

## Spiropalm 6MWT

### Ventilatory Six Minute Walk test (V6MWT)

#### Assessment of parameters of lung ventilation during 6-minute walk test in patients with COPD

*Elrina Ponomareva, Vladimir Abrosimov, Natalia Peregodova - Eur Res Journal, 2015 Vol 46 Issue suppl 59.*

**BACKGROUND:** Patients with COPD have reduced exercise tolerance. Low tolerance to physical exercise in patients with COPD is multifactorial and is due to several reasons, rather important of which is reduction of lung ventilation ability. Registration of indices of ventilation during the test widens diagnostic possibilities of 6-minute walk test (6 MWT).

**METHODOLOGY:** male patients with COPD (n=34) II-IV degree of severity, average age 57,5±7,1, FEV146,8±14,3% predicted and male patients without COPD, average age 60,8±4,6, FEV193,3±14,4% predicted are involved in the investigation. This investigation was held on the equipment Spiropalm 6 MWT (Cosmed, Italy), which allows to measure parameters of minute ventilation (VE) in the process of standardized 6 MWT.

**RESULTS:** distance, walked by patients with COPD was 362,3 ± 10,3 m and in control group 510,4 ± 15,6 (p<0,05). Indices of initial ventilation in groups weren't significantly different VE 8,9±3,6 l / min in group of patients with COPD and 7,6±4,5 l/min (p>0,05) in control group; according to peak ventilation significant differences 17,4±8,8 l/min and VE 29,5±13,7 l/min (p<0,05) are marked; according to indices of final ventilation significant differences VE 15,4±9,5 l/min and 26,5±12,9 l/min (p<0,05) are also marked.

**CONCLUSIONS:** studying the ventilation parameters during exercise tests in patients with COPD can be used for identification of reasons, limiting tolerance to physical exercise, what, finally, will allow to provide personified approach to programme of treatment of patients with COPD. Measuring of ventilation indices during 6 MWT widens assessment of functional status of the patient.

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#### Ventilatory analysis during 6MWT gives relevant information about exercise limitation in COPD

*Eva Bernardi, Benedetta Stiz, Sergio Angelini, Marco Contoli, Annalisa Cogo. Eva Bernardi, Benedetta Stiz, Sergio Angelini, Marco Contoli, Annalisa Cogo - Eur Res Journal, 2015 Vol 46 Issue suppl 59.*

**BACKGROUND:** It's well known that exercise performance of COPD is limited by ventilation (VE), in particular the inability of further increasing VE. The 6-minute walk test (6MWT) is the most established field exercise test. The VE analysis during 6MWT can be a useful tool to better understand the causes of exercise limitation in COPD.

**AIM:** to investigate the respiratory responses during 6MWT in untrained COPD.

**METHODOLOGY:** 37M, 12F (age 48-85 yr) performed spirometry and 6MWT equipped with Spiropalm®, an instrument which allow VE measurement breath by breath and a continuous monitoring of heart rate and SpO2. Breathing reserve (BR) is calculated by the instrument as the difference between maximal voluntary ventilation (FEV1x40) and max VE reached during the test.

**RESULTS:** Subjects were classified according to FEV1 as % of predicted. 6MWT data are reported in Table 1.

**Table 1**

	FEV1 ≥70% (n=11)	FEV1 <70%≥60% (n=10)	FEV1 <60%≥50% (n=14)	FEV1 <50%≥35% (n=12)	FEV1 <35% (n=2)
Distance (m)*	400±99	411±79	424±131	381±74	180±70
Borg dyspnea (/10)	6±2	6±1	5±2	6±2	9±1
Mean SpO2 %	93±3	93±2	92±3	91±2	92±2
Mean Ventilation (l/min)	27.4±8.8	32.1±5.4	29.4±8.2	28.0±5.2	20±5.4
BR (l)*	42.1±21.7	24.2±11.6	18.2±11.8	11.1±11	5.3±2

\*p<0.05, one-way ANOVA

We found a correlation between FEV1 and BR (r=0.86, p<0.001); BR and oxygen desaturation [basal SpO2 minus final SpO2 (r=-0.38, p=0.009)]; BR and dyspnea Borg score (r=-0.36, p=0.01). A correlation between distance and dyspnea was also found (r=-0.55, p<0.001).

**CONCLUSIONS:** BR is a mark of exercise limitation, therefore the analysis of VE during 6MWT can be a simple tool contributing to explain exercise limitation in COPD even in the absence of more sophisticated tests.

### **6MWT performance by means of Spiropalm in patients affected by fibrotic idiopathic interstitial pneumonias: Preliminary observations**

*Bocchino M, Cobuccio R, De Martino M, Rea G, Matarese A, Canora A, Vitale C, Stanziola A, Sanduzzi A. Eur Res Journal, 2014 vol. 44 no. Suppl 58.*

**BACKGROUND:** Despite there is no definitive reference to the role of the 6-minute walk test (6MWT), it is frequently used to assess overall cardiopulmonary fitness and predict outcome in patients with diffuse interstitial lung diseases.

**AIM:** Aim of the present study was to assess 6MWT performance with the Spiropalm device (that allows a combined evaluation of lung function parameters and pulse-oxymetry) in a group of patients affected by clinically stable idiopathic pulmonary fibrosis (n=15) and fibrotic non specific interstitial pneumonia (n=8).

**RESULTS:** Overall, there were 17 males with a mean age $\pm$ SD: 65 $\pm$ 9yrs. Twelve were ex-smokers. Significant O<sub>2</sub> desaturation was detectable in all cases (p<0.0001) with a mean distance walked of 404 m (78% of predicted) accounting for a 6MW work of 30685 kg\*m. Ventilation and tidal volume were significantly increased at the end of 6MWT (15.3 vs 45.6 L/min and 0.6 vs 1.1 L, respectively), while the respiratory reserve was decreased (77 vs 35 %, p<0.0001). The distance-saturation product (DSP), that is the product of distance walked and lowest O<sub>2</sub> saturation, was 322 $\pm$ 110 m%, while the desaturation-distance ratio (DDR), that is the ratio between the desaturation area (difference between maximal SpO<sub>2</sub> and patient's SpO<sub>2</sub> every 2 seconds) and distance walked, was 8.5 $\pm$ 5.5. DDR was inversely correlated with both FVC and DLCO (r=-0.5, p=0.04, and r=-0.66, p=0.004). A positive correlation was instead found with the composite physiologic index (r=0.66, p=0.006).

**CONCLUSIONS:** Spiropalm may be successfully applied to ameliorate 6MWT performance in fibrotic idiopathic interstitial pneumonias. Performance upon incremental oxygen supplementation should be investigated.

### **Is measuring ventilation during the six minutes walking test (6MWT) important?**

*Stroescu C, Croitoru A, Ionita D. Eur Res Journal, 2014 Vol 38 Issue Suppl 55.*

**BACKGROUND:** 6MWD and FEV<sub>1</sub> are used as a one-time measure of functional status, as predictors of morbidity and mortality, and for measuring the response to medical interventions. The additional value of ventilation (VE) monitoring during the 6MWT is unknown.

**AIM:** Evaluation of VE during the 6MWT and its correlation with the validated parameters (6MWD and FEV<sub>1</sub>).

**METHOD:** Patients (P) and healthy subjects (H) performed two standard 6MWT (S6MWT) and one 6MWT with VE monitoring (V6MWT), at minimum 1 hour intervals. The inspiratory capacity (IC) was measured before and after the V6MWT. VE profile and correlations between parameters were assessed.

**RESULTS:** 23P (15 COPD cases) and 5H performed the tests. The baseline VE did not correlate with FEV<sub>1</sub> and 6MWD nor with the baseline or end-of-test IC. Most subjects reached a VE plateau within the first 3 minutes of the test. The time to a stable VE did not correlate with the V6MWD or FEV<sub>1</sub>, but with baseline IC (r 0.428). The peak VE, as well as the difference between initial and final (delta) VE, did however significantly correlate with FEV<sub>1</sub> (r 0.696 and 0.686 respectively) and 6MWD (r 0.515 and 0.476 respectively). Strong correlations were found between FEV<sub>1</sub>, V6MWD and baseline and end-of-test IC (r > 0,7), but not with the delta IC. The correlation of ventilatory parameters (IC, peak VE, delta VE) with the 6MWD was proven to be FEV<sub>1</sub> dependent as, when controlled for FEV<sub>1</sub>, these correlations did not remain significant.

**CONCLUSIONS:** Some ventilatory parameters measured during the 6MWT did correlate with the 6MWD and FEV<sub>1</sub>. The importance of VE profile evaluation during the 6MWT needs further assessment.

### **Is there a difference between the results of the standard six minutes walking test (S6MWT) and the test with ventilation monitoring (V6MWT)?**

*Stroescu C, Croitoru A, Ionita D. Eur Res Journal, 2014 Vol 38 Issue Suppl 55.*

**BACKGROUND:** 6MWT is a validated test for the evaluation and monitoring of patients with cardiovascular and respiratory conditions. The standard test evaluates the initial and final heart rate (HR) and oxygen saturation (SaO<sub>2</sub>), and does not measure ventilation.

**AIM:** To assess (a) the similarities of the main parameters between S6MWT and V6MWT and (b) the mask-related discomfort during V6MWT.

**SUBJECTS AND METHOD:** 23 patients (P) with respiratory diseases (15 COPD cases) and 5 healthy subjects (H) performed two S6MWT and one V6MWT, at 1 hour intervals. 6MWT distance (6MWD), initial and final HR, SaO<sub>2</sub> and symptoms, and the mask-related discomfort were recorded.

**RESULTS:** The mean 6MWD was 9 meters longer in S6MWT than in V6MWT (range -65, +135 m). In 7P (30%) the 6MWD was significantly different (>50 m) between the tests, with 5 P (22%) walking less and 2P walking more at the V6MWT. The mean initial and final symptom scores were similar between the tests (difference <0.5 points). At the end of V6MWT, 8P (35%) had higher dyspnoea scores and 5P had higher scores for both dyspnea and fatigue. The mean desaturation was similar between the tests, but 7P (30%) desaturated more at V6MWT (difference >4%). The mean initial and final HR was similar, but 7P had higher initial HR and 9P higher final HR at V6MWT. Mask-related discomfort was minor in 20P and 4H (86% tests), moderate in 2P and 1H, and major in 1P.

CONCLUSIONS: The mean results of the measured parameters were similar in V6MWT and S6MWT, but the 6MWD was significantly different in 30% of patients. The mask needed for the V6MWT was generally well tolerated.

### The six-minute walking test accompanied by pulse oximetry and ventilation assessment in patients with pulmonary arterial hypertension

*Bystrov V, Martynyuk T, Arhipova O, Galitsin P, Chazova I. Eur Res Journal, 2013 Vol 42 Issue Suppl 57.*

AIM: to evaluate exercise capacity, oxygen desaturation and minute ventilation (VE) during six-minute walking test (6MWT) in pts with pulmonary arterial hypertension (PAH).

METHODS: 25 pts with PAH (aged  $41,3 \pm 13,5$  yrs) included in study. 18 pts had idiopathic PAH, 4 pts- PAH associated with systemic scleroderma, 3 pts- PAH associated with Eisenmenger syndrome. All pts had WHO functional class II-III, systolic pulmonary artery pressure  $71,2 \pm 21,4$  mmHg. 6MWT performed according to the requirements of American Thoracic Society (2002) with spirometer Spiropalm 6MWT (COSMED, Italy) with integrated pulse oximeter and ventilation measurement. Borg index was assessed in accordance with the 10-point scale. SpO<sub>2</sub> estimated at baseline and during 6MWT by continuous pulse oximeter using finger to determine exercise induced desaturation. VE was continuously measured using portable system Flowmeter. The measurement SpO<sub>2</sub>, VE, respiratory frequency (RF), heart rate during 6MWT, distance walked were recorded and calculated.

RESULTS: The mean distance 6MWT was  $460,12 \pm 102,0$  m with Borg index =  $2,8 \pm 1,0$ . Results of measurement during 6MWT demonstrated in table.

#### Results of measurement during 6MWT

	SpO <sub>2</sub> , %	HR, beatpm	VE, l/min	RF, bpm
Start	$93,17 \pm 8,3$	$78,0 \pm 12,1$	$10,4 \pm 3,9$	$21,38 \pm 10,3$
Peak	$85,76 \pm 11,2$	$121,0 \pm 18,9$	$36,6 \pm 9,6$	$31,39 \pm 4,4$
Final	$88,46 \pm 10,6$	$114,3 \pm 22,1$	$33,6 \pm 9,3$	$28,83 \pm 4,1$

CONCLUSIONS: Oxygen desaturation and VE assessment during the 6MWT may improve functional status evaluation in PAH pts. It is helpful to monitor changing degree of functional impairment, quantify perceive dyspnea, to study presence and extent of desaturation on tension.

### Analysis of ventilation profile during six minutes walking test: Preliminary study

*Piaggi G, Piran M, Rossi V, Cirio S, Ceriana P. Eur Res Journal, 2013 Vol 42 Issue Suppl 57.*

BACKGROUND: The evolution of the Respiratory Therapy has led us to cure the patients with comorbidities and/or chronically ill. Moreover, it has induced us to suspect that the six-minutes walking test (6-MWT) might be maximal for subgroup of patients.

AIM: Firstly, verify the percentage of patients of whom the 6-MWT has a maximal trend (6-MWT max) by analyzing their ventilation profile during the test. Secondly, identify the threshold characteristics and predictor parameters of patient' 6-MWT max.

METHODS: 97 COPD patients performed forced vital capacity (FVC), forced expiratory volume in 1 sec (FEV<sub>1</sub>), FEV<sub>1</sub>/FVC%, maximal voluntary ventilation, inspiratory capacity (CI), minute ventilation (VE) with portable spirometer Spiropalm®, before and immediately after 6-MWT. In the 6-MWT max we calculated the best thresholds using the resampling procedure called "bootstrapping", in order to discriminate whether the test was a maximal performance or not. The discrimination capability of each threshold was evaluated in terms of accuracy of classification.

RESULTS: About 70% of patients recruited achieved a 6-MWT max for symptoms, HR or VE max. About 57% of patients had a maximal performance exclusively from the ventilatory index. The most predictive parameters for a maximal test were: FEV<sub>1</sub>/FVC < 46% ( $p < 1 \times 10^{-5}$ ), FEV<sub>1</sub>% < 44% ( $p < 1 \times 10^{-5}$ ) e MVV < 46.5 ( $p < 1 \times 10^{-5}$ ).

CONCLUSIONS: Preliminary data suggest that FEV<sub>1</sub>/FVC%, FEV<sub>1</sub>% and MVV are predictor factors for a maximal performance. The 6MWT may underestimate the real potential of the patient. Instead, it would be more useful to assess, before starting the training, whether the 6-MWT was a maximal test or not.