BRIEF REPORT

Tolerance to Exercise Stress Testing While Wearing a Face Mask

Tolerancia a la prueba ergométrica graduada al utilizar barbijo o tapaboca

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ABSTRACT

Background: Tolerance to exercise with the use of face mask is not well known.
Objective: The aim of this study was to investigate the tolerance of exercise parameters during exercise stress testing (EST) while wearing a face mask.
Methods: Multicenter study of EST while wearing face mask.
Results: 118 ESTs (62 on treadmill, 56 on cycle ergometer), 68 men, age 46.74 ± 16.7 years. Seventy patients (59.3%) completed the EST wearing a face mask, and 48 (40.7%) removed it; 17 patients (27.4%) were on treadmill and 31 (55.4%) on cycle ergometer (p= 0.002). Percentage of maximum predicted heart rate attained when the patients removed their face mask: 94.5 ± 5.35%. Age of those who removed the face mask: 42.69 ± 17.35 years and of those who tolerated the face mask: 49.51 ± 15.88 years (p= 0.003). Baseline SpO2 was 97.46 ± 1.01 % and 96.58 ± 1.37 % on peak exercise wearing face mask (p < 0.0001). SpO2 when the face mask was removed: 97.06 ± 1.35% (p < 0.0001). Younger age and use of cycle ergometer were predictors of intolerance to face mask.
Conclusion: Most patients completed peak exercise with face mask. Exercise intensity was high when the face mask was removed. Oxygen saturation dropped during exercise with face mask without clinical impact.

Key words: Exercise - Face mask - SARS-COV2 - COVID 19 - Exercise testing

RESUMEN

Introducción: Es poco conocida la tolerancia al ejercicio con el uso de barbijo.
Objetivo: Investigar tolerancia al barbijo en ergometrías (PEG).
Material y métodos: Estudio multicéntrico con PEG con barbijo.
Resultados: 118 PEG (62 cinta, 56 cicloergómetro), 68 hombres, edad 46,74±16,7 años. Setenta (59,3%) completaron PEG con barbijo, 48 (40,7%) debieron retirarlo: 17 en cinta (27,4 %), 31 (55,4%) en bicicleta (p = 0,002). Porcentaje de frecuencia cardíaca al retirar barbijo con respecto a máxima alcanzada: 94,5±5,35 %. Edad de quienes retiraron barbijo: 42,69±17,35 años y de quienes toleraron: 49,51 ± 15,88 (p = 0,003). Saturación basal: 97,46 ± 1,01 %; en esfuerzo máximo con barbijo: 96,58 ± 1,37% (p <0,0001). Al retirar barbijo, saturación de 97,06 ± 1,35% (p < 0.0001). Edad menor y uso de cicloergómetro fueron predictores de no tolerar el barbijo.
Conclusiones: La mayoría completó el ejercicio máximo con barbijo. La intensidad de ejercicio al retirar el barbijo fue alta. La saturación cayó en ejercicio con barbijo, aunque sin repercusión clínica.

Palabras clave: Ejercicio – Barbijo - Máscara facial - SARS-COV2 - COVID 19 - Ergometría

INTRODUCTION

The use of face masks has been mandatory during the pandemic before leaving home to prevent the transmission and spread of SARS-COV2. The practice of the physical activity recommended often requires the use of face masks that prevent the entry and exit of micro-droplets that may carry the virus. (1) During exercise the spread of micro-droplets is greater and can reach up to 10 or 20 meters depending on the traveling speed. (2-4)

Exercise is involved in the prevention and treatment of multiple diseases and improves fitness and sports performance. Many people have sought advice on the use of face masks for initiating outdoor physical

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activities. In theory, wearing face masks could reduce O2 uptake and retain CO2, thus impairing the cardiac and respiratory response to exercise. This could general discomfort due to breathing impairment that could have influence on the physical and psychological aspects during physical activities. The aim of this study was to investigate the tolerance and outcome of exercise parameters during exercise stress testing while wearing a face mask.

METHODS

We conducted a descriptive, multicenter and cross-sectional study with relational analysis in four centers of Argentina. The patients included had no history of respiratory diseases and underwent 12-lead exercise stress testing (EST), either a treadmill EST using the Bruce protocol with 2-minute stages, or an Astrand cycle ergometer test. In all the cases, the EST was performed with continuous electrocardiographic and oxygen saturation (SpO2) monitoring and blood pressure measurement at each stage. Those tests stopped due to patient's request because of severe fatigue were considered for the analysis, while those stopped due to angina, ST-segment depression, systolic blood pressure > 250 mm Hg or diastolic blood pressure > 120 mm Hg were excluded. All the tests were performed with the patient wearing a face mask. If the patient felt discomfort, he/she could take it off. At each stage, the participants were asked about discomfort and symptoms triggered by the face mask according to a 4-point scale that was explained in detail to all participants:

1. No discomfort.
2. Mild discomfort but could go on with the test.
3. Moderate discomfort but could go on wearing the face mask.
4. Severe discomfort, could not tolerate the face mask. Requests removing it or takes it off by him/herself.

The maximum predicted heart rate was calculated as 220 (210 for women) minus the patient's age. Exercise-induced desaturation was defined as a drop in SpO2 of 4% or greater. Oxygen saturation was measured with pulse oximeters placed on the middle finger of the hand close to the operator. The following variables were evaluated: functional capacity, maximum heart rate attained, % of maximum predicted heart rate, SpO2 when the face mask was removed and at peak exercise, and % of maximum predicted heart rate when the face mask was removed.

All the values are expressed as mean ± standard deviation. A p value < 0.05 was considered statistically significant.

Statistical analysis

Statistical analysis was performed using SPSS 20 software package. The chi square test was used to analyze categorical variables. Paired-samples t test and independent-samples t test were used, as applicable. Logistic regression analysis was also performed. The study was organized following the Resolution 1480/11 of the Ministry of Health of Argentina, Guidelines for Good Clinical Practice in Research on Human Subjects.

RESULTS

A total of 129 ESTs were performed; 5 were excluded because the patients refused to wear a face mask, 2 for stopping the test due to angina before the patient reported fatigue, 3 due to technical difficulties in the evaluation of SpO2, and 1 because the patient had chronic obstructive pulmonary disease. The sample was made up of 118 patients, 68 men and 50 women; mean age was 46.74 ± 16.7 years. Eight patients had heart disease (6.8%): 1 had hypertrophic cardiomyopathy, 1 mitral valve repair and 6 with coronary artery disease. Nine patients were receiving beta blockers. Sixty-two tests were performed on treadmill and 56 on cycle ergometer (Table 1).

Seventy persons (59.3%) completed the test wearing the face mask. Sixty-two (88.6%) reported mild to moderate discomfort (scale 2-3). Forty-eight (40.7%) took off the masks due to severe discomfort; 17 ESTs (27.4%) were performed on treadmill and 31(55.35%) on cycle ergometer (p= 0.002). The % of maximum predicted heart rate attained when the patients removed their face masks was 94.73 ± 3.58 for those on treadmill and 94.37 ± 6.37 for those on cycle ergometer (p NS). After performing logistic regression analysis including sex, presence of heart disease, age, type of equipment and treatment with beta blockers, only age (OR 1.027; 95% CI 1.001-1.054) and the use of a

Table 1. Patients with and without severe discomfort while wearing a face mask

	Did not take off the face mask	Took off the face mask	Total
Complete test	70 (59.3 %)	48 (40.7 %)	118
Sex			
Female	33 (66 %)	17 (34 %)	50
Male	37 (54.4 %)	31 (45.6 %)	68
With heart disease	5 (62.5 %)	3 (37.5 %)	8
Mean age (years)	42.69 ± 17.35	49.51± 15.88	(p = 0.003)
Face mask score:			
1. No discomfort.	8	0	8
2. Mild discomfort.	25	0	25
3. Moderate discomfort.	37	0	37
4. Severe discomfort.	48	48	48
Functional capacity:			
Treadmill (mets)	9.84 ± 3.32	10.73 ± 3.9	(p = 0.2)
Cycle ergometer (kgm)	834 ± 410.9	1035.48 ± 412.3	(p = 0.07)

cycle ergometer (OR 3.66; CI 1.57-8.54) were related with the removal of the face mask. Baseline SpO2 was 97.46 ± 1.01 % and 96.58 ± 1.37 % on peak exercise wearing a face mask ($p < 0.0001$). This drop was not considered abnormal. However, among subjects who took off the face mask (48), SpO2 wearing a face mask was 96.58 ± 1.37%, and increased to 97.06 ± 1.35% ($p < 0.0001$) until reaching peak exercise without the face mask. In those patients who did not take off the face mask, SpO2 on peak exercise was 96.61 ± 1.39%.

DISCUSSION

In the present study, most patients reported discomfort while wearing a face mask, although most of them did not need to remove it. Such discomfort appeared at high exercise intensity levels and was not related to electrocardiographic changes or severe symptoms. Treatment with beta blockers may reduce aerobic capacity but did not have influence on face mask removal. In those patients who completed the test wearing the face mask, the level of discomfort on peak exercise was mild to moderate and was higher in those on cycle ergometer.

The environment in which ESTs are performed is not the same as most outdoor environments where people perform physical activities. Duration of physical activities is longer than that of an EST, and humidity and temperature conditions might be higher inside the face mask. However, according to the results obtained, the use of face masks does not prevent mild to moderate intensity activities and that, in case of high intensity exercise, no life-threatening hemodynamic changes would occur. People voluntarily removes the face mask when discomfort develops, which means that they can do so without expecting any cardiac or respiratory abnormality.

Fikenzer (5) evaluated subjects with and without face masks in the first randomized study with EST and spirometry test and observed that ventilation was reduced by 12-23% depending on the type of mask. Temperature and humidity increase inside the face mask and, together with greater respiratory activity with increased muscular work, might intensify discomfort. (6)

Mild desaturations may occur in athletes during EST and SpO2 ≥ 95% can be considered normal. (7) We found differences between SpO2 at rest and at peak exercise while wearing a face mask, but these values were not higher than those observed in previous studies. However, in subjects who had to remove their face masks and continued with the test until peak exercise, SpO2 increased slightly, which could mean that the face mask contributed to desaturation. As SpO2 is a measure of the percentage of inspired oxygen reaching the blood, and as environmental hypoxia could decrease it, these findings could be interpreted as mild hypoxia inside a face mask. Desaturation may occur in less trained subjects during heavy exercise. (8) In this study, we have considered a drop of 4% as normal.

Patients on cycle ergometer reported higher level of discomfort than those on treadmill. This could be theoretically explained by the position of the chest leaned while cycling and the effect of higher intrathoracic pressure generated by the compression of the arms on the handlebars. This would produce greater respiratory distress than that experienced during walking or jogging. This is consistent with publications reporting that the use of face masks during cycle ergometer EST increases the perceived respiratory distress, although its use does not affect cardiopulmonary function. (9)

The percentage of maximum predicted heart rate attained in subjects who took off their face masks due to discomfort was 94.5%, which is consistent with intense physical activity.

Study limitations

We did not specify the type of face mask used as we prioritized the true aspect of using the face mask people wear in daily life. Levels of SpO2 were measured with digital pulse oximeters with the eventual variations they may present. The scale of discomfort perception with the use of the face mask was not previously validated and was designed by the authors.

CONCLUSIONS

Most subjects reached peak exercise wearing a face mask. Discomfort while exercising with the face mask was observed at high percentage of maximum heart rate attained. There was a slight increase in SpO2 when the face mask was removed until reaching peak exercise without the mask, which would imply a slight desaturation attributable to the face mask. Patients on cycle ergometer reported greater discomfort with the use of face masks and took them off in a greater proportion. The practice of physical activities and recreational exercises with mild to moderate intensities for health promotion would not be hindered using face masks. Further evaluation of respiratory variables during exercise is necessary to estimate possible abnormalities during exercise and record the direct parameters of the kinetics of O2 uptake and CO2 production.

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Conflicts of interest

None declared.

(See authors' conflict of interests forms on the web/Additional material.)

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