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Original Research

DIFFUSE LUNG DISEASE

Physical Activity in Daily Life of Patients With Fibrotic Idiopathic Interstitial Pneumonia

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Background: **The 6-min walk test (6MWT) is commonly used to assess exercise capacity in patients with fibrotic idiopathic interstitial pneumonia (f-IIP). However, it is not known whether patients with f-IIP have reduced levels of physical activity in daily life (DLPA) or whether pulmonary function tests and the 6MWT correlate with their DLPA.**

Methods: **The aim of this study was to measure DLPA in patients with f-IIP and to determine the relationships between DLPA and the 6MWT, pulmonary functional parameters, and anxiety and depression scores. Fifty patients with f-IIP and 25 sex- and age-matched healthy control subjects were enrolled. Markers of DLPA were assessed with a physical activity monitor for 4 consecutive days. Hospital Anxiety and Depression Scale (HADS) scores were evaluated.**

Results: **DLPA parameters were significantly reduced in patients with f-IIP compared with control subjects (all $P < .001$). The mean number of steps per day correlated strongly with diffusing capacity of the lung for carbon monoxide (DLCO), FVC, the 6MWT distance, and the 6MWT lowest oxygen saturation as measured by pulse oximetry (Spo_2). DLPA was unrelated to HADS scores. Multivariate analysis showed that DLCO and 6MWT distance explained only 31% of the variance in the number of steps per day. DLCO, 6MWT distance, 6MWT lowest Spo_2, and DLPA were significant predictors of mortality, but only DLCO and 6MWT distance were independent predictors.**

Conclusions: **Quantitation of DLPA is a novel patient-centered approach to assess function in f-IIP and may be a useful tool for clinical care and assessing response to therapy.**

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Abbreviations: 6MWT = 6-min walk test; DLCO = diffusing capacity of the lung for carbon monoxide; DLPA = physical activity in daily life; f-IIP = fibrotic idiopathic interstitial pneumonia; HADS = Hospital Anxiety and Depression Scale; Hb = hemoglobin; ILD = interstitial lung disease; MET = metabolic equivalent; PFT = pulmonary function test; Spo_2 = oxygen saturation as measured by pulse oximetry

According to the international consensus statement of 2011, idiopathic pulmonary fibrosis and nonspecific interstitial pneumonia can be classified as fibrotic idiopathic interstitial pneumonias (f-IIPs) of unknown cause and poor prognosis.[1] Although the pathologic abnormalities of the diseases are quite different,[2,3] patients display persistent and significant dyspnea, exercise intolerance, and poor health-related quality of life.[4] Physical activity is an important clinical parameter related to morbidity and mortality in many chronic diseases.[5,6] Patients with COPD show reduced physical activity, but this is not completely reflected by the clinical characteristics commonly used to determine disease severity.[7,8]

The 6-min walk test (6MWT) is commonly used to assess exercise capacity in patients with f-IIP. However, it is not known whether patients with f-IIP have reduced levels of physical activity in daily life (DLPA)

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or whether the 6MWT and pulmonary function tests (PFTs) are representative of their DLPA. Indeed, the relationships between DLPA and clinical characteristics reflecting the disease severity, such as the magnitude of lung restriction, the impairment of diffusing capacity of the lung for carbon monoxide (DLCO), and the 6MWT distance, have never been evaluated in patients with f-IIP, to our knowledge. To address this, we measured DLPA in patients with f-IIP and in healthy, age- and sex-matched control subjects and determined the relationships between DLPA and the 6MWT, pulmonary functional parameters, and anxiety and depression scores.

Materials and Methods

Fifty white patients (male to female ratio, 29:21; mean age, 64.3 ± 10 years) with a diagnosis of f-IIP were consecutively referred at the time of diagnosis or before inclusion in a home-based pulmonary rehabilitation program.[9] Inclusion criteria consisted of a diagnosis of idiopathic pulmonary fibrosis according to the international consensus guidelines[1] or a diagnosis of nonspecific interstitial pneumonia (radiographic or histopathologic diagnosis). Exclusion criteria were other pulmonary diseases (including obstructive disease), left-sided heart failure, a history of pulmonary embolism, or the presence of pathologic conditions that could impair DLPA (eg, rheumatism and cerebrovascular diseases). Connective tissue diseases were ruled out. No acute exacerbation was observed in the 3 months preceding inclusion. At the time of inclusion in the study, the majority of patients (66%) were taking no medications, 12 patients were taking corticosteroids, nine patients were taking azathioprine, and three patients were taking mycophenolate mofetil. Only 12 patients used supplemental oxygen during exercise, with a mean duration of 1.2 h per day. Clinical data and the results of PFTs and the 6MWT were collected. Patients were followed up until the end of the study to record mortality. Therefore, the duration of follow-up ranged from 6 to 36 months.

The control group included 25 healthy age- and sex-matched subjects (male to female ratio, 14:11; mean age, 59.3 ± 6.9 years; BMI, 24.3 ± 2.3 kg/m^2) who were relatives of employees or students at the hospital. All control subjects had normal spirometry results.

None of the patients or control subjects were engaged in exercise training programs prior to the study. All individuals gave informed consent. Approval for the use of these data were provided by the Institutional Review Board of the French Learned Society for Pulmonology (CEPRO 2011-039).

Pulmonary Function Tests

FVC, FEV_1, and total lung capacity were measured by spirometry and plethysmography with a Jaeger-Masterlab cabin. Single-breath DLCO (mL CO/min/mm Hg) was measured and corrected for hemoglobin (Hb) concentration (g/dL) according to Cotes' equation: corrected (Hb) DLCO = DLCO × (10.2 + Hb)/(1.7 × Hb). Values were expressed as percentages of the predicted normal values calculated according to sex, weight, and age.[10-12] The 6MWT was performed in accordance with international recommendations and was designed to ensure an accurate assessment of oxygen desaturation.[13]

Assessment of DLPA

Subjects were equipped with a physical activity monitor (SenseWear Pro armband and SenseWear software version 6.1; BodyMedia Inc) and instructed to wear the device continuously, except while showering or bathing, for 4 consecutive days. Two of the 4 days were required to be weekends. The device was positioned on the upper right arm at the midpoint between the acromion and the olecranon. The monitor contains a biaxial accelerometer (longitudinal and transverse) and multiple sensors (galvanic skin response, heat flux, skin temperature, and near-body ambient temperature). This device provides objective, accurate, individualized, and detailed descriptions of activity patterns, including time and intensity of physical activities, and has been validated in diverse populations, including patients with chronic diseases.[14-19] DLPA was assessed by measuring four parameters: the number of steps per day, the time (min) spent in activities above an estimated energy expenditure of 2.5 metabolic equivalents (METs), the total energy expenditure above 2.5 METs (kcal), and the daily energy expenditure (kcal).

Evaluation of Anxiety and Depression

The Hospital Anxiety and Depression Scale (HADS) was designed to identify and quantify the two most common forms of psychologic disorders in medical patients[20] and in patients with interstitial lung disease (ILD).[21] For both subscales, a score ≥ 8 (scale, 0-21) is indicative of clinically relevant symptoms.

Statistical Analysis

Statistical analysis was performed using the SAS statistical software, version 9.3 (SAS Institute Inc) and GraphPad Prism 5 (GraphPad Software, Inc). Normal distribution was checked with the Shapiro-Wilk test. Quantitative variables are expressed as mean ± SD. Qualitative variables are presented as frequency and percentage. Comparisons of quantitative variables according to the

Table 1—*Characteristics of the 50 Patients With f-IIP*

Characteristic	All Patients	IPF	NSIP
No.	50	29	21
Sex, male (female)	29 (21)	23 (6)	6 (15)
Age, y	63.6 ± 10	64.6 ± 10	62.2 ± 10
BMI, kg/m^2	26.3 ± 4.8	26.6 ± 4.4	26 ± 5.4
Surgical lung biopsy, No.	31	16	15
Treatment, No.			
Clinical trial	18	18	0
Steroids	12	3	9
Immunosuppressive drugs	12	1	11
Supplemental oxygen	12	7	5
FEV_1, %	69 ± 19	71 ± 19	67 ± 18
FVC, %	71 ± 21	71 ± 21	71 ± 21
DLCO, %	37 ± 13	33 ± 13	43 ± 11
6MWT distance	347 ± 109	328 ± 127	371 ± 74
6MWT lowest Spo_2, %	83 ± 7	82 ± 8	84 ± 7
6MWT ΔSpo_2, %	12 ± 7	12 ± 7	11 ± 7
HADS scores	14.6 ± 7.3	15.5 ± 7.9	13.4 ± 6.4
Anxiety	8.2 ± 4.3	8.5 ± 4.6	7.7 ± 3.8
Depression	6.4 ± 4.1	6.9 ± 4.4	5.7 ± 3.5

Values are mean ± SD unless otherwise noted. 6MWT = 6-min walk test; DLCO = diffusing capacity of the lung for carbon monoxide; f-IIP = fibrotic idiopathic interstitial pneumonia; HADS = Hospital Anxiety and Depression Scale; IPF = idiopathic pulmonary fibrosis; NSIP = nonspecific interstitial pneumonia; Spo_2 = oxygen saturation as measured by pulse oximetry.