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SPECIAL ARTICLE

The use of face masks and the impact on heart rate variability during baseline ECG

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Sumary
We compared electrocardiograms (ECGs) findings with one year difference between each other with and without use of face mask at the moment to be tested. The first ECG was done one year before without face mask, and the second ECG with a mask one year later after 3 months of mandatory use for epidemiological COVID-19 pandemic justifications in healthy youth elite athletes.
Results: Regarding heart rate variability (HRV), an increase in RMSSD was recorded when the test was performed with a mask (M): 108.5 $\pm$ 90 ms vs. No mask (NM): 72.9 $\pm$ 54.2 ms ($p < 0.002$). And also an increase in SDNN, when the test was done with a M: 86.2 $\pm$ 47.2 ms vs. NM: 65.9 $\pm$ 43.5 ms ($p < 0.036$).
Conclusions: The results on ECG are consistent with the increasing predominance of parasympathetic regulation, which is responsible for regulation of the autonomic loop when the subject is using face mask.

Introduction

The effect of hypercapnea on autonomous nervous system (ANS)[6] was studied by some authors in different conditions.[1,2] However, the physiological changes associated with hypercapnea for the use of face mask during COVID-19 pandemic was not studied yet in healthy athlete population.

The annual athlete medical screening were resumed during the COVID-19 pandemic at the Medical Unit on Centro de Tecnificacion deportiva de Catalunya, after 3 months of

To consult the study data: https://blocs.mesvilaweb.cat/ignasiblume17/the-use-of-masks-for-protection-against-covid-19-generates-variations-in-the-variability-of-the-heart-rate-during-the-obtaining-of-an-electrocardiogram-at-rest/ (This study has not received any specific funding, being included in the usual work of the Medical Center.)

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mandatory use of face mask for daily activities by regulations of Ministery of Publich Health (MoPH).

We studied the impact of mild hypercapnea for the use of face mask on ANS on the ECG tested during anual medical screening in elite athlete.

Material and method

A routine annual medical screening was done during October 9, 2020 and February 22, 2021. Including baseline ECG, using face mask at same medical center by same nurse practitioner.

We selected 30 young healthy athletes (15 of them women), age 16.75 ± 2.4 years old, with previous normal medical screening and baseline 12-seconds electrocardiograms (ECG-12).

The use of face mask was mandatory in public spaces according regulations by MoPH for COVID-19 pancemic since 3 months before to start the annual screening. For that reason, the ECG was done using face mask.

The inclusion criteria for this study were: healthy adolescents athletes with ECG at the same medical center with and without face mask at the moment to be tested. The ECG machine was "touch HD+ Cardioline".

A brief ECG-12 supine on rest was studied, following the criterion of Fred Shaffer and JP Ginsberg (2017),[3] Salahuddin L, Cho J, Jeong MG, Kim D.[4] (2007) and Baek HJ, Cho CH, Cho J, Woo JM (2015)[5]

The study of heart rate variability (HRV) was following the methodology disclosed by V.S. Mishenko and V.D. Monogarov (1995)[6] proposed by RM Baevski et al.[7] from 1965. The "rr" distance of each cardiac cycle was measured manually by same technician, estimating to the tenth of a millimeter. All the mathematical operations were done in an Excel spreadsheet to obtain the parameters of each subject. Means and standard deviations and comparative statistics were performed between the two conditions studied.

Results

The heart rate (HR) was lower when the test was performed with facial mask (M): 59.2 ± 7.5 bpm vs. No-mask(NM): 62.0 ± 10.4 bpm (no statistical significance: $p < 0.134$).

In relation to heart rate variability (HRV), an increase on "root mean square of successive differences" RMSSD was recorded when were tested with M: 108.5 ± 90 ms vs. NM: 72.9±54.2 ms ($p < 0.002$).

The variables PNN50 (proportion of successive beats with more than 50 ms difference) was withM: 51.6% ± 28.1 vs. NM: 38.0% ± 29.0 ($p < 0.001$).aalso an increase on SDNN, when the test was performed with M: 86.2 ± 47.2 ms vs. NM: 65.9 ± 43.5 ms ($p < 0.036$).

Discussion

The results shows that using face mask is associated with some changes on ECG, that can be analyzed with ultrashort cardiac variability (HRV) techniques[3,4] when we compare it with a previous ECG. These differences affect many parameters as RMSSD, PNN50 and SDNN. This is due to (in short-term ECG recordings) the activation of autonomic regulation promoting the effect of breathing on heart rate.[8] This is probably a consequence of breathing over-exertion for the use of face mask.[9]

We found similar results with studies[1,2] carried out under severe hypercapnic hypoxia, in which case the physiological response is analogous: parasympathetic predominance with a slowdown on the heart chronotropic adaptation and an increased a bathmotropic response.

In the present study we didn't monitoring the bathmotropic response, but the small difference on chronotropic component doesnt have statistical significant.[10]

Our data describe the impact on the neurovegetative balance by the use of face mask in healthy young athletes. The physiological response is done even in conditions where asume that the intracavitary air volumen is modest and it isn't harmfull; but it shows a sensible physiological response (sympathetic/parasympathetic) for the use of face mask in some of the volunteers.

A few clinical consequences could be observed a priori. Only suceptible population predisposed to bronchoespasm or other medical conditions. The conditions with predominance of parasympathetic system and type of face mask is prescribed should be considered.

Limitations: The distribution of ECG with and whitout mask was not random: We use a retrospective analysis for ECG without mask from previous year. The type of face mask used was not described, and the content of intracavitary hypercapnea was not tested.

The impact of maturation and anatomo functional heart changes during the growth period were not taking in consideration for the retrospective component of our data. So far, the sample was on late puberty period were the changes in this system are not significatives. The design of this study was based on standard for best medical practice at that moment of this study.

The analysis followed the classic manual method used 1990 in which the distance "rr" was measured manually in millimeters (on printed 12-second ECG), more imprecise than the current measurement in milliseconds.

Further investigations: a prospective study is need it, with a faithful measurement of the "rr" intervals, with a record greater than 12 seconds, and verify through HRV, if the sympathetic-parasympathetic balance is affected by the use of face mask at rest on supine position.

Probably these changes may justify physiologically the disconfort reported for some patients for the use of face mask he study has bee nfavorably informed by the Ethics Committee of the Sports Administration of Catalonia (certificate: 018 / CEICGC /2021.

Conclusions: The data suggests an increased predominance of the parasympathetic response, responsible for the regulation of the ANS when the subject is submitted to the ECG with face mask.

Conflicts of interest

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None of the signatories present a conflict of interest in relation to the study.

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