78 - CARDIORESPIRATORY RESPONSE TO THE AEROBIC EXCERCICE WITH NON INVASIVE VENTILATION AT DPOC CARRIERS

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Chronic Obstructive Pulmonary Disease (COPD) is a preventable, treatable and whose components are characterized by progressive airflow limitation that is not fully reversible, due to an abnormal inflammatory response of the lung to particles or evil gases[1]. Smoking is the most common risk factor found for COPD, although in many countries, air pollution resulting from wood burning and other biomass fuels have also been identified as a risk factor. During the last years COPD has become a public health case with growing worldwide concern, since its outbreak is scheduled for the year 2020 where it is estimated that it will occupy the third place of death cause and the fifth at prevalence[1]. Some significant extra pulmonary effects of COPD may contribute to the severity of the disease with a consequent reduction of global physical activities ought to progressive worsening of lung function that is translated by dyspnea and perceived fatigue while performing any physical effort. The progressive physical deconditioning associated with inactivity initiates a vicious cycle where worsening of dyspnea is associated with less physical efforts, with severe life quality commital[2].

Aerobic exercise and muscle strength training for the members are recommended for individuals with COPD and should be initiated regardless of the disease stage, as this training increases the concentration of oxidative mitochondrial enzymes, trained muscles capillarization, anaerobic threshold, maximum oxygen consume and creatine-phosphate recovery time, resulting in an exercise ability improvement[1]. Thus, regular physical exercise causes a series of physiological, autonomic and hemodynamic adaptation at the body systems, particularly in the cardiovascular system, in order to maintain cellular homeostasis in face of metabolic demand increase[3].

As adjunctive therapy in cardiac rehabilitation, noninvasive ventilation (NIV) has been used in order to reduce the recruitment of inspiratory muscles, to reduce the elastic work and prevent the early dynamic collapse of the airways, thereby reducing the dynamic hyperinflation during effort 4,5 . Studies realized so far, have provided important scientific subsidy on the subject, however, to broaden this knowledge, this study aimed to evaluate the cardiorespiratory response of patients with COPD during aerobic activity on a vertical ergometer cycle using NIV compared to spontaneous breathing.

MATERIALS AND METHOD.

This survey of a cross-sectional, of the type study cases 6 evaluated for convenience 08 adults with COPD, of both sexes, participants of the Cardiopulmonary and Metabolic Rehabilitation at the University of Santa Cruz do Sul at the Santa Cruz Hospital, duly approved by Ethics and Research Committee of the University of Santa Cruz do Sul - CEP / UNISC, Brazil, report no. 2733/10.

Inclusion criteria were: patients with stable DPOC, clinically controlled with medication, without any neurological alteration and with a good cognitive, consent and signing the consent form informed and down with. Exclusion criteria were: patients who have not adapted to the use of NIV to be suffering from claustrophobia, or uncontrolled cardiac or/ in an exacerbation pulmonary disease.

The participants were underwent to measurements of the following variables: blood pressure (BP), heart rate (HR), respiratory rate (RR), peripheral oxygen saturation (SpO2), Borg scale of dyspnea and original perceived effort, with the conditions: rest, during aerobic activity on a ergometer cycle (at 01, 05, 15 and 30 minutes) and after cessation of exercise until recovery to the baseline (minute by minute). The protocol of aerobic activity on a vertical cycle ergometer of the low members was performed for 30 minutes, as directed by GOLD - Global Obstructive Lung and Disease[1] and according to Furtado e cols7, using the FC training in agreement with Karvonen et al.8. All patients received the protocol, applied by the same appraiser in non-consecutive days in 03 different data collections: aerobic activity with the patient using non-invasive ventilation with continuous positive airway pressure (CPAP); aerobic activity using non-invasively ventilation with two levels of positive airway pressure (BiPAP), aerobic activity in spontaneous breathing. For the application of NIV we used BiPAP ® (Respironics BiPap STD/30) and CPAP (C-Series Tango, ResMed) through a face mask setting the following pressure levels: BiPAP (IPAP = 12 cmH2O, EPAP = 8 cmH2O) and CPAP (PEEP = 8 cmH2O) 4,5.

The BP was measured by auscultation method, using a stethoscope and a sphygmomanometer aneroid (Missouri ®), both properly adjusted and calibrated. The respiratory rate was measured by counting the number of breaths in one minute; the SpO2 and HR were measured using a portable pulse oximeter (Nonin ®). The data was entered in the database of the Research Group "Health and Rehabilitation in their Interfaces," in specific program for statistical analysis Statistical Package for Social Sciences - SPSS version 18.0. Continuous variables were described through average ± standard deviations or medians (minimum and maximum). Analysis of variance was used for repeated measures in order to compare changes in cardiorespiratory variables throughout the aerobic activity, with and without the use of NIV. To determine possible correlations between the variables we used Pearson correlation test. In all comparisons were considered significant $p \leqslant 0.05$.

RESULTS

All patients included in this study had obstructive lung disease, whose clinical characteristics and history are described in Table 1. As the genre a feature that infers on cardiorespiratory variables, our results are presented stratified by sex.

Table 1. Clinical Characteristics and Smoking History of the Subjects.

Characteristics	Women (n=4)	Men (n=4)
Age (years)	65±3.36	72.25±7.50
BMI (kg/m²)	24.68±5.74	24.65±1.92
SBP rest (mmHg)	113±5.00*	130±8.16*
DBP rest (mmHg)	73±5.00**	83±5.00**
HR rest (bpm)	83±20.20	93±11.17
SpO_2 rest (%)	95±4.08	98±0.50
BORG Dyspnea (rest)	0.75 (0-2)	1 (0-2)
FEV_1 (% predict)	34.50 (19-83)	43.25±21.42
FVC (% predict)	62.25±25.01	64.25±16.46
FEV_1/FVC (% predict)	62 (19-84)	62±19.40
Disease Staging#	1/0/1/2	0/2/1/1
Illness Time (years)	7 (1-10)	9 (5-14)
Smoking *Status*$	1/3	0/4
Smoking Lasting (years)	42±10.44	37±9.41
Smoking Cessation (years)	7 (3-11)	14,50 (5-29)
Cigarretes/year(ex-smokers)	7300 (2190-10950)	7300 (5475-14600)
Comorbidities (Yes/No)	3/1	1/3

Data presented in average ± standard deviation and median (minimum and maximum); SBP= Systolic Blood Pressure; DBP= Diastolic Blood Pressure; HR= Hearth Rate; SpO_2= Peripheral Oxygen Saturation; FEV_1, *forced expiratory volume in 1 s*; FVC, *forced vital capacity*; *p=0,011; **p=0,30; #Light/Moderate/Severe/Very Severe(GOLD, 2010); $Never/Ex-smoker.

There was a significant difference between men and women for SBP ($p = 0.001$) and DBP ($p = 0.030$) at rest without NIV. For the other cardiorespiratory variables the result was similar between men and women. It is noteworthy that both genders had obstructive process in the lung function, which is more severe and heterogeneous in women. Also, the duration of smoking was higher among women, as well as smoking cessation occurred more recently.

The results obtained during aerobic exercise with spontaneous breathing with CPAP and BiPAP are described in Table 2.

Table 2. Cardiorespiratory variables during exercise in spontaneously breathing and with the use of NIV (CPAP and BiPAP).

	Women (n=4)				Men (n=4)			
Spontaneous Breathing								
	1º min	5º min	15º min	30º min	1º min	5º min	15º min	30º min
SBP	128±12.58	138±17.07	135±17.32	130±8.16	135±10.0	133±9.57	140±8.16	138±9.57
DBPPAD	80±8.16	80±8.16	80±8.16	73±12.58	80±8.16	80±8.16	75±5.77	83±9.57
HR	98±17.76	99±21.09	101±19.50	101±27.30	94±17.27	101±14.66	99±13.62	103±16.46
SpO_2	93±5.56	95±3.55	96±4.04	95±3.55	96±1.25	96±2.63	96±2.63	96±2.06
CPAP								
SBPS	133±12.58	138±9.57	130±8.16	140±8.16	125±12.91	135±10.00	133±9.57	135±10.00
DBPPAD	85±5.77	88±5.00	83±9.57	83±5.00	80±0.00	85±5.77	85±5.77	85±5.77
HR	99±14.52	104±15.67	104±20.33	109±15.19	79±18.45	98±18.11	93±16.25	95±17.09
SpO_2	93±3.74	95±3.69	95±3.59	94±4.11	96±1.41	95±3.36	96±1.41	96±1.89
BiPAP								
SBP	130±8.16	143±12.58	130±8.16	130±8.16	138±9.57	138±5.00	138±17.07	138±12.58
DBPAD	80±0.00	80±8.16	78±5.00	80±8.16	83±5.00	85±5.77	83±5.00	85±5.77
HR	103±24.73	104±21.88	109±25.31	106±33.69	93±13.59	95±13.32	97±15.75	98±14.02
SpO_2	93±3.36	94±4.54	95±4.35	94±4.11	96±2.16	96±.70	96±1.82	96±1.41
HR recovery (min) After Exercising								
Spontaneous Breathing		2.50±1.91				2.50±1.91		
CPAP		2.25±0.50				6.25±3.20		
BiPAP		2.50±1.29				5.50±6.35		

SBP= Systolic Blood Pressure; DBP= Diastolic Blood Pressure; HR= Hearth Rate; SpO_2= Peripheral Oxygen Saturation; Min=Minute(s).

No significant difference was found for the observed changes in cardiorespiratory variables during the exercise. When patients made use of BiPAP during aerobic activity, the perceived exertion by the Borg scale was smaller and no dyspnea occurred. We expected that HR peak, observed at 15 minutes of the exercise, would present an increase when patients made use of NIV and the consequent absence of dyspnea, although it did not occur. Relevant to HR recovery after the exercise, the resting values, the average time did not vary among women, but among men the use of NIV prolonged recovery time of HR. Correlations between variables were found for the whole group of DPOC studied here, and can be viewed at Table 3. The presence of dyspnea at rest and during the first minutes of aerobic exercise, accommodation phase of aerobic activity, prolonged recovery time of HR, both spontaneous breathing and for the use of NIV with CPAP

Table 3. Correlation between the analyzed parameters in patients.

Correlation between the analyzed parameters in patients.

Parameters	*Pearson's*	*P*
Sex – SBP rest without NIV	0.831	0.001
Sex – DBP rest without NIV	0.756	0.030
HR Recovery – Dyspnea rest without NIV	0.772	0.025
HR Recovery – Dyspnea at 5' without NIV	0.743	0.035
HR Recovery – Dyspnea rest CPAP	0.856	0.007
HR Recovery – Dyspnea at 5' CPAP	0.809	0.015
HR Recovery – Dyspnea at 15' CPAP	0.830	0.011

SBP= Systolic Blood Pressure; DBP= Diastolic Blood Pressure; NIV= Non Invasive Ventilation; Recovery time= time that HR takes to return to baseline levels after 30 min of aerobic exercise; ' = minutes; CPAP = *Continuous Positive Airway Pressure*.

DISCUSSION

The analysis of Borg Scale dyspnea showed that the use of NIV decreased breath shortness and made possible the development of aerobic activity without dyspnea. Borghi-Silva et al.4 observed when BiPAP is applied on exercise tolerance in COPD patients, SpO2 increased and values of dyspnea decreased. Other scientific studies have also demonstrated that the use of NIV can provide effects of reduced work breathing, dyspnea reducing and improvement of exercise tolerance in patients with chronic obstructive illness 14.Costa et al.15 found no significant differences related to HR, SpO2, subjective sensation of dyspnea, measured during the 6-minute walk test (6MWT), after treatment with NIV, although the patients walked longest distance in the post-treatment indicating improvement of physical condition or tolerance. Moreover, from clinic the point of view, SpO2 showed much better results after the use of NIV, as well as the perception of dyspnea tended to decrease15 .

The presence of dyspnea at rest and during the first minutes of aerobic exercise was an important factor for the prolongation of HR return time to baseline levels, compared to spontaneous breathing, in our study. In COPD, the coexistence of expiratory limitation flow and loss of lung elastic recoil causes progressive changes in standard breathing, volume and lung capacity16,17. The chronic cardio-respiratory diseases cause misalignments of sympatho-vagal balance on hearth rate control.

An inadequate response of HR has often been associated with an increased of mortality risk and abnormal values have been hypothetically associated with an autonomic disorder18. In theory, the identification of this disorder could indicate a group of individuals with an increased sudden risk of death. Numerous models of autonomic function have been proposed among HR variability, and the difference between the maximum value the obtained at the end of the first minute of recovery, have been shown as prognostic markers 18

CONCLUSION

In conclusion, the use of NIV, through CPAP or BiPAP, during aerobic activity on a ergometer cycle did not infer on cardiorespiratory variables (blood pressure, heart rate and oxygen saturation) as well as prolonged recovery time for rest heart rate values in men with COPD when compared to spontaneous breathing. In contrast, the use of NIV during exercise was effective in exercise tolerance, with decrease of dyspnea with the use of CPAP and no dyspnea with the use of BiPAP. The use of noninvasive ventilation in this study, improved respiratory performance, but the increase of n sample in future studies will allow greater inference on the cardiorespiratory response of patients with COPD in this therapeutic modality. It is noteworthy that the literature is limited in describing the PA during aerobic exercise with the use of NIV, lasting 30 minutes, which is more common in training sessions. As a result, this study helps, especially in the clinical practice of cardiorespiratory rehabilitation, supporting that the BP measurement can be performed during exercise on a ergometer cycle, without any this would prejudice to the patient's physical performance

ACKNOWLEDGMENTS

Thanks to all staff "Rehabilitation Research Group Health and its Interfaces" of UNISC / HSC and patients who participated in this research.

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CARDIORESPIRATORY RESPONSE TO AEROBIC EXERCISE WITH NONINVASIVE VENTILATION IN THE COPD PATIENTS

Introduction: Patients with Chronic Obstructive Pulmonary Disease (COPD) have submitted losses in the ability to exercise and the use of non-invasive ventilation (NIV) associated with aerobic exercise improves tolerance to effort in these patients. Objective: To evaluate the cardiorespiratory response to aerobic exercise on a ergometer cycle with the use of NIV in COPD patients. Methods: the Case study investigated 08 patients of both sexes, submitted to aerobic exercise on a cycle ergometer with and without the use of NIV (Bi-Level Positive Airway Pressure BiPAP and Continuous positive airway pressure, CPAP). The variables analyzed before, during and after from the exercise recovery to the resting values were: blood pressure (BP), heart rate (HR), oxygen saturation (SpO2), the Borg Dyspnea Scale (EBD) and Perceived exertion (EBEP). Results: There was a significant difference between men and women for SBP and DBP at rest without NIV [SBP (men vs. women 130 ± 113 8.16 ± 5.00, p = 0.01) and DBP (men 83 ± 5, women 00 vs. 73 ± 5.00, p = 0.03)]. The score in EBEP was lower in women with CPAP (8.5) and men with BiPAP (09), compared to spontaneous breathing (9.5). The score was lower in the CPAP EBD (01) and BiPAP (0) for both groups, compared to spontaneous breathing. The recovery of HR at rest was prolonged with the use of NIV in men and dyspnea at rest was a relevant factor for the extension of this time. Conclusion: The use of NIV improved respiratory performance of COPD patients in this study, with the absence of dyspnea during aerobic exercise.

KEYWORDS: Cardiorespiratory Response. COPD. Exercise Tolerance. Non-Invasive Ventilation (NIV).

LA REPONSE CARDIORESPIRATOIRE A L'EXERCICE AEROBIQUE AVEC VENTILATION NON INVASIVE CHEZ LES PATIENTS MPOC

Introduction: Les patients atteints de maladie pulmonaire obstructive chronique (MPOC) ont subi des faiblesses sur l'aptitude à l'exercice et l'utilisation de la ventilation non invasive (VNI) associé à l'exercice aérobie améliore la tolérance des efforts de ces patients. Objectif: évaluer la réponse cardiorespiratoire à l'exercice aérobie sur un ergomètre avec l'utilisation de la VNI chez les patients atteints de MPOC. Méthodes: Etude de cas, nous avons étudié 08 patients des deux sexes, soumis à l'exercice aérobie sur un ergomètre avec et sans l'utilisation de la VNI (Bi Level Positive Airway Pressure- BiPAP et Continuous positive airway pressure- CPAP). Les variables analysées avant, pendant et après l'exercice de récupération des valeurs de repos ont été: la pression artérielle (PA), la fréquence cardiaque (FC), la saturation d'oxygène (SpO2), l'échelle de dyspnée de Borg (EBD) et l'effort perçu (EBEP). Résultats: Il y avait une différence significative entre les hommes et les femmes pour la PAS et la PAD au repos sans VNI [PAS (hommes vs femmes 130 ± 113 ± 8,16 5,00, p = 0,01) et PAD (hommes 83 ± 5,00 vs femmes 73 ± 5,00, p = 0,03)]. Le score était inférieur au EBEP chez les femmes avec CPAP (8,5) et les hommes avec BiPAP (09), par rapport à la respiration spontanée (9,5). Le score était inférieur dans les EBD CPAP (01) et BiPAP (0) pour les deux groupes, par rapport à la respiration spontanée. La récupération des FC au repos a été prolongée avec l'utilisation de la VNI chez les hommes et la dyspnée au repos a été un facteur pertinent pour l'extension de cette époque. Conclusion: L'utilisation de la VNI a amélioré les performances respiratoires des patients atteints de MPOC dans cette étude, avec l'absence de dyspnée au cours des exercices aérobiques.

MOTS-CLÉS: la réponse cardio-respiratoire, la MPOC, tolérance à l'exercice, la ventilation non invasive.

LA RESPUESTA CARDIORRESPIRATORIA AL EJERCICIO AERÓBICO CON LA VENTILACIÓN NO INVASIVA EN PACIENTES CON EPOC

Introducción: Los pacientes con Enfermedad Pulmonar Obstructiva Crónica (EPOC) tienen daño en la capacidad de ejercicio y el uso de ventilación no invasiva (VNI) asociados con el ejercicio aeróbico mejora la tolerancia a los esfuerzos de estos pacientes. Objetivo: Evaluar la respuesta cardiorrespiratoria al ejercicio aeróbico en una bicicleta ergométrica con el uso de la VNI en pacientes con EPOC. Métodos: Estudio de caso, donde hemos investigado 08 pacientes de ambos sexos, sometidos a ejercicio aeróbico en una bicicleta ergométrica con y sin el uso de la VNI (Bi Level Positive Airway Pressure- BiPAP y Continuous Positive Airway Pressure -CPAP). Las variables analizadas antes, durante y después del ejercicio para recuperar los valores de reposo fueron: Presión Arterial (PA), frecuencia cardíaca (FC), saturación de oxígeno (SpO2), la Escala de Borg Disnea (EBD) y el Esfuerzo Percibido (EBEP). Resultados: Se observó una diferencia significativa entre hombres y mujeres para PAS y PAD en reposo sin VNI [PAS (hombres 130 ± 113 vs mujeres 8,16 ± 5,00, p = 0,01) y PAD (hombres 83 ± 5,00 vs mujeres 73 ± 5,00, p = 0,03)]. La puntuación en el EBEP fue menor en las mujeres con CPAP (8,5) y los hombres con BiPAP (09), en comparación con la respiración espontánea (9,5). La puntuación en la EBD fue menor con CPAP (01) y BiPAP (0) en ambos grupos, en comparación con la respiración espontánea. La recuperación de la FC en reposo se prolonga con el uso de la VNI en los hombres y la disnea en reposo fue un factor relevante para la extensión de este tiempo. Conclusión: El uso de la VNI mejora el rendimiento respiratorio de los pacientes con EPOC en este estudio, con la ausencia de disnea durante el ejercicio aeróbico.

PALABRAS CLAVE: Respuesta Cardiopulmonar, EPOC, Tolerancia al Ejercicio, Ventilación no Invasiva.

RESPOSTA CARDIOIRRESPIRATÓRIA AO EXERCÍCIO AERÓBICO COM VENTILAÇÃO NÃO-INVASIVA EM PORTADORES DE DPOC

Introdução: Portadores de Doença Pulmonar Obstrutiva Crônica (DPOC) apresentam prejuízos sobre a capacidade de exercício físico e o uso da ventilação não-invasiva (VNI) associado ao exercício aeróbico melhora a tolerância aos esforços nesses pacientes. Objetivo: Avaliar a resposta cardiorrespiratória ao exercício aeróbico em cicloergômetro com uso de VNI em portadores DPOC. Métodos: Estudo de casos, investigou-se 08 pacientes de ambos os sexos, submetidos ao exercício aeróbico em cicloergômetro com e sem uso de VNI (Bi Level Positive Airway Pressure - BiPAP e Continuous positive airway pressure - CPAP). As variáveis analisadas antes, durante e após o exercício até a recuperação aos valores de repouso foram: pressão arterial (PA), frequência cardíaca (FC), saturação periférica de oxigêino (SpO2), Escala de Borg Dispnéia (EBD) e Esforço percebido (EBEP). Resultados: Encontrou-se diferença significativa entre homens e mulheres para PAS e PAD em repouso sem VNI [PAS (homens 130±8,16 vs mulheres 113 ±5,00, p=0,01); PAD (homens 83±5,00 vs mulheres 73 ±5,00, p=0,03)]. A pontuação na EBEP foi menor nas mulheres com CPAP (8,5) e nos homens com BiPAP (09), comparados a respiração espontânea (9,5). A pontuação na EBD foi menor CPAP (01) e BiPAP (0) para ambos os grupos, comparados a respiração espontânea. A recuperação da FC ao nível de repouso foi prolongada com o uso de VNI nos homens e a dispnéia em repouso foi fator relevante para o prolongamento deste tempo. Conclusão: A utilização de VNI melhorou a performance respiratória dos portadores de DPOC deste estudo, com ausência de dispnéia durante o exercício aeróbico.

PALAVRAS-CHAVE: Resposta Cardiorrespiratória, DPOC, Tolerância ao Exercício, Ventilação não invasiva.