COVID-19 pandemic: the potential effects of quarantine-induced stress on arrhythmias

Anna Vittoria Mattioli[1], Andrea Cossarizza[1], and Giuseppe Boriani[2]

[1]University of Modena and Reggio Emilia Faculty of Medicine and Surgery
[2]Azienda Ospedaliera Universitaria Policlinico di Modena

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Abstract

Since the WHO defined the diffusion of novel coronavirus, Severe Acute Respiratory Syndrome-Coronavirus-2 (SARS-CoV-2) as pandemic, the global effort has been on finding a cure and preventing transmission. As a consequence, people are going through many psychological problems in adjusting to the current lifestyles and fear of the disease. The link between the psychological effects of quarantine and arrhythmias has been poorly explored. However it is known that sudden catastrophic events i.e. earthquake are associated with an increase in sudden cardiac deaths. Acute stress and anxiety could act as a trigger for ventricular arrhythmias, which are found to have increased significantly after an earthquake. Quarantine induced a chronic stress enforced by alarming news reports in the media. Closure of businesses increased the stress due the expected crisis after the lockdown. Stress activates both the sympathetic nervous system and the axis of the renin-angiotensin-aldosterone system, leading to an increased risk of cardiac events. The aim of the present editorial is to analyze the potential impact of quarantine –induced stress on the development of arrhythmias.

COVID-19 outbreak, stress, atherosclerosis and immune function

Stress is a major factor that can alter the immune system. During the lockdown due to the pandemic, a huge number of persons have developed relevant signs of psychological suffering, that can significantly affect the capacity of the organism to react to external stimuli like those represented by microorganisms. It has been known for a long time that the immune response is regulated by soluble factors which include not only numerous cytokines and chemokines, but also a large number of hormones and neurotransmitters, whose receptors are found both on cells of innate and acquired immunity. Among these molecules, glucocorticoids play a fundamental role, and are responsible for a variety of immunological effects. Psychological stress, as well as several proinflammatory cytokines, acts at the hypothalamus level, provoking the production and release of corticotropin-releasing hormone (CRH) and arginine vasopressin (AVP) that, in turn, induce the anterior pituitary gland to synthesize adrenocorticotropin hormone (ACTH), which is able to stimulate steroidogenesis in adrenocortical cells. [5,6]This is crucial to give origin to cortisol, the main corticosteroid. In turn, glucocorticoids trigger a negative feedback, according to which the hypothalamic–pituitary–adrenal axis is inhibited. In general, it can be well stated that the main physiological effects of glucocorticoids go in the direction to suppress immune responses. However, these are not the only important effects described for these molecules. Atherosclerosis is a process in which ACTH and cortisol may play an important role. Acting on proinflammatory or anti-inflammatory cytokines, they can regulate vascular endothelial functionality and recruit monocytes, that can enter the wall and differentiate first into macrophages, second into foam cells. Their capability to modulate the capacity of macrophages to remove the excess free cholesterol from the atherosclerotic plaque is also crucial for maintaining an efficient endothelial functionality. [6] The pathogenesis of COVID-19 is associated with elevation of several immune plays as well as inflammatory factors which contributes to cytokine storms.

Covid-19 outbreak and arrhythmias

Currently, little is known about the psychological impact and mental health of the general public during the peak of the COVID-19 epidemic.[1,2,3] This is especially pertinent with the uncertainty surrounding an outbreak of such unparalleled magnitude.

Wang and coworkers analyzed the psychological impact of COVID 19 epidemic in China and suggest that with respect to the initial psychological responses of the general public between 31 January and 2 February 2020, just two weeks into the country's outbreak of COVID-19 and one day after the WHO declared a public health emergency of international concern, 53.8% of respondents rated the psychological impact of the outbreak as moderate or severe; 16.5% of respondents reported moderate to severe depressive symptoms; 28.8% of respondents reported moderate to severe anxiety symptoms; and 8.1% reported moderate to severe stress levels. [7]

Varshney M and coworkers reported a lower psychological impact of COVID-19. They found that 33.2% of respondents to the questionnaire showed significant (mild / moderate /severe) psychological impact regarding COVID-19. However, as these results were registered during the initial phase of the COVID-19 epidemic in the country, it is likely that they may have changed over time and should therefore be interpreted accordingly. [8]

Depression, anxiety and post-traumatic stress symptoms are known risk factors for adverse events in patients with chronic heart disease. Interestingly, much less is known about the effect of stress on the incidence and course of arrhythmias.

Baldi and coworkers found an increased number of out of hospital cardiac arrests in northern Italy that matched the same geographical areas most harshly affected by the pandemia. [9] A significant increase in SCD events (58%) was reported in this region and these investigators attribute this spike to late complications of myocardial infract or ischemia, as patients were more likely to remain at home and avoid hospitalization for fear of COVID-19 infection. [9]

Similarly, a significant reductions in the overall number of hospital admissions in patients presenting with acute coronary syndromes has been reported. [10,11]

The responses to chronic stress also include a number of modifying lifestyle behaviors such as increased alcohol consumption, heavier smoking, and diet high in sugar and fat. [2,12] Together with sedentary lifestyle these unhealthy changes in diet contribute to excess energy intakes and weight gain. Unhealthy lifestyle increases oxidative stress and inflammation. [2,12] When subjects respond to stress by eating more, substantial anecdotal evidence suggests the foods selected are typically high in sugar and fat. This phenomenon has been described as "Food craving". Food craving has been defined as a multidimensional experience since it includes cognitive (e.g., thinking about food), emotional (e.g., desire to eat), behavioral (e.g., seeking and consuming food), and physiological (e.g., salivation) aspects. [12,13] Food craving can be associated with a reduced intake of fruit and vegetables. However, a plant-based diet, rich in anti-inflammatory and anti-oxidative components, has been shown to significantly affect the most common cardiovascular risk factors in a positive way.

Sedentary life also contributes to an increase in cardiovascular risk.

While the positive effects of exercise are well studied also in the elderly less attention was dedicated to the impact of detraining in the elderly, although the worsening of dynamic balance found in patients aged 75 as a consequence of a 3-month period of detraining may have an impact not only on quality of life but also on exercise-induced cardiovascular adaptations and probably stress-induced arrhythmogenesis.[2,14]

We expect an increase in arrhythmic phenomena following quarantine due to higher stress levels and an unhealthy lifestyle that heightens the overall cardiovascular risk factor. In addition, stress related to quarantine induces a change in lifestyle and nutritional habits:, which is mainly due to reduced availability of goods, limited access to food, and reduction of outdoor physical activity. (figure 1)

Conclusions

We need to be prepared to confront the likely increase in arrhythmias risk burden following the pandemic.[15] Following quarantine period we must promote going back to a healthy lifestyle that includes a healthy diet and physical activity. Selected patients may benefit from psychological support and evaluation for persisting anxiety disorders. Moreover, it will be necessary to re-evaluate the arrhythmogenic risk of patients to prevent the sudden development of arrhythmias.

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Figure 1

Mechanisms involved in the relationship between quarantine-induced stress and COVID-19