20.2A: Stress and Immunity

Evidence shows that stress has a negative effect on the body’s immune system.

Learning Objectives

• Describe the effects of stress on the immune system

Key Points

• Cortisol is released in the adrenocortex by the neuroendocrine activity of the hypothalamus and anterior pituitary gland during acute stress responses, which involve sympathetic nervous system stimulation to cause a fight or flight response.

• Chronic stress is a state of prolonged tension from internal or external stressors, which may cause various physical manifestations—asthma, back pain, arrhythmias, fatigue, headaches, high blood pressure, irritable bowel syndrome, ulcers, high blood sugar, diabetes, heart problems, and Cushing’s syndrome.

• Cortisol, a hormone released during stressful situations, affects the immune system by preventing the production of inflammatory mediators. During chronic stress, cortisol is overproduced, causing fewer receptors to be produced in immune cells and inducing chronic inflammation.

• Managing stress is important for maintaining a healthy lifestyle. Exercise, meditation, hobbies, social activities, and listening to music are all effective ways to manage stress.

Key Terms

• stress: Emotional pressure suffered by a human being or other animal.
• **Cortisol**: The hormone that facilitates the physiological response to stress by raising blood sugar to increase cellular metabolism, activating the sympathetic nervous system and suppressing the inflammatory response.

**EXAMPLES**

In one study, individuals caring for spouses with dementia, representing the stress group, saw a significant decrease in immune response to an influenza-virus vaccine compared to a non-stressed control group.

Stress is the body’s reaction to any stimuli that disturb its equilibrium. Stress responses release a hormone called cortisol in the adrenocortex through a complex neuroendocrine pathway that is controlled by the hypothalamus and anterior pituitary gland.

**Effects of Acute Stress on the Immune System**

Cortisol has numerous effects on the body, such as sympathetic nervous system activation, increasing blood sugar for energy purposes, and anti-inflammatory effects that include the inhibition of certain inflammatory mediators that are important in innate immunity. For example, expression of IL-1 IFN-gamma and TNF-alpha from immune cells are all inhibited by cortisol, while cytokines that control helper T-cell activity are increased. Evolutionary biologists believe that this stress mechanism is intended to protect the immune system from becoming overactive to facilitate the fight-or-flight response, which would be weakened by inflammation. Other studies show that the weakened inflammatory effect makes pathogen-caused diseases more likely to lead to infection.

Research studies in which participants were subjected to a variety of viruses showed that stress has a negative effect on the immune system. A study was conducted using a rhinovirus, the causative agent of the common cold. Participants were infected with the virus and given a stress index. Results showed that an increase in score on the stress index correlated with greater severity of cold symptoms. Studies with HIV have also shown that stress speeds up viral progression. Men with HIV were two to three times more likely to develop AIDS when under above-average stress.

**Effects of Chronic Stress**

Normally, stress responses are beneficial for the body, provided they are moderate and cortisol returns to normal levels after the stressful situation ends. Chronic stress occurs when the body’s stress levels remain too high for too long and do not return to normal levels for long enough. Chronic stress is associated with many chronic diseases, including asthma, back pain, arrhythmia, fatigue, headaches, high blood pressure, irritable bowel syndrome, ulcers, high blood sugar and diabetes.

Chronic stress takes a more significant toll on the body than does acute stress. It can raise blood pressure enough to cause hypertension, increase the risk of heart attack, stroke, and cardiac hypertrophy, increase vulnerability to anxiety and depression, contribute to infertility, and hasten the aging process. Cushing’s syndrome is a chronic disease caused by persistent and excessive cortisol levels (from stress and often tumors that secrete cortisol). It typically causes weight gain, hair growth, and increased risk for diabetes. Over time, immune cells may become desensitized to cortisol and express fewer cortisol receptors, so chronic inflammation can develop as the anti-inflammatory effect of cortisol is
weakened.

**Skin Ulcer**: Erythema nodosum—lesions that occur in some patients suffering from inflammatory bowel syndrome.

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**Dealing with Stress**

Proper stress management is important for good overall health because it can prevent the plethora of chronic diseases and short-term illnesses incurred by a stressful lifestyle. Common effective ways to manage stress include exercise, meditation, therapy, and participating in hobbies, music, and social activities. Exercise relieves stress through endorphins, which have an inhibitory effect on cortisol secretion. Other activities like meditation and listening to music have been found to calm the mind, which can relax the parts of the brain responsible for the stress response (such as the anterior pituitary gland). There are many other ways to deal with stress, and they all have the potential to improve both mental and physiological health.

**LICENSES AND ATTRIBUTIONS**

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