A Simple Pulmonary Rehabilitation Program Improves Health Outcomes and Reduces Hospital Utilization in Patients With COPD*

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Study objectives: A prospective longitudinal study to investigate if a simple outpatient-based pulmonary rehabilitation program (PRP) can improve health outcome and hospital utilization in patients with COPD.

Patients: Patients with COPD and FEV$_1$ < 60% predicted.

Setting: Outpatient physiotherapy department at a district general hospital (Fairfield Hospital, Sydney, Australia).

Intervention: Completion of a simple PRP.

Results: Thirty-six patients with COPD completed the PRP. Improved exercise endurance (mean 6-min walking distance increased from 333 ± 76 to 423 ± 107 m [p < 0.001]), reduced dyspnea scale, and improved quality-of-life measurements were found. There was no improvement in lung functions (FEV$_1$ preprogram mean, 0.97 ± 0.43 L; postprogram mean, 0.96 ± 0.42 L). In the 12 months following completion of program, hospitalization and length of stay were reduced compared to prior to starting the program (preprogram, 7.4 days; postprogram, 3.3 days; p < 0.005).

Conclusions: A simple, low-cost, outpatient PRP was able to improve health outcome for patients with COPD. Hospital utilization and health cost were reduced as well.

(CHEST 2003; 124:94–97)

Key words: exercise capacity; hospital utilization; pulmonary rehabilitation program; quality of life

Abbreviations: CRDQ = chronic respiratory disease questionnaire; LOS = length of stay; PRP = pulmonary rehabilitation program; QOL = quality of life; 6MWD = 6-min walking distance

Pulmonary rehabilitation programs (PRPs) have been recommended as an integral part of management of patients with COPD. Randomized controlled trials have shown PRPs to reduce symptoms of dyspnea, and improve exercise capacity and overall quality of life (QOL) in patients with COPD. Summaries and recommendation of practice of PRPs have been published. In all these guidelines, the recommended PRPs are based on a multidisciplinary team approach. The team can include physicians, a dedicated physiotherapist, specialist respiratory nurse, occupational therapist, dietetic staff, social worker, and smoking-cessation counselor. Activities in a comprehensive program can include exercise training, education, nutritional advice, and psychosocial and behavioral intervention. Such comprehensive programs require a high level of resources and are costly. We introduced a simple PRP in our hospital (a district general hospital) and hypothesized that a simple low-cost program should be able to improve health outcome for patients with COPD. The program is primarily based on incremental exercise endurance training, incorporating upper- and lower-limb weight training and endurance activities. The team consists of a physiotherapist supervised by a respiratory physician. In addition, we investigated if patients required less hospital utilization in the year following completion of the PRP.

Materials and Methods

Patients were referred to the program by specialists, general physicians, or general practitioners. The program was conducted...
by a physiotherapist, and patients attended twice a week for 8 weeks of the PRP. Patients with COPD and FEV\textsubscript{1} < 60% predicted or limitation of exertion by dyspnea were enrolled into the program. Exclusion criteria were severe cardiovascular disease or other comorbidities that limited exercise. The program consisted of increasing exercise endurance training, as well as upper- and lower-limb exercise training. Endurance exercise training commenced with walking, progressing to bicycle ergometer according to the method of Alison et al;\textsuperscript{7} with subsequent addition of steps and jogging on a mini-trampoline as appropriate. Incremental progression was based on performance at each session. Upper- and lower-limb weight training exercises commenced at week 3 of the program. No other formal educational, dietary, pharmacy, or psychosocial support was provided, and no other allied health professional was involved. Treatment and management of patients were left to the discretion of referring physicians, and compliance to treatment was not monitored.

At initial attendance, baseline evaluation included spirometry, 6-min walking distance (6MWD), Borg dyspnea scale (after the 6-min walk), and QOL assessment with the chronic respiratory disease questionnaire (CRDQ).\textsuperscript{8} These measurements were repeated within 1 week of completion of the program.

During each session, a physiotherapist and assistant physiotherapist supervised a maximum of eight patients, and caregivers were encouraged to attend. Each session lasted 1.5 h, with equal rest time between exercises. Patients attended two sessions per week, and were encouraged to maintain regular walking and upper-limb exercises at least 1 day at home.

Hospital utilization of all patients for the year immediately before and after completion of the PRP was examined by reviewing hospital records. Only hospital admissions directly relating to exacerbation of COPD were included.

Data are presented as mean (SD) unless otherwise indicated, and statistical analysis was by paired t test, except length of stay (LOS) and hospital admissions, which were analyzed by Wilcoxon signed-rank test (Version 9; SPSS; Chicago, IL).

**RESULTS**

**Patient Demographics**

Consecutive patients with COPD who attended the first 18 months after commencement of the program were analyzed. During that time, 42 patients were enrolled. All patients had COPD, and one patient had coexisting asbestosis. Six patients dropped out, and data from the remaining 36 patients who completed the program were analyzed. Demographic characteristics are shown in Table 1.

**Lung Functions, QOL, and Exercise Capacity**

At the end of the program, there were no significant changes in lung functions. However, 6MWD increased significantly from 333 (SD, 76) to 423 m (SD, 106) [\(p < 0.001\)] after the program (Table 2, Fig 1). The mean increase in 6MWD was 90.5 m (SD, 63). There were also significant improvements in QOL assessment with respect to dyspnea scale (\(p < 0.001\)), fatigue score (\(p < 0.05\)), and mastery (\(p < 0.005\)) components of the CRDQ (Table 3).

**Hospital Utilization**

In the 12 months before completion of the PRP, 28 patients required hospital admissions for exacerbation of COPD (1.2 episodes of hospital admissions per patient per year) and mean LOS was 7.4 days. In the 12 months following completion of the PRP, hospital admission fell to 0.6 episodes per patient (\(p < 0.005\)) and mean LOS fell to 3.3 days (\(p < 0.01\)).

**DISCUSSION**

Multidisciplinary PRPs have been shown to benefit patients with COPD. Our results showed that a simple PRP was able to improve exercise capacity as well as health outcome and QOL in patients with COPD. Although our study was not a randomized control trial, the results were consistent with previous randomized controlled trials using more comprehensive multidisciplinary PRPs. In addition, episodes of hospitalization and LOS were reduced for 12 months after completion of program.

Improvement in exercise endurance in patients with COPD after a PRP is a consistent finding from a number of randomized controlled studies comparing PRP and standard medical management. Goldstein et al\textsuperscript{9} showed that an 8-week inpatient group followed up with 16-week supervised home program was able to improve exercise endurance compared to a control group treated with conventional care. In their group of 59 patients, the improvement in 6MWD was 37.9 m. Benstrup and colleagues\textsuperscript{10} studied the impact of an outpatient-based PRP on a group of 32 patients with COPD, and found a significantly increased 6MWD of 113 m, a magni-

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**Table 1—Demographics of the 31 Patients Who Completed the Program**

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, yr</td>
<td>69 ± 7.7</td>
</tr>
<tr>
<td>Male gender</td>
<td>22 (59)</td>
</tr>
<tr>
<td>FEV\textsubscript{1}, L</td>
<td>0.99 ± 0.43 (43% predicted)</td>
</tr>
<tr>
<td>FVC, L</td>
<td>1.84 ± 0.61 (97% predicted)</td>
</tr>
</tbody>
</table>

*Data are presented as mean ± SD or No. (%).

**Table 2—Effect of PRP on Lung Functions, 6MWD, and Borg Dyspnea Scale**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Before Program</th>
<th>After Program</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEV\textsubscript{1}, L</td>
<td>0.97 (0.43)</td>
<td>0.96 (0.43)</td>
<td>0.8</td>
</tr>
<tr>
<td>FVC, L</td>
<td>1.84 (0.61)</td>
<td>1.91 (0.68)</td>
<td>0.06</td>
</tr>
<tr>
<td>6MWD, m</td>
<td>333 (76)</td>
<td>423 (106)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Borg scale</td>
<td>5.38 (2.1)</td>
<td>5.16 (2.0)</td>
<td>0.5</td>
</tr>
</tbody>
</table>

*Data are presented as mean (SD).
tude that is similar to that of our study. Wedzicha and colleagues\textsuperscript{11} found that the group of patients stratified as moderate COPD had improvement of 6MWD from 191 to 279 m after pulmonary rehabilitation. Our study group of patients had an increased 6MWD from 333 to 423 m at the end of the program. An increase of 54 m in 6MWD was thought to be clinically relevant and to represent noticeable improvement by patients.\textsuperscript{12} The increase of 90 m in 6MWD in our patients clearly exceeds this threshold.

Our patients who completed the simple PRP also had improvement in overall QOL as assessed by the CRDQ. This finding is also consistent with a number of randomized controlled trials with a multidisciplinary PRP. CRDQ scores were significantly higher after both inpatient- or outpatient-based PRPs.

In our study, there were no changes in lung functions and oxygen saturation as measured by pulse oximetry. These findings are also not unexpected, again consistent with the randomized controlled studies.

Very few studies examined the impact of a PRP on hospital utilization and health-care cost. Griffiths and colleagues\textsuperscript{13} found that the number of hospital admissions was not reduced, but LOS was reduced after 12 months of completion of a multidisciplinary PRP. The magnitude of reduction of LOS was similar to our study. Quantification of health cost is difficult with different case-mixes and hospital practices between countries. Nevertheless, as hospital costs are high, reduced LOS no doubt leads to reduced health-care cost.

The American Thoracic Society has recently published its official statement on pulmonary rehabilitation, providing a summary of evidence to date on the benefits of pulmonary rehabilitation.\textsuperscript{4} The essential components were considered to include exercise training, education, psychosocial/behavioral intervention, and outcome assessment provided by a multidisciplinary team. The multidisciplinary team may include physicians, nurses, physiotherapists, respiratory therapists, psychologists, and social workers. The complexity and high resource requirements of a multidisciplinary PRP may deter the establishment of such programs at smaller hospitals. The program of Goldstein et al\textsuperscript{14} involved an 8-week inpatient and 16-week outpatient multidisciplinary program, which is too expensive for our health service. The estimated incremental cost of the PRP was $11,597 (Canadian) per patient.\textsuperscript{14} In the United Kingdom, the provisions for PRPs in hospitals were found to be poor.\textsuperscript{15} PRPs are not commonly available at smaller district general hospitals in the Sydney metropolitan area, and a commonly cited reason is the perception that a multidisciplinary program is required (unpublished survey data). The present study shows that a successful PRP can be set up with few resources and low costs. The program was conducted by a physiotherapist with supervision from a respiratory physician, utilizing existing facilities and equipment in the physiotherapy department of a small district general hospital. In addition, a simple program can be established with minimal set-up time. We have shown that a simple PRP such as ours was just as effective as comprehensive program and was able to improve outcome in patients with COPD. Programs such as ours could be easily adopted by general district hospitals, and should

![Image of Figure 1: Improvement in 6MWD before (Pre) and after (Post) completion of the PRP.](http://publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21996/ on 04/28/2017)

Table 3—Effect of the PRP on QOL Assessment With CRDQ\textsuperscript{*}

<table>
<thead>
<tr>
<th>QOL Variables</th>
<th>Before Program</th>
<th>After Program</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyspnea scale</td>
<td>3.30 (1.3)</td>
<td>4.36 (1.1)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Fatigue score</td>
<td>3.8 (1.3)</td>
<td>4.54 (1.1)</td>
<td>&lt; 0.005</td>
</tr>
<tr>
<td>Emotional index</td>
<td>4.44 (1.1)</td>
<td>5.05 (1.1)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Mastery</td>
<td>4.37 (1.4)</td>
<td>5.28 (1.2)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

\*Data are presented as mean (SD).
have beneficial outcomes for patients with COPD in the local communities of such hospitals. Such programs would be more easily accessed by patients with COPD with limited exercise capacity, who otherwise may be required (or even unable) to cope with the longer distances to larger hospitals with multidisciplinary programs. We believe that simple programs based on our approach should be able to improve accessibility to health programs by patients with COPD. Furthermore, provision of even a simple PRP can reduce hospital utilization, and therefore reduce health-care cost to the community.

In conclusion, we have shown that a simple, outpatient-based PRP was able to improve outcomes in patients with COPD. Clinically relevant improvements in exercise endurance and health outcomes in terms of QOL measurements were seen. We would like to advocate that simple PRPs can and should be set up. Low level of resources should not be a deterrent for setting up a PRP. In addition to improved health outcomes of patients with COPD, a simple PRP can reduce hospital utilization and therefore reduce health costs to the community.

REFERENCES