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SHORT COMMUNICATION

Walking distance is a predictor of exacerbations in patients with chronic obstructive pulmonary disease

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Summary
Background: Patients with chronic obstructive pulmonary disease (COPD) are responsible for a high utilisation of the health care resources, and the cost is expected to increase. Physiological measures of lung function often fail to describe the impact the symptoms have on exacerbations, days of hospitalisation, and on a patient's health.
Methods: Twenty-one patients (14 female) with COPD (65 years, 40–79 years) admitted to the Department of Respiratory Medicine in Uppsala, performed a pulmonary function test (FEV_1% predicted = 37) and health status measurement (St. Georges Respiratory Questionnaire, SGRQ) at discharge. Four to six weeks after discharge, when they were in a stable clinical condition, they performed an exercise test (Incremental Shuttle Walk Test, ISWT) to measure their exercise capacity.
Results: Nine of 21 patients (43%) were rehospitalised within 12 month. The mean distance walked in the ISWT was 174 m in patients who were hospitalised and 358 m in non-hospitalised patients ($P<0.001$). Oxygen saturation $\leqslant$88% after the ISWT was found in 73% of hospitalised patients in contrast to only 22% in non-hospitalised patients ($P<0.05$). Activity related health status (SGRQ-activity) was higher (worse) in hospitalised patients than in non-hospitalised patients (75 vs. 50) ($P<0.05$). The association between walking distance and the risk of rehospitalisation was significant after adjusting for oxygen saturation and health status (hazard risk ratio 0.8 (0.67–0.97) per 10 m).
This study has shown that walking distance is a good and reliable predictor of rehospitalisations in moderately and severely disabled patients with COPD.

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Introduction

Chronic obstructive pulmonary disease (COPD) is a systemic disease with airflow limitations, dyspnoea, peripheral muscle dysfunction, exercise intolerance, malnutrition, and exacerbations leading to hospitalisations.[1]

Exacerbations are associated with high health care costs,[2] impaired quality of life,[3] increased mortality,[4] and increased risk of readmission.[5] Risk factors for morbidity and mortality in COPD patients are under prescription of long term oxygen therapy (LTOT),[6] poor scores on quality of life questionnaires,[3,7–10] patients with LTOT,[9] long term steroid use,[8] exposure to passive smoking,[6] pulmonary hypertension,[11] poor pulmonary function,[5,6,9] and history of previous admissions.[5,6,9,10]

Though it has been shown that there is a significant relationship between functional exercise capacity (6-min walk distance) and survival in COPD patients[12] no data have so far been reported whether there is a relationship between exercise capacity and morbidity.

The objective was to assess the independent contribution of exercise capacity (walking distance) to rehospitalisation in COPD patients who had been admitted to hospital due to an exacerbation.

Methods

Study design

This was a prospective study of patients with COPD hospitalised with acute exacerbations of obstructive lung disease.[9,13,14] The study was approved by the ethical committee, Uppsala University. Informed consent was obtained from the patients.

Subjects

Consecutive patients that had been admitted with acute exacerbation of obstructive lung disease performed an exercise test 4–6 weeks after discharge.

Measurements

Spirometry, body mass index and smoking history: Predicted values for forced expiratory volume in 1 s (FEV_1) and forced vital capacity (FVC) (Master scope, Jaeger, Germany) were calculated based on the European Coal and Steel Union reference values.[15] Body mass index (BMI) was calculated as weight (kg)/length $(m)^2$. Information on smoking history was collected by interview.

Health status was assessed using the disease-specific St. George's Respiratory Questionnaire (SGRQ).[16]

*Exercise capacity w*as assessed using the Incremental Shuttle Walk Test (ISWT).[17] Before and after the test, heart rate (HR), oxygen saturation (SpO_2) (Pulse oximetry, Nonin 9500 Onxy, Nonin Medical Ino, Minneapolis), and Peak Expiratory Flow (PEF) (Mini-Wright, Clement Clarke International Ltd., UK) were measured.

Follow up: Enrolled patients were contacted by phone 1 year after discharge in order to obtain information regarding number of hospitalisations. These data were confirmed by checking hospital records.

Statistics

The χ^2 test and an unpaired *t*-test were used when comparing patients that had or had not performed the ISWT, and had been hospitalised during the study period.

The time until readmission was analysed by the Kaplan–Meier survival analysis and Cox regression. The Cox regression model included all variables that were significantly related to hospitalisation in the univariate analysis as well as sex and age. Linear regression was used to analyse the relationship between ISWT and health status. A *P*-value of <0.05 was considered statistically significant.

Results

ISWT and rehospitalisation

Of the 38 patients invited 21 (55%) accepted to participate in the ISWT. No significant differences were found between the participants and non-participants regarding age, gender distribution, smoking, BMI or health related quality of life. Nine of the 21 patients (43%) were rehospitalised within 12 months (Table 1). Patients that were rehospitalised during the follow-up had a significantly shorter walking distance, lower oxygen saturation (SpO_2) before the ISWT and were more likely to have a $SpO_2 \leqslant 88\%$ after the ISWT. Patients that had a rehospitalisation had a significantly lower activity related health status (higher activity score).

The median walking distance in the ISWT was 270 m. Only one hospitalisation was found among patients with a walking distance above the median while 8 of the 11 patients with a walking distance $\leqslant 270$ m were rehospitalised (Fig. 1). The association between walking distance and the risk of rehospitalisation remained statistically significant after adjusting for oxygen saturation and health status (hazard risk ratio 0.80 (0.67–0.97) per 10 m).

ISWT and health related quality of life

Walking distance was the variable with the highest correlation to activity and impact score, while SpO_2 after the ISWT was the variable that was most closely correlated to symptoms and the total SGRQ score (Table 2).

The correlation between walking distance and FEV_1 was non-significant ($r = 0.40$, $P = 0.06$). FEV_1 correlated significantly to the activity score ($r = -0.41$, $P = 0.049$) but not to any of the other health related quality of life scores.

Discussion

This study has shown that exercise capacity, measured as Incremental Shuttle Walk Distance (ISWD), is an independent predictor of rehospitalisation in patients with a moderate and severe disease. Walking distance remained significant after adjusting for the other variables that were associated with the risk of rehospitalisation, i.e. resting oxygen saturation, exercise desaturation $<88\%$, and SGRQ activity