Chapter

Introductory Chapter: How Does Stress Impact Human Body?

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1. Introduction

Epidemiologic, clinical, and experimental studies show that the stress either acute or chronic affects deleteriously the functions of visceral system in some degree [1]. Stressors significantly impact physical and emotional well-being. Reported studies clearly show that there is a strong relationship between stress and several disorders from inflammation, metabolic, reproductive, autoimmune, and growth disorders to malignancy [1, 2]. It is well defined that all the biological systems of the human body, even skin and collagen tissue, were affected by stress [2]. In a stressful situation, the musculoskeletal system is also affected and muscles get tensed up. Actually, muscle tension is a reflex reaction to protect body against injury and pain. Clearly understand the molecular mechanisms and biochemical pathways of stress hormones provides better control of diseases arise from stress. The neuronal and endocrinal pathway of stress response is well understood [2, 3]. However, there is still necessity for further research to comprehend molecular mechanisms of the stress response. For this reason, researchers are exploring the exact mechanisms of stress-induced pathology which require molecular and biomedical research [3, 4]. Life always together with the stress and organism response to stressors varies individually. Also, the target organ of stress varies for each person. In this review it has been summarized the effects of stress in human body.

2. Nervous system

The nervous system is divided as the central (involving the brain and spinal cord—CNS) and the peripheral (consists of the autonomic and somatic nervous systems—ANSs). The central nervous systems directly regulate body's endocrine system. The CNS is particularly important in stress responses, but the ANS plays a key role in physical response to stressors. The ANS consists of sympathetic nervous system (SNS) and parasympathetic nervous system (PNS). The sympathetic nervous system activated adrenal gland to release hormones called stress hormones adrenalin (epinephrine) and cortisol [1, 3, 4]. These hormones are responsible for the activation of autonomic nerves that coordinate the cardiovascular, respiratory, gastrointestinal, and musculoskeletal systems. The SNS becomes active during stress reaction to regulate physiological functions of human body and provide adaptation to emergency situation. When emergency situation is over, the PNS activated several physiological functions to return organism to peaceful condition [1, 3, 4]. Namely, the PNS has opposite effects to the SNS. In summary, the SNS prepares organism for the "fight or flight" and the PNS for rest and digest. Continuous activation of the sympathetic nervous system causes several problems in visseral system. The response of the brain to stressors is complicated. It has been

clearly shown that chronic stress decreases the brain mass and leads to atrophy in important parts of the human brain such as hypocampus, hypothalamus, and amygdala, thus disturbing main brain functions such as memory and cognition [6]. However, it has been reported that the effect of stress on memory was dependent on the time of exposure to the stressful stimulus. Researchers claim that exposure to stress before learning activity might be increased in the power of memory in their study [5].

3. Immune system

Both the SNS and the PNS interact with the immune system. Therefore, the immune system is affected by stressors, and it can also modulate stress reactions. It has been established that instant stressors do not change immune functions. Rather acute stressors cause to increase on natural immune factors such as natural killer cells, granulocytes, interleukin, and IgA [2]. However, it has been reported that chronic stressors activated hypothalamic-pituitary-adrenal (HPA) axis (one of the two main systems mediates a stress response) and HPA releasing glucocorticoids, hormones that suppress immune system in multiple levels. It has been proved that the long-term stress can impair the connection between the immune system and the HPA axis, and it is resulted as physical and mental health problems [1, 6]. It is clearly known that glucocorticoids decrease cytokines and other mediators of inflammation and cause cellular inflammation in the human body. Because of the sympathetic nervous system that innervates bone marrow and spleen, which are the main immunological structures, the long-term stress heavily influenced the function of these structures. Stressors depress immune functions of the organism and increase the susceptibility to host of several diseases. In a depressed immune system, the risk of several diseases such as collagen tissue, infection, inflammation, malignancy, connective tissue, and skin disorders increases [2].

4. Cardio-vascular system

Stressors may have profound inflammation especially in the coronary arteries and deleterious effect of cardiovascular system. Stressors activated the sympathetic nervous system and thus affect the function of the circulatory system. These activations initially lead to increase in the heart rate, venous narrowing, arterial vasodilation of skeletal muscles, and contraction of the splenic and kidneys' arteries and thus decrease sodium excretion. In course of time, it has led to increased coronary vasoconstriction, atherosclerosis, and increased blood pressure. Chronical stimulation of the sympathetic nervous system also increased the risk of myocardial ischemia, cardiac arrhythmias, platelet aggregation, endothelial dysfunction and, finally, sudden death [1, 3].

5. Gastrointestinal system

The brain-gut axis is a bidirectional connection between the brain (parasympathetic-sympathetic pathways) and the enteric nervous system. Stress strongly influences the brain-gut pathway. The corticotropin-releasing hormone (CRH) manages this process. It has been reported that stress can have several negative effects on gastrointestinal functions. The various gastrointestinal problems were defined related to stress from gastroesophageal reflux and peptic ulcer to inflammatory

bowel disease. Either acute or chronic stress affects gastrointestinal motility patterns. Stress increases the intestinal permeability and colonic inflammation [1, 7]. Stress also changes microbiata. While acute stress decreased gastric motility and increased colonic motility, the chronic stress decreased colonic motility. Acute stress leads to delayed gastric emptying, and the long-term exposure to gastric acid results to gastric ulcer. Acute and chronic stress affects brain-gut communication and thus influences emotions [1, 7].

6. Endocrine system

Actually, the stress response is an adaptive reaction of the organism. The purpose of the stress response is to sustain homeostasis. Hypothalamic-pituitary-adrenal axis is primarily responsible for endocrine stress response. HPA axis activated the production of glucocorticoids. During stress, the hypothalamus activated the pituitary gland, and pituitary gland activates adrenal glands to produce cortisol. Cortisol directly affects human biological systems. Cortisol has an important role for the circadian rhythm, glucose and lipid metabolism, and regulation of blood pressure. Cortisol production is necessary throughout the day to maintain daily cycle of energy. But the production of cortisol needs to be slowly declining according to biological rhythm. During a long-term stress, an increased level of cortisol leads to prolonged or extreme challenge for biological system [1–3].

7. Respiratory system

Many emotional and physical stressors increase the ventilation in humans such as excitement, fear, exposure to sudden and long-term cold, heat, hypoxia, and severe pain. Several clinical studies show that there is a strong relationship between lung disease and chronic anger. Acute stress causes many of distresses in respiratory system from rapid breathing and hyperventilation to shortness of breath. Acute stress could trigger asthma attacks but it has been reported that chronic stress aggravate asthma and chronic obstructive pulmonary disease, chronic bronchitis, and emphysema [8–11].

8. Reproductive system

Acute stress and chronic stress cause several problems in female reproductive system, from menstruation, premenstrual syndrome, sexual desire, pregnancy to menopause. It has been shown that high levels of stress could be associated with absent or irregular menstrual cycles, more painful periods, and changes in the length of cycles. Also, the male sexual desire, reproduction, and diseases of the reproductive system are affected by the nervous system. Long-term and excessive cortisol releasing might affect the normal biochemical functioning of the male reproductive system. While the parasympathetic nervous system causes relaxation, the sympathetic nervous system activates sexual desire in males [12, 13].

9. How to cope with the stress

It has been reported that some people are more vulnerable than others to stress-related health problems [4]. Because of the stress that is not inevitable in life, it is

important to learn how one can manage it. There are myriad of effective ways to reduce stressors in life. Living accordingly with the circadian rhythm is one of the most important stress-reduced factors. Regular physical activity, especially the long distance walking, healthy nutrition, adequate sleep, living in healthy environment, solve economic problems, life satisfaction, and healthy social network and support are known as stress-relieving lifestyles. It has been clearly shown that applying relaxation techniques and adapting stress-relieving lifestyles improve the emotional function and reduce stress-influenced disorders, such as chronic pain, headache, obesity, diabetes, heart disease, hyperthyroidism, gastric ulcer, hair loss, and sexual dysfunction. Physical activity is the most effective way to manage endocrine system and mediate stress. It has been reported that diaphragmatic breathing practice improves the cognitive performance and reduces the adverse effect of stress in healthy adults [6, 14–17]. It has been provided that effective stress management strategies such as meditation, yoga, deep breathing, which is defined as a mindfulness activity efficient for integrative body-mind training and reduces stress-related disorders, contribute to healthy lifespan, increase the quality of life, and prevent sudden death [18].

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