115. Exercise tests and emerging outcomes: defining the impact of pulmonary rehabilitation

P1221
Effect of COPD severity on hemodynamic responses to exercise in patients with GOLD stages I-IV
Maroula Vasilopoulou1, Ioannis Vogiatzis1,2, Ioannis Nasis1,2, Stavroula Kontouri1,2, Eleni Kortziouti1,3, Maria Koskoulou1, Antonia Koutsooukou1, Manos Alhanitis1, Nikolaos G. Koulouris4,5, Physical Education and Sports Sciences, National and Kapodistrian University of Athens, Athens, Greece; 61St Department of Respiratory Medicine, University General Hospital of Heraklion, Heraklion, Greece; 7Department of Respiratory Medicine, Evangelismos General Hospital, Athens, Greece; 8Thessaloniki University, Thessaloniki, Greece; 9Respiratory Medicine, General Hospital “Thessaloniki,” Thessaloniki, Greece

Introduction: Exercise-induced dynamic hyperinflation and large intrathoracic pressure swings can compromise the normal increase in cardiac output (Q) during exercise in COPD. Therefore, it is anticipated that the greater the disease severity, the greater would be the impairment in Q during exercise.

Aim: Thus, the aim of the study was to investigate whether the Q response is more severely impaired in the more advanced stages of COPD.

Method: We studied sixty COPD patients (15 patients at each stage, I to IV).

Patients underwent a constant load test (75% WR peak) and a six minute walking test (6MWT). Q at rest and during exercise protocols measured by bioimpedance (PhysioFlow, Enduro) to determine the kinetic response at the onset of exercise (On-transient) and during recovery (Off-transient).

Results: While Q kinetics (On & Off) were not different between the two exercise protocols, on-transient and off-transient time constants were slower the more severe the disease severity was (Table 1).

Table 1. Q Kinetics (On & Off)

<table>
<thead>
<tr>
<th>GOLD Stages</th>
<th>On-transient Q (sec)</th>
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<tr>
<td>I</td>
<td>41.5±4.3*</td>
<td>45±2.1*</td>
</tr>
<tr>
<td>II</td>
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<td>IV</td>
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6MWT Constant | 6MWT Off-Constant
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Values are means ± SEM. *Significant difference among stages.

Conclusion: The more advanced the disease severity the more impaired was the hemodynamic response to 6MWT and the constant load test, possibly reflecting greater cardiovascular impairment in COPD or greater physical deconditioning.

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Conclusion: The more advanced the disease severity the more impaired was the hemodynamic response to 6MWT and the constant load test, possibly reflecting greater cardiovascular impairment in COPD or greater physical deconditioning.

P1223
Electrocardiographic and echocardiographic abnormalities in COPD patients according to disease severity
Laura Caram, Cristiane Naves, Silméia Zanati, Suzana Tanni, Liana Coelho, Renata Ferrari, Irmã Godoy, Department of Internal Medicine, Botucatu Medical School - São Paulo State University – UNESCO; Sao Paulo, Distrito de Rubiao Júnior, sp, Brazil.

Epidemiological studies show high prevalence of cardiovascular disease (CVD) in COPD patients; however, few studies have assessed the prevalence of cardiac abnormalities in different stages of COPD. The aim of this study was to assess the prevalence of electrocardiographic and echocardiographic changes in 50 mild/severe COPD patients (62% male gender, age= 67.9±9 years, FEV1= 56±23%). All individuals underwent to medical history and physical examination, electrocardiographic and Doppler echocardiography evaluations. Changes suggestive of ischemic heart disease occurred in 10% and mild left ventricular diastolic dysfunction in 88% independently of COPD stage. Mild/moderate COPD patients showed higher prevalence of anormalies in segmental contractility (p=0.01), while severe/severe COPD patients showed higher prevalence of right ventricular overload (p=0.01) and increased right heart chambers (p=0.001). Age, male gender, systemic arterial blood pressure, C-reactive protein and BODE index were included in a multiple linear or logistic regression analysis with the left ventricular diastolic diameter/the size left atrium as dependent variables. Male gender and the BODE index were selected as predictors of left ventricular diastolic diameter (R2=0.12; p=0.03 and p=0.01, respectively); systemic arterial blood pressure was the only variable selected as predictor of enlarged left atrium (OR=3.85 (1.04-12.7), p=0.04). In conclusion, patients with COPD have high prevalence of eccocardiographic subclinical cardiac abnormalities, regardless of disease severity. Gender and the COPD severity are associated to cardiac structural changes. Research supported by FAPESP (2010/10312-1)

P1224
Efectos de la rehabilitación pulmonar (PR) sobre el reflejo arterial en pacientes con COPD: El CIBROCO estudio
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Background: Arterial stiffness, a strong predictor of cardiovascular mortality, is increased in patients with COPD. The effects of PR on arterial stiffness have been studied scarcely.

Methods: Pulmonary function, 6MWD, BMI, SGRQ, mMRC dyspnea score, aortic pulse wave velocity (APWV) and pulse wave analysis (SphygmoCor; AtCor Medical, Sydney, Australia) were determined in 102 patients (35 female; age: 64.7±7 years, FEV1= 53±17) with clinically stable COPD, prior and subsequently to a 35-session PR program including high-intensity interval and resistance training.

Results: 6MWD (+31,3±5.5; p<0.001), mMRC score (-0,5±0,0; p<0.001), SGRQ (-2,4±11,8; p<0.001) and BMI (0±41,4 kg/m2; p=0.006) all improved, compared to baseline. Overall there were no changes in APWV, BPWV, central blood pressure and augmentation index (AI), while central and peripheral pulse pressure (PP) increased slightly. Peripheral PP increased by a modest but significant reduction in peripheral diastolic blood pressure (DP). All a significant, but clinically irrelevant reduction in heart rate (HR) was seen.

Baseline After PR P
APWV, mm Hg 8.9±2.9 8.8±2.5 0.835
BMI, kg/m2 29.8±7.2 28.8±5.9 0.001
Sp. mm Hg 137±3.9 137±2.11 0.868
Dp. mm Hg 82±3.9 80±8.8 0.034
Pp. mm Hg 54±0.16.1 57.4±15.3 0.017
Corrected Sp. mm Hg 127±2.19.6 128±9.18.0 0.270
Corrected Dp. mm Hg 82±3.9 80±8.8 0.176
Corrected Pp. mm Hg 45.2±14.5 47.8±14.7 0.026
Central AI (75 bpm) 20±8.8 29±2.8 0.457
HR, bpm 68±11.8 67±30.14 0.027

Conclusion: On average, pulmonary rehabilitation does not reduce arterial stiffness in patients with COPD.
Background: Endothelial dysfunction represents a key step in the increase in cardiovascular risk. We prospectively investigated the determinants of endothelial function in patients with chronic obstructive pulmonary disease (COPD).

Methods: Digital pulse amplitude augmentation assessed by post-ischemic reactive hyperemia (RH-PAT) was measured in 47 consecutive COPD patients (41 men, BMI: 25.5 ± 5.5 kg/m²; age: 65.9 ± 9 yrs, 35 patients in stable condition and 12 within exacerbation). RH-PAT was analyzed with the following clinical and biological covariates: body mass index (BMI), fat-free mass (FFM), pulmonary function tests, blood pressure, inflammatory and oxidative stress biomarkers, six-minute walking distance (6MWD) and peripheral muscle function, medications, diabetes, and prevalent cardiovascular diseases.

Results: After adjustment for age and sex, RH-PAT was linked to FFM, heart rate, prevalent chronic obstructive pulmonary disease (COPD), body mass index (BMI), age, sex, BMI: 25.5 ± 5.5 kg/m²; age: 65.9 ± 9 yrs, 35 patients in stable condition and 12 within exacerbation).

Conclusions: A higher FFM index was associated with higher RH-PAT explaining 54% of the variance ($\varphi = 0.0001$). A higher FFM index was associated with higher grade of inflammation, increased oxidative stress and more severe endothelial dysfunction. RH-PAT was significantly lower in patients within exacerbation as compared with those in stable condition.

COPD patients were asked to perform a certain amount of work (120% of measurement) and then rest for 3 minutes. After the rest period, they were asked to perform the same exercise at a lower intensity (80% of measurement) and then rest for 3 minutes. This process was repeated three times.

Aim: The purpose of this study was to evaluate the inhibitory effect of short-acting b2-receptor agonist (SABA) on exercise dynamic lung hyperinflation during the 6-minute walk test (6MWT) in stable COPD patients.

Subjects and methods: We examined 14 patients with stable COPD (mean age: 76yr; mean FEV1: 57%pred) who were referred to our clinic between July 2008 and October 2009. 6MWT and lung function test were performed after the inhalation of SABA (3% salbutamol hydrochloride, 10mg) or placebo.

Results: Compared to the baseline assessment, 6MWD increased by a mean of 20.5m when measured after inhalation of SABA (512.4 ± 90.7m vs. 532.9 ± 79.8m; $p < 0.05$). During the 6MWT, inspiratory capacity (IC) decreased significantly with time. The IC was higher after inhalation of SABA (1.52 ± 0.49 l/min vs. 1.31 ± 0.44 l/min; $p < 0.05$).

Conclusions: The present study suggests a significant attenuation in exercise dynamic lung hyperinflation, suggesting the important rescue role SABA in the management of COPD. It is therefore likely that most patients with COPD may derive considerable benefit from rescue bronchodilator therapy with SABA.

P1228 Inhibitory effect of SABA on exercise dynamic lung hyperinflation during 6-minute walk test in stable COPD patients

Masahiro Satake1, Takanobu Shira1, Hitomi Takahashi1, Hiroya Sugawara1, Chikage Kasa2, Nontaka Kiyokawa1, Toru Watanabe1, Sayaka Fujii1, Atsuyoshi Kawagoshi1, Mitsuhiro Homma1, Physical Therapy, Akita University Graduate School of Health Sciences, Akita, Japan; 2Rehabilitation, Higashi Inaniwa Clinic, Akita, Japan; 3Pulmonary Medicine, Akita City General Hospital, Akita, Japan; 4Rehabilitation, Hyagai Inamoru Clinic, Akita, Japan; 5Pulmonary Medicine, Akita City General Hospital, Akita, Japan

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P1229 Energy economy of walking with a wheeled ambulatory aid (radiator) in patients with chronic obstructive pulmonary disease (COPD)

Kylie Hill1, Thomas E. Dolmage2, Lynda Woon3, Dina Brooks4, Roger Goldstein1, School of Health and Exercise Sciences, Institute of Human Performance Research Institute, Curtin University of Technology, Bentley, Western Australia, Australia; 2Respiratory Diagnostic & Evaluation Services, West Park Healthcare Centre, Toronto, ON, Canada; 3Department of Respiratory Medicine, West Park Healthcare Centre, Toronto, ON, Canada; 4Department of Physical Therapy, University of Toronto, Toronto, ON, Canada; 5Department of Respiratory Medicine, West Park Healthcare Centre, Toronto, ON, Canada

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P1227 Reproducibility of a time trial cycle ergometer test in comparison to a constant work rate test protocol in patients with COPD

Wilm Gossens1,2, Joost Oomen1, Alex van’t Hall1, Matthys Hesseling1, Lars Bress, University of Applied Sciences, Institute of Human Performance Research Institute, Curtin University of Technology, Bentley, Western Australia, Australia; 2Respiratory Diagnostic & Evaluation Services, West Park Healthcare Centre, Toronto, ON, Canada; 3Department of Respiratory Medicine, West Park Healthcare Centre, Toronto, ON, Canada

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Conclusion: Rollator use does not acutely affect walking economy in patients with COPD. A better understanding of how people with COPD benefit from rollator use may facilitate their design and prescription.

P1230
Characterization of balance impairments in individuals with COPD
Marla Beauchamp1,2, Kathryn Sibley1,4, Bimal Lakhan1,4, Julia Romano2, Shunita Mathur2,6, Roger Goldstein2, Dina Brooks4,5. 1Graduate Department of Rehabilitation Medicine, University of Toronto, Toronto, Canada; 2Respiratory Medicine, West Park Healthcare Centre, Toronto, Canada; 4Physical Therapy, University of Toronto, Toronto, Canada; 5Mobility Team, Toronto Rehabilitation Institute, Toronto, Canada

Background: Balance deficits are increasingly recognized as an important secondary impairment in COPD, however little is known regarding the specific components of balance that are impaired.

Objectives: 1) To determine the specific components of postural control that are impaired in individuals with COPD compared to age-matched healthy controls; 2) To determine if deficits in balance in COPD are related to muscle strength or physical activity.

Methods: Balance, physical activity and lower extremity muscle strength were assessed in 37 patients with COPD and 20 healthy controls using the Balance Evaluation Systems Test (BESTest), the Physical Activity Scale for the Elderly (PASE), and an isokinetic dynamometer, respectively. A subset of subjects (20 COPD and 20 controls) underwent a second testing session in which postural perturbations were delivered using a lean-and-release system. Center of pressure data were collected from three force plates mounted in the platform.

Results: Subjects with COPD (age 71±7 yrs; FEV1 39±16 percent predicted) exhibited significantly lower scores than controls (age 67±9 yrs) on all of the BESTest subscales (p<0.001). The largest deficits in postural control were evident in biomechanics, transitions and gait. The PASE was a significant predictor of BESTest scores (p=0.034) in COPD. In response to anterior perturbations, subjects with COPD showed a longer time to foot-off (p=0.027) and foot-on (p=0.018) as well as a longer duration anticipatory phase (p=0.008) compared to controls.

Conclusions: Comprehensive balance assessment and management should be included in pulmonary rehabilitation. Deficits in balance in COPD appear to be related to decreased physical activity levels.

P1231
Comparison of maximal exercise capacity between patients with COPD from Brazil and United Kingdom
Rafael Silva,1,2 Andréa Nina,2,3 Carolin Sandland,1 Nilda Aparecida Hernandez1,2, Vanessa Suziane Probst1,2, Sally Singh,3 Fabio Pitta1.
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Background: Field exercise tests such as the incremental shuttle walking test (ISWT) have been used worldwide in order to assess exercise capacity of patients with chronic obstructive pulmonary disease (COPD). However, the responses to this test in patients from different world regions have not yet been compared.

Objectives: To compare the responses to the ISWT between patients with COPD from Brazil and United Kingdom (UK).

Methods: 20 patients with COPD from Brazil were matched to 20 patients from the UK concerning gender distribution, age, body mass index and FEV1. All patients performed the ISWT during the baseline assessment for admission to a pulmonary rehabilitation program in their respective country. The total distance walked was recorded and heart rate (HR), oxygen saturation (SpO2) and dyspnea scores ( Borg scale) were assessed before and after the test in both centers.

Results: In both groups, SpO2 decreased and HR and dyspnea scores increased significantly after the test (p<0.05 for all). Brazilian patients walked farther and achieved higher 173 vs 209±12 vs 64±16 percent predicted) exhibited significantly lower scores than controls (age 67±9 yrs) on all of the BESTest subscales (p<0.001). The largest deficits in postural control were evident in biomechanics, transitions and gait. The PASE was a significant predictor of BESTest scores (p=0.034) in COPD. In response to anterior perturbations, subjects with COPD showed a longer time to foot-off (p=0.027) and foot-on (p=0.018) as well as a longer duration anticipatory phase (p=0.008) compared to controls.

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P1233
Age of loss of walking ability in patients with Duchenne muscular dystrophy: A marker for the elective use of mechanical ventilation
Dicle Kaymaz1, Pinar Ergün 1, Gülseren Kayalar 2, Fatma Sengül1, Nese Demir 1.
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Introduction: In adolescence of Duchenne muscular dystrophy (DMD) comes the cardioventilatory restrictive impairment (hypventilation, sleep breathing disorder and order respiratory effort), marked by the loss of ambulation. At that time, the institution may be required ventilatory support. At that time, the loss of ambulation can be a sign of critical illness reducing need for tracheostomy and increasing quality of life in DMD. Public Program (Ventilator-VP) in John Paul II Child Hospital/Hospital Foundation of Minas Gerais State, Belo Horizonte, Minas Gerais, Brazil, 2Neuromuscular Disease Program, Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil

Conclusion: Age of loss of ambulation at age 10 is a marker for estimating the need of early VS in patients with DMD.

P1234
In which male patients with COPD participated in a pulmonary rehabilitation program should be evaluated for osteoporosis?
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Osteoporosis is common in patients with COPD and an important risk factor for the development of hip, vertebral or long bone fracture which could add further disability and incapacity. The aim of the study was to analyze the utility of different measures (age, smoking habit, body mass index and respiratory characteristics) for detecting the need of evaluation in male COPD patients who were participated in a PR programme.

Methods: Patients who were in a pulmonary rehabilitation programme with confirmed stable COPD and not on long-term oral corticosteroids (n=57) performed spirometry. They underwent nutritional assessment by midarm circumference,calculation BMI and FFMI. Dyspnea sensation was assessed with the MRC,where health related quality of life was assessed with the SGRQ.Exercise capacity was measured using the SWT.All had DXA assessment of Bone Mineral Density.

Results: 18 patients were unable to complete STS either pre- or post-PR. 6 were unable to perform STS pre-PR but improved sufficiently to do so after PR. STS at baseline correlated significantly with ISW (r=-0.53), MRC (r=0.35), modified MRC (r=0.26) and ADD (r=0.35), but not with age, FEV1,predicted, BMI or SGRQ. In 65 patients with full pre- and post-PR data, median STS time improved from 13.8s to 12.0s following PR (p<0.0001). Median improvement was -1.8s in patients feeling “much better” after PR and -2.4s in those achieving the MCID of the ISW. Conclusions: Not all COPD patients referred to PR can complete a STS. The STS is sensitive to change following PR. The MCID for the PR is probably a decrease of greater than 2 seconds.

226s
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**P1235**

The effectiveness of pulmonary rehabilitation in COPD outpatients with comorbidities

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**Aim:** Chronic obstructive pulmonary disease (COPD) is often associated with other chronic diseases. The aim of this study was to determine the frequency and prevalence of chronic comorbidities in patients with COPD and to assess their influence on the effects of pulmonary rehabilitation (PR).

**Method:** 183 patients were included multidisciplinary comprehensive PR program between July 2007 and September 2010 in our outpatient PR center. All patients were grouped according to the following comorbidity categories: 0 (absence of comorbidity), 1 and ≥2 (depending on the number of comorbidity). Incremental Shuttle Walking Test (ISWT) and Endurance Shuttle Walking Test (ESWT) was used to evaluate exercise capacity. Medical Research Council (MRC) for the perception of dyspnea, St. George’s Respiratory Questionnaire (SGRQ) for quality of life, Hospital Anxiety and Depression Scale (HADS) for psychological evaluation and BMI, fat-free mass (FFM), fat-free mass index (FFMI) analyzing for body composition.

**Results:** 131 patients reported at least one chronic comorbidity added to COPD. Metabolic (systemic hypertension, diabetes, dyslipidemia) and heart diseases (chronic heart failure, coronary heart disease) were the most frequently reported comorbid combinations (88 and 23, respectively). Statistically significant improvement was determined in ISWT and ESWT (p<0.01); statistically significant decrease was determined in MRC, SGRQ and HADS (p<0.001) for each comorbidity categories.

**Conclusion:** Chronic comorbidities are very frequent in patients with COPD undergoing PR. Comorbidities does not preclude access to effectiveness of rehabilitation.

**P1236**

Comorbidities in COPD patients are not associated to higher disease severity

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The influence of disease severity on the prevalence of comorbidities in COPD patients is unclear. The aim of this study was to assess the prevalence of comorbidities in 25 mild/moderate COPD patients (68% male gender, age: 65±8 years, FEV1= 73±15% and 25 severity/severity COPD patients (56% male gender, age: 69±9 years, FEV1= 40±18%). Comorbidities were registered based on medical charts diagnoses, on Charlson comorbidity index and on Hospital Anxiety and Depression Scale. Of the 50 patients evaluated, 70% had diagnosis of comorbidities, and 42% of these were cardiovascular diseases (40% hypertension, 10% coronary artery disease and 6% heart failure grade I). Depression was present in 20% of patients, dyslipidemia in 14% and diabetes mellitus in 14%. The prevalence of dyslipidemia (p=0.02), depression (p=0.008) and alcoholism (p=0.06) were higher in patients with mild to moderate disease. Charlson comorbidity index, systemic arterial blood pressure, diabetes mellitus, ischemic heart disease and chronic cardiac failure and the scores of the Hospital Anxiety and Depression Scale were similar between both groups. The majority of patients with diagnostic of dyslipidemia had concentrations of lipids (total cholesterol, HDL, LDL and triglycerides) within normal values and the lipid profile were similar between groups. In conclusion, comorbidities are highly prevalent in COPD patients regardless of the disease severity. Some diseases such as dyslipidemia, depression and alcoholism are even more prevalent in mild/moderate patients.

Research supported by FAPESP (2010/10312-1)

**Background:** HFCWO is commonly used for airway clearance. However the effect of mucus clearance on the rheological property, driving pressure and frequency during HFCWO is not clear. The purpose of this study is to clarify differences of airway clearance efficacy.

**Method:** 24 normal subjects participated in the study. 1. Mucus stimulants (MS) were prepared using thickener 1, 2, 3 and 4% and the pressure controls of SmartVest™ were driven 20, 40 and 60 on the frequency 13Hz. MS rheological studied were measured using Rheometer. They were quiet breathing into the endotracheal tubes having internal diameter of 7mm during SmartVest™. Measurement methods and items were carried out in a similar manner of Study 1.

**Results:** The higher setting pressure and frequency controls droved, the more PEFR and PEmax increased (p<0.05). In the rheology of MS, the lower viscoelasticity of 1% MS had the faster clearance velocity moved (p<0.05). However, the clearance velocity did not increase in the higher viscoelasticity of MS in spite of high driving pressure. The 13Hz oscillation was most reduced in viscoelasticity and yield value by comparison with 9Hz and 17Hz. The lower viscoelasticity of MS in the each frequency, the clearance velocity increased (p<0.05). The subjects were not tolerable on 17Hz.

**Conclusions:** The oscillation of 13Hz and driving pressure 40 is the most effective for mucus clearance.