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PSYCHOSOCIAL STRESS, CARDIOVASCULAR RESPONSES, AND THE ROLE OF RISK FACTORS

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The cardiovascular responses represent one of the major adaptive mechanisms to environmental stressful challenge. At the same time, the cardiovascular system is a major target of single traumatic and/or chronic stressors in animal and man. Human epidemiological data suggest a number of risk factors that, in interaction with stressors, may precipitate cardiovascular disease including sudden cardiac death. Age, high blood pressure, obesity, behavioral factors such as personality are among those that are considered to represent risk. The mechanisms of stress-risk interactions are largely unknown. Therefore we have developed animal models to investigate cardiac responses to relative subtle psychosocial stressors using male rats. The attention was focused on both acute and conditioned cardiac responses. Rat strains genetically selected for hypertension, obesity or avoidance behavior, and aged Wistar rats were used as models of risks.
In the young adult or adult male rats stressors requiring active coping to the environment such as escape or defence evoked tachycardiac response with occasional tachyarrhythmia. In contrast, stressors evoking passive behavioral coping like immobility induced bradycardia with occassional bradyarrhythmia. Risk factors such as age, high blood pressure, obesity and genetically determined behavioral characteristics had marked influences on cardiac response to acute or chronic stressors. The most remarkable alteration was the absence of bradycardiac as accompanied by tachyarrhythmic responses to both acute and chronic stressors. These alterations were primarily due to disappearance of vagal influence on heart rhythm. There were less obvious alterations in sympathetic influences on the cardiac responses to stressors as the consequence of risk factors. As far as the blood pressure is concerned a remarkable fall occured in base line systolic blood pressure of hypertensive rats following the repeated application of various psychosocial stressors. This phenomenon was independent of the origin of hypertension. The fall in blood pressure resulted in an increased incidence of tachyarrhythmic response to superimposed stressor. Extensive research on the mechanisms by which risk factors affect vagal cardiac responsiveness point to the central nucleus of the amygdala (CEA) as a major integrator of the behavioral and vagal cardiac responses to psychosocial stressors. Aminergic and vasopressinergic transmitter/modulator mechanisms in the brain, particularly in the CEA, may be involved.

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TEMPORAL DYNAMICS OF THE STRESS RESPONSE: ROLE IN THE DEVELOPMENT OF PATHOLOGY.

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Stress is considered to be a major factor in the etiology of a variety of pathologies like chronic heart disease, depression, anorexia, infectious diseases, etc. An important source of stress in everyday life concerns the complex social environment in which many animal species including human beings, are living. Studies in humans emphasize the importance of major social life events in the development of cardiovascular pathology or depression. Therefore, in our experimental approach in animal models we focus on the behavioral and physiological consequences of a single social stress. The type of stress used in our studies concerns the loss of social status in male rats due to social defeat by a dominant male conspecific. Such a social defeat will induce a classical stressresponse, i.e. an acute and strong increase in heart rate, bloodpressure and body temperature, as well as strong neuroendocrine responses (corticosterone, prolactin, adrenaline, noradrenaline, testosterone). However, more chronic recordings indicate a different timecourse of the various stress parameters. Whereas the cardiovascular and catecholaminergic response to a one hour social defeat diminishes within one or two hours after the defeat, the corticosterone response lasts more than four hours. After the initial rise, plasma testosterone drops below baseline levels and remains at extremely low levels for about two days. A single social defeat appears to induce changes in the circadian variation in body temperature for about ten days. Preliminary observations suggest that also the proliferative capacity of lymphocytes is changed for a period of several weeks. The behavioral-and physiological experiments support our conclusion that the single life event stress used in our experiments induces a depression-like syndrome which may last for three or more weeks. In fact, social defeat induces a dynamic change in physiological state, which seems to make the animal more vulnerable to the pathophysiological consequences of subsequent stressors.

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