overexertion, and fear of shortness of breath are included for a total of 24 items.

Visual Analog Scale: The visual analog scale (VAS) is presented to the subject as a 10-cm vertical or horizontal line, sometimes accompanied by anchors, such as “not at all breathless” and “very breathless.”10 Subjects are instructed to place a mark on the line indicating their level of breathlessness.

Borg Scale of Perceived Dyspnea: The modified Borg scale is a 0 to 10 rating scale (0 = none, 10 = severe) on which subjects are asked to rate their level of breathlessness.11 Written descriptors are placed so that a doubling of the numerical rating corresponds to a twofold increase in sensation intensity. The original Borg scale of perceived exertion ranged from 6 to 20, also with written descriptors, and was revised to give this essentially categorical scale the properties of a ratio scale.12 The VAS and Borg scale were administered in two ways: (1) to obtain historical reports of patients' VAS and Borg average level of dyspnea during the past week, (VAS-Hx and Borg-Hx, respectively) and (2) to obtain VAS and Borg dyspnea ratings following a 6-min walk test (VAS-6MW and Borg-6MW, respectively).

General Measures

In addition to the dyspnea measures, four general measures were included because dyspnea has been reported to correlate with exercise endurance, general functioning, anxiety and depression. It was hypothesized that reductions in dyspnea would result in improvements in these domains.

Exercise Tolerance

The 6-min walk (6MW) test is a standard measure of exercise tolerance used with lung and cardiac disease populations.13 The test was conducted in an area free from distractions with standardized encouragement provided by the experimenter. Subjects were asked to cover as much ground as possible in 6 min. The walk test has been shown to be reliable,14 with moderate correlations with tests of pulmonary function and exercise capacity.8 We performed two walks to compensate for possible learning effect for repeat testing. Because of time constraints in the study protocol, the two walks were separated by 10 min of rest. Data from the longer of the two walks was used. Subjects rated their dyspnea using the Borg scale and VAS at the end of each walk.

Health-Related Quality of Well-Being

The quality of well-being (QWB) scale is a comprehensive measure of health-related quality of life that has been used extensively in a variety of medical and health services research studies.5,16 It includes components of mobility, physical activity, social activity, and symptomatic complaints. The observed level of function and the subjective symptomatic complaint are weighted by general population preferences. Using this system, it is possible to place the general health status of any individual on the continuum between death (0) and optimal functioning (1) for any point in time.

Anxiety

The Spielberger state-trait anxiety inventory (STAI) was a self-reporting measure of both state and trait anxiety that is used widely in research. The STAI contains 40 statements to which subjects respond using a 4-point rating scale indicating the extent to which the statements describe the way they feel (1 = not at all to 4 = very much so).

Depression

The Center for Epidemiologic Studies' Depression (CESD) scale is a general measure of depression that has been used extensively in epidemiologic studies. The scale includes 20 items and taps dimensions of depressed mood, hopelessness, appetite loss, sleep disturbance, and energy level. Scores on the CESD range from 0 to 60, with scores greater than 15 generally considered indicative of clinically significant levels of depressive symptoms in adults. The CESD discriminates between clinical and normal populations, and the reliability and validity have been replicated across various normal and clinical samples.

Results

Of the 98 subjects randomly assigned to treatment (n = 47) and control (n = 51) groups, nine dropped out before treatment, one from the treatment and eight from the control group. Reasons for dropping included illness (treatment = 1, control = 1), time conflict (control = 4), and lack of interest (control = 3). To evaluate the possibility of differential loss, we compared the pretreatment drops to the remaining 89 subjects at baseline on the 12 outcome measures using t tests. A significant difference between the two groups was seen only on one of the 12 variables. The pretreatment drops had slightly higher dyspnea reports on the VAS 6MW (mean for pretreatment drops = 7.0, mean for subjects in treatment = 5.8, p<0.05). The nine pretreatment drops were not followed up subsequently. Table 1 lists the characteristics of the 89 subjects who entered the clinical trial.

An additional nine subjects dropped out during treatment, five from the treatment and four from the control group. We compared these subjects to the 80 subjects completing the study on the same 12 outcome measures at baseline using t tests. The nine treatment drops were different from those complet-
ing the study on only one variable, health-related QWB. Subjects who dropped out of the study during treatment had slightly lower QWB scores (mean for treatment drops = 0.61, mean for subjects completing study = 0.64, p<0.05). We attempted to follow up these subjects at the posttreatment and 6-month follow-up periods and included them as part of the study database resulting in 46 subjects in the treatment group and 43 subjects in the control group. However, only one subject returned to complete the 6-month follow-up examination.

The t tests comparing the treatment and control groups on 12 outcome measures at baseline revealed no significant differences between the two groups (Table 2).

The primary analyses in this study evaluated whether a treatment focused on dyspnea management strategies alone produced significant improvement on the 12 outcome measures. A 2X3 analysis of variance of condition (treatment, control) versus time (baseline, posttreatment, 6-month follow-up) with repeated measures on the second factor was conducted on each outcome variable. Statistical analyses were performed by BMDP Program 4V, dropping cases with missing values. Where appropriate, Greenhouse-Geisser adjusted degrees of freedom were used to correct for departures from sphericity assumptions of the variance-covariance matrix.

The outcome measures evaluated include eight dyspnea measures, exercise tolerance, quality of life, anxiety, depression, and two pulmonary function parameters (FEV₁ and forced vital capacity). As shown in Table 2, there were no significant differences between the treatment and control groups on any dependent variable, ie, there were no significant group by time interactions or main effects of the group. There was a significant time main effect for one dependent variable, the SOBQ. Subjects in both groups showed a reduction in SOBQ dyspnea ratings over time. At the 6-month follow-up, the treatment group showed significant improvement on the TDI as compared with the control group. Differences between groups across time on the BD and TDI were evaluated by independent t tests rather than repeated measures analysis of variance because changes from the baseline BDI are evaluated using a different instrument, the TDI.

**DISCUSSION**

The purpose of this study was to evaluate the effectiveness of a treatment program utilizing specific coping strategies for dyspnea management in patients with COPD. After the 6-week intervention, there were no significant group differences in dyspnea, exercise tolerance, health-related quality of well-being, anxiety, or depression. A significant improvement in dyspnea across both groups was seen only in the SOBQ. At the 6-month follow-up, there was a significant improvement in TDI in the treatment group in comparison with the control group. Given the number of statistical tests, we attribute these few differences to chance.

There are a number of possible explanations for why a treatment effect was not seen following the dyspnea management treatment program. First, it has been suggested by Carriero and Janson-Bjerklie that patients living with a chronic illness develop many coping strategies and skills on their own. Second, in comparing the content of this treatment program to the components typically included in most comprehensive pulmonary rehabilitation programs, there are some notable differences. The intervention evaluated in this study emphasized education and individualized symptom (dyspnea) management strategies alone. Comprehensive pulmonary rehabilitation programs, in addition, include other key elements, such as exercise training, psychosocial support, and instruction in respiratory and chest physiotherapy techniques. We taught diaphragmatic and pursed-lip breathing but not bronchial drainage, controlled coughing, or use of respiratory medications. Comprehensive pulmonary rehabilitation has been shown to be beneficial as a preventive health measure and an effective adjunct to standard medical therapy by reducing symptoms and increasing exercise tolerance and endurance. These programs typically include all of the components of education, individual instruction, group support, and exercise training. Without the advantage of specific exercise training, patients in this study were less likely to improve not only their dyspnea ratings, but
Table 2—Repeated Measures Analysis of Variance on Outcome Measures*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline</th>
<th>Posttreatment</th>
<th>6-Month Follow-up</th>
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<td>43</td>
<td>37</td>
<td>38</td>
<td>9.0</td>
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<td>BDI</td>
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<td>4.5 ± 2.3</td>
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<td>TDI</td>
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<td>0.8 ± 1.4</td>
<td>1.0 ± 2.2†</td>
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<td>...</td>
<td>0.6 ± 1.8</td>
<td>-0.2 ± 2.4</td>
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<td>6.4 ± 1.8</td>
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<tr>
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<tr>
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<td>Treatment</td>
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<td>411.8 ± 76.0</td>
<td>408.7 ± 84.6</td>
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<td>384.4 ± 130.3</td>
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<td>0.66 ± 0.07</td>
<td>0.65 ± 0.07</td>
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*All values are expressed as mean ± SD.
**G×T=Group×Time interaction
†Independent t test (treatment vs control) at 6-month follow-up; t=2.3; p<0.05.
‡Probability value less than 0.01.

also their exercise endurance as measured by the 6 MW test. Unfortunately, this study was not designed to evaluate the exercise hypothesis. Future studies that systematically manipulate the inclusion of exercise are needed.

The design of this study, and the relatively small number of subjects did not allow us to individualize treatment interventions. Program time was used to teach panic control to all experimental patients, whether or not they had documented panic problems. It is possible that individualized programs may be more effective, and we encourage future research to evaluate these questions.

One concern about the lack of a statistically significant treatment effect in this study might be insufficient power given the sample size. In the original power estimates, we reviewed previous studies on pulmonary rehabilitation and estimated that a moderate size treatment effect for changes in symptoms and function would be feasible. This study may not have had sufficient power to detect a smaller treatment effect. However, we do not believe that the
results, even if statistically significant, would suggest that symptom change of this small magnitude would be clinically meaningful. Also, there was little to suggest even such small treatment trends in our results. Most of the F values for the interaction terms were less than 1.0, which is the level expected by chance in random data.

The reasons for the significant improvement across the entire group on the SOBQ and the difference between groups on the TDI at the 6-month follow-up are unclear. With multiple comparisons, these significant results may have been due to chance. However, the difference in the TDI is of some interest. This measure is based on the patient’s subjective evaluation of his or her own improvement and is open to several biases. It is possible that these biases account for the change and may explain why patients often report improvements even though there is no other evidence of benefit.

In summary, the results of this evaluation suggest that a treatment program focused solely on dyspnea management strategies, without structured exercise training or other components typically included in a comprehensive pulmonary rehabilitation program, is not a powerful enough intervention to produce improvement in dyspnea, exercise tolerance, health-related QWB, anxiety, or depression in patients with COPD. Therefore, dyspnea management may be a necessary but not sufficient component of pulmonary rehabilitation programs.

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