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Gender disparity of changes in heart rate during the six-minute walk test among patients with chronic obstructive airway disease

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RESEARCH

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ABSTRACT

Background

Chronic obstructive pulmonary disease (COPD) is a major cause of chronic morbidity and mortality worldwide. Clarify; COPD is the fifth leading cause of death and disease burden globally.

Aims

The purpose of this study is to compare the gender disparity of changes in heart rate during 6-minute walk test (6MWT) among patients with chronic obstructive airway disease (COPD). We also aimed to assess the relationship between change in heart rate and body mass index (BMI).

Methods

We randomly selected 59 elderly subjects with COPD (made up of 45 men and 14 women). The selected patients all had Medical Research Council (MRC) dyspnea index of ≥ 3 . All patients in this study had informed written consent and carried out the 6 minute walk tests (6MWT) according to standards. Data analysis was carried out with SPSS version

21.0 software and Excel 2016 with level of significance taken as $p < 0.05$. We used of ANOVA to identify difference in the means among three or more groups.

Results

As the BMI range is 15–50 while the mean BMI was 26 ± 00 include the standard deviation has been observed overweight in all patients with COPD. There was significant difference in the distance covered during the 6MWT between men and women (Men=397.00, Women=375.00) at $p < 0.001$. Also, we can be seeing lowest significant different in heart rate basic (Mean Square=0.0) and oxygen saturation at rest (Mean Square=2.0) in value $p < 0.00$ between men and women.

Conclusion

In this study, distance, SPO₂, resting heart rate and 1-minute heart rate variables were evaluated for assessing exercise capacity and then the amount of breathlessness and exercise in patients with COPD.

Key Words

COPD patients, main HR parameters, men, women, 6MWT

What this study adds:

1. What is known about this subject?

This report, which was written on our pulmonary rehabilitation project, the heart rate parameters of men and women and its ischemic factors were significantly different.

2. What new information is offered in this study?

Highest significant difference was in the parameters of heart rate, the distance between men and women, and the least significant was in Spo₂ and basic saturation.

3. What are the implications for research, policy, or practice?

In evaluating patients with COPD, distance, Spo₂, O₂ basic saturation, resting heart rate and heart rate 1 minute plays an important role.

Background

Chronic obstructive pulmonary disease (COPD) is recognized as a serious global health burden with an increasing incidence, estimated to represent the third most common cause of death worldwide by 2020. COPD is a major cause of chronic morbidity and mortality in the world especially in United States and United Kingdom. Currently COPD is the fifth leading cause of death and disease on index burden globally, COPD is characterized by significant physical and psychosocial challenges.¹ COPD is characterized by chronic airflow limitation and a range of pathological changes in the lungs, some significant extra pulmonary effects (special skeletal muscle dysfunction), and important comorbidities, which may contribute to the severity of the disease.² COPD is clinically characterized by a pathological rate of decline in lung function with age, and, as a result, patients with COPD often complain of dyspnea and exercise intolerance, both of which not only interfere with the ability to perform the activities of daily life but also significantly impede quality of life.^{2,3} COPD patients have limited exercise capacity due to complex pathophysiology, and evaluation of exercise performance at all stages of COPD is important if we are to understand disease progression better⁴. However, there has been limited development of maximal incremental load exercise test specific for heart rate parameters in patients with COPD. Furthermore, Functional exercise tests, such as six-minute walk test, vary significantly in how they are performed from center to center, despite guidelines. The 6-minute walk test (6MWT) has classically been used in clinical settings to evaluate exercise capacity at submaximal exercise levels and to assess the effects of treatment in individuals with a variety of cardiovascular and pulmonary diseases, including COPD.^{4,5} The test is easy to administer, better tolerated than some other tests, and its reflective of physical activities.⁶ The 6-minute walk distance (6MWD) has been widely applied as a representative parameter in the 6MWT, in patients with COPD. As described in the official statements of 6MWT guideline, the test was originally designed to assess the integrated responses of the body systems involved during exercise, including the pulmonary, cardiovascular systems, neuromuscular units, and muscle metabolism.⁶ However, it is unclear whether existing parameters, like the 6MWD, are suitable for analysis of the functional contribution of individual body systems during exercise. Considering that COPD has recently been characterized by multiple phenotypes of the respiratory, cardiovascular, and muscular systems, it is likely that all these systems play roles in the pathogenesis of reduced exercise capacity in COPD patients.^{7,8} Therefore, main parameters heart rate in the 6MWT are now required for holistic analysis of exercise capacity in patients with COPD

and they are different between men and women. In this study, the comparison of heart rate parameters between male and female in COPD patients and their cardio-pulmonary health status after 6MWT are determined based on their heart rate indexes.⁹

Methods

Study design

Ethics: The study was been approved by the institutional Ethics Committee and research committee of the Hospital. All patients that volunteered to participate in this study gave informed written consent after receiving full information on the objectives, techniques and possible consequences of participating in the study.

Inclusion criteria: The existence of clinical criteria for chronic conditions with pulmonary and cardiac radiography, heart and lung in a stable phase (at least two months without change in semiotics) indicates moderate symptoms (predicted 50 per cent FEV1 <80 per cent), severe (predicted 30 per cent FEV1 <50 per cent) and very severe (predicted FEV1 <30 per cent) obstructive pulmonary disease via pulmonologist diagnosis.

Exclusion criteria: Occurrence of arrhythmias, cardiac ischemia during training, cardiac surgery during the past 3 months, neuromuscular disorders, orthopedic and rheumatoid arthritis, metabolic syndrome, which can be associated with results and cause extraordinary difficulty in producing severe malnutrition, Ethical and confidential reasons for patients and physical activities that interfere with blood pressure and heart rate.

Participants: We randomly selected 45 men and 14 women with COPD. A randomized selection of patients participating in the study is a community of COPD patients who are continuously referred to the hospital for continued pulmonary rehabilitation every week. This selection has been made on the intranet of the hospital's respiratory patients. They were classified based on COPD severity into mild, moderate and severe the population of patients including middle-aged and elderly people (66±10) had a ≥3 obstruction score in the MRC index that participated as volunteers. All patients with COPD general characteristics (sex, age, weight, height, and body mass index) were evaluated, and all patients with COPD symptoms and signs that were diagnosed by the Pneumonia and Rehabilitation Specialists in accordance with the ERS/ATS guidelines. Diagnosis of the physical comorbidity based on medical reference, patient clinical history, physical examinations, maximum use of supplementary O₂, long history of smoking

(years), lung function, evidence of continuous and severe airflow obstruction indicated in the criteria (ERS/ ATS instruction). The research project is shown in the Flowchart.

Six-Minute Walk Test (6MWT): Iwama et al.¹⁰ designed this test for cardiac and respiratory patients with severe situation and employed it more in clinic for clinical practice with patients with exercise (ERS/ATS guidelines). The therapist should pay attention to patients and if they have fatigue or dyspnea, they must rapidly stop the test and go to rest on a chair or bed. It is performed on a 30-meter-long flat hallway twice daily with a 30-minute interval between each session; the largest value of distance traveled will be selected for analysis. The patients were instructed and encouraged to walk as fast as possible for 6 minutes, using standardized phrases every minute of the self-paced tests. The percentage of distance traveled to be calculated using the following equation of Iwama et al.:

Distance traveled at 6MWT/predicted distance \times 100.

The changes in (SpO₂) during exercise will be measured using a lightweight portable pulse oximeter. The longest 6MWD of two tests (per-formed the same day and separated by 20 min) to be the primary outcome measure. Pre- and post-6MWT dyspnea will be measured using the Borg scale. We determined the effort level using the ratio between HR max during the test and HR max per cent prediction (formula HR max=220–age).¹⁰

Statistics: For measurement of characteristics of COPD patients (sex, age, weight, height and BMI), we used of descriptive statistics (mean values \pm standard deviation). For finding comparison between of mean variables of 6MWT in men and women and differences between them used of ANOVA test as appropriate and identify different means has been used of Tukey test. All of the data base and analysis were carried out using SPSS version 21.0 software (SPSS Inc., 2012, Chicago, IL, USA) and Excel 2016 (office 2016) with level of significance taken as $p < 0.05$.

Results

A total 59 patients with COPD were involved this study. Table 1 presents the background information of the subjects. No subjects had a baseline SpO₂ less than 90 per cent or received domiciliary oxygen therapy. We can see all the characteristics of COPD patients in this study and according to the table, the BMI variable has the most significant changes (minimum=15.0, max 50.0), and the mean BMI (26 \pm 00) in all COPD patients is overweight it shows.

6MWT, the most significant values are at distance (men=397.00, women=375.00) and the least significant in heart rate basic is 6MWT (men=82.00, women=82.00) at a significant level of $p < 0.001$. Also, the base saturation, SpO₂ (men=95.00, women=95.00), which is between men and women with stable status, is visible in Table 2 and has the least significant difference at $p < 0.051$.

We can say that in the initial analysis of the ANOVA result, the most significant difference was observed in the mean square at Distance (5496.00) and at the value of $p < 0.001$. The least significant amount in O₂ (0.001) shown at the level of $p < 0.001$. Also, in all patients with COPD, in both men and women, the baseline heart rate (0.021) and SpO₂ basic saturation (2.00) were observed at $p < 0.001$, respectively, in Table 3, which had a significant difference.

Discussion

In this study, we tried to detect the risk factors affecting the outcome of the study and isolate patients with cardiac disorders and ischemic regard Exclusion criteria's. Also, patients who do not have a non-pulmonary secondary illness according to a pulmonologist diagnosis. In this study, we focused on the cardiac factors of COPD patients after the exercise, and we decided to explore other new findings related to the risk factors in the future. It has been previously demonstrated that the 6MWT is associated with the following lung functions in COPD: the degree of airflow limitation as indicated by FEV₁; the diffusing capacity of lung as indicated by DLCO; and dynamic hyperinflation as assessed by inspiratory capacity during exercise.^{10,11} Thus, the 6MWT is considerably impacted by impaired lung function in patients with COPD. In the present study, we also found that the 6MWT was significantly correlated with the degree of heart rate and diffusing capacity of the lung and cardiac output in patients with COPD. In addition, for the first time, our findings of this study have been showed that HR parameter was significantly relation with level of SpO₂ during the 6MWT.

In contrast, we also found that the reduction in SpO₂ was not significantly correlated with the Distance 6MWT, which is consistent with the findings of previous studies of World Medical Association (2013) and Camargo et al.^{7,12,13} The 6MWT includes two objective parameters: walk distance (6MWD) and oxygen saturation (SpO₂). Georgiopolou et al. and Borghi-Silva et al., reported that under the influence of a pulmonary rehabilitation program, improve heart rate in exercise and lower heart rate at rest.¹⁴⁻¹⁶

Borghi-Silva also pointed out that this program beneficial impact on the reduced significantly on ventilation and sensitivity rate.¹⁶ Lacasse et al., says that heart rate at rest is the result of tone is inherent and vagal while the influence of the sympathetic nerve can also be. Recent data the researcher shows an imbalance in chronic obstructive pulmonary patients leads to an increased resting heart rate.¹⁷ According to opinions Streuber et al., rehabilitation research beneficial effects on heart rate parameters in patients with heart failure. However, long term training programs to create significant changes in heart failure is needed that has been seen in sympathovagal patients.¹⁸ It is important to examine the deterioration of exercise capacity due to the functional abnormalities of extra pulmonary systems, since COPD is characterized by various comorbidities, including cardiovascular and metabolic abnormalities, affecting oxygen delivery and consumption in peripheral muscles special in quadriceps. Therefore, reductions in SpO₂ during the 6MWT also indicate the impact of these comorbidities in heart rates models in COPD patients.

Accordingly, it is likely that the walking distance does not provide specific information on multiple comorbidities in COPD and we couldn't find rational and significant relationship with HR basic, HR Saturation basic, HR min 1 recovery and PO₂ and except of distance, all of the parameters don't have significant different in men and women suffer from COPD. Furthermore, it would be helpful to suggest further practical implications of these findings for practitioners in pulmonary rehabilitation regard to all of the cardiac parameters special in HR and Spo₂ in cardiac muscles in men and women suffer from COPD disease.

Conclusion

In conclusion, the distance during 6MWT has the greatest difference with other parameters. Also, basic heart rate, basic saturation SPO₂, and final heart rate in COPD patients are similar in men and women and have the least significant difference. Additionally, the distance to assess exercise capacity with oxygen saturation (Spo₂), final HR and HR 1 minute, and then reversible after exercising in patients with COPD, is very important for their health status. For future, it is suggested that the effect of heart rate parameters on physical activity and mortality should be investigated in patients with COPD.

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ETHICS COMMITTEE APPROVAL

Commission of Research and Ethics of Health Parc Sant Joan de Deu, at 5 October 2015. The letter of Research and Ethics Committee to be attached.

Table 1: Descriptive Statistics of general characteristics of COPD patients in this study

Characteristics		N	Minimum	Maximum	Mean +/- SD	+/- SD	Variance
Gender	Male	45					
	Female	14					
Age		59	48	86	66±10	9	95
Weight (Kg)		59	37	153	73±02	20	410
Height (cm)		59	150	186	163±07	22	488
BMI (kg/cm2)		59	15	50	26±00	6	47
Valid (N)		59	-	-	-	-	-

Table 2: Descriptive statistics of parameters HR in 6MWT

HR parameters		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
6MWT_Distance (m)	Men	45	397	120	17	361	433	75	567
	Women	14	375	85	22	325	424	225	555
	Total	59	392	113	14	362	421	75	567
6MWT_%	Men	45	79	23	3	72	86	15	118
	Women	14	77	13	3	69	84	52	113
	Total	59	78	21	2	73	84	15	118
6MWT_HR_basic	Men	43	82	13	2	77	86	52	118
	Women	14	82	10	2	76	87	65	98
	Total	57	82	13	1	78	85	52	118
6MWT_HRR_final	Men	44	110	13	2	106	114	75	143
	Women	13	107	16	4	97	117	78	132
	Total	57	109	14	1	105	113	75	143
6MWT_HRR 1 min	Men	19	90	18	4	81	99	57	132
	Women	6	84	10	4	73	96	73	98
	Total	25	89	17	3	82	96	57	132
6MWT_O2	Men	46	1	0	0	1	1	1	1
	Women	16	1	0	0	1	1	1	1
	Total	62	1	0	0	1	1	1	1
6MWT_sat_basic	Men	45	95	2	0	94	95	91	99
	Women	14	95	2	0	94	97	91	99
	Total	59	95	2	0	94	95	91	99
6MWT_1 min_sat	Men	44	89	4	0	87	90	76	97
	Women	14	91	3	1	88	93	83	98
	Total	58	89	4	0	88	90	76	98

Table 3: ANOVA in parameters of HR, 6MWT

HR parameters		Sum of Squares	df	Mean Square	F	Sig.
6MWT_Distance (m)	Between Groups	5496.0	1	5496.0	0.0	0.0
	Within Groups	735595.0	57	12905.0		
	Total	741092.0	58			
6MWT_%	Between Groups	58.0	1	58.0	0.0	0.0
	Within Groups	25956.0	57	455.0		
	Total	26014.0	58			
6MWT_HR_basic	Between Groups	0.0	1	0.0	0.0	0.0
	Within Groups	9529.0	55	173.0		
	Total	9529.0	56			
6MWT_HRR_final	Between Groups	95.0	1	95.0	0.0	0.0
	Within Groups	10993.0	55	199.0		
	Total	11089.0	56			
6MWT_HRR 1 min	Between Groups	165.0	1	165.0	0.0	0.0
	Within Groups	7089.0	23	308.0		
	Total	7254.0	24			
6MWT_O2	Between Groups	0.0	1	0.0		
	Within Groups	0.0	60	0.0		
	Total	0.0	61			
6MWT_sat_basic	Between Groups	2.0	1	2.0	0.0	0.0
	Within Groups	263.0	57	4.0		
	Total	266.0	58			
6MWT_1 min_sat	Between Groups	46.0	1	46.0	2.0	0.0
	Within Groups	1210.0	56	21.0		
	Total	1256.0	57			

Flowchart of the research project:

