McCance: Pathophysiology, 6th Edition

Chapter 10: Stress and Disease

Key Points – Print

SUMMARY REVIEW

Concepts of Stress

1. Modern society is full of stress.
2. Psychologic stress may cause or exacerbate (worsen) several disease states. Stress is directly related to the cause of or affects the severity of symptoms and outcomes of diseases and conditions. Research is focused on the mechanisms responsible for these mind-body interactions.
3. Stress has been defined as the state of affairs arising when a person relates to (i.e., interacts or transacts with) situations in a certain way. Important is how he or she appraises and reacts to situations.
4. In general, a person experiences stress when a demand exceeds a person's coping abilities.
5. Hans Selye identified three structural changes in rats subjected repeatedly to noxious stimuli (stressors): enlargement of the cortex of the adrenal gland, atrophy of the thymus gland and other lymphoid tissues, and gastrointestinal ulceration.
6. Selye believed that the three changes were caused by a nonspecific physiologic response to any long-term stressor. He called this response the GAS.
7. The GAS occurs in three stages: the alarm stage, the stage of resistance or adaptation, and the stage of exhaustion. Diseases of adaptation develop if the stage of resistance or adaptation does not restore homeostasis.
8. Selye identified three components of physiologic stress: the stressor, the physiologic or chemical disturbance produced by the stressor, and the body's adaptational response to the stressor.
9. The nonspecific physiologic response consists of interaction among the sympathetic branch of the ANS and other neural signals that activate the endocrine system known as the HPA axis.
10. The nonspecific physiologic response is a common residual response and can be elicited with diverse agents such as cold, heat, x-rays, adrenaline, insulin, tubercle bacilli, and muscular exercise. Although the reactions of these stages are nonspecific, evidence supports the coexistence of highly specific, adaptive reactions to any of these agents.
11. As with a physically mediated stress response, psychologic stressors can elicit a reactive stress response, that is, a physiologic response derived from psychologic stressors.
12. Another type of psychologic-mediated stress response is the anticipatory response.
13. In a conditioned response, the organism learns that specific stimuli are associated with danger and anticipation of subsequent encounters with that particular stimulus produces a physiologic stress response.

14. Psychoneuroimmunology is the study of the interaction of consciousness (psycho), brain and spinal cord (neuro), and the body's defense against external infection and abnormal cell division (immunology).
15. Psychoneuroimmunology assumes that all immune-related disease is multifactorial. The immune system is integrated with other physiologic processes and is sensitive to changes in CNS and endocrine functioning, such as those that accompany psychologic states.
16. Important is release of CRH centrally from the brain and peripherally at inflammatory sites.

Stress Response

1. The stress response is initiated by the CNS and endocrine system. Where the stress response begins depends on whether the stressor is perceived or real.
2. Perceived stressors elicit an anticipatory response that usually begins in the limbic system of the brain. The limbic system elicits an endocrine stress response indirectly by stimulating neural pathways responsible for receiving sensory information and elicits a central response directly by stimulating the LC to release LC/NE.
3. Real stressors elicit a reactive response that can begin either in the limbic system or in the brain in response to specific sensory information. This information is then relayed to the PVN. The PVN stimulates the LC and both central and endocrine stress responses.
4. The neuroendocrine response to stress consists of sympathetic stimulation of the adrenal medulla to secrete catecholamines (norepinephrine and epinephrine) and stressor-induced stimulation of the hypothalamus to secrete CRH, which in turn stimulates the pituitary to secrete ACTH, which then stimulates the adrenal cortex to secrete steroid hormones, particularly cortisol.
5. In general, the catecholamines prepare the body to act, and cortisol mobilizes energy (glucose) and other substances needed to fuel the action.
6. Epinephrine exerts its chief effects on the cardiovascular system. Epinephrine increases cardiac output and increases blood flow to the heart, brain, and skeletal muscles by dilating vessels that supply these organs. It also dilates the airways, thereby increasing delivery of oxygen to the bloodstream.
7. Norepinephrine's chief effects complement those of epinephrine. Norepinephrine constricts blood vessels of the viscera and skin; this has the effect of shifting blood flow to the vessels dilated by epinephrine. Norepinephrine also increases mental alertness.
8. CRH influences the immune system indirectly by the activation of glucocorticoids (cortisol) and catecholamines. Peripheral CRH is proinflammatory, causing vasodilation and vascular permeability. It appears that the mast cells are the target of peripheral CRH.
9. Cortisol's chief effects involve metabolic processes. By inhibiting the use of metabolic substances while promoting their formation, cortisol mobilizes glucose, amino acids, lipids, and fatty acids and delivers them to the bloodstream. Cortisol's effect on the immune system is concentration and location dependent and may include either stimulation or inhibition of the immune system.

10. The nervous, endocrine, and immune systems communicate through the common use of signal molecules and their receptors, which in turn regulate the behavior of cells in each system during stress challenge.
11. There are direct and indirect pathways of influence among the nervous, endocrine, and immune systems. Neuropeptides have direct effects on immune cells, as well as indirect influences through neuromediated endocrine modulation of immune function. Endocrine products (cortisol) also influence nerve cell behavior. Immune cell products affect both nerve and endocrine cell function, reflecting an adaptive role for the immune system as a "signal" organ to alert other systems of threatening stimuli.
12. Other hormones are affected by the stress response and include increased circulating levels of β-endorphins, growth hormone, and prolactin and a decrease in antidiuretic hormone with extreme stress. Luteinizing hormone, estradiol, progesterone, and possibly testosterone decrease during the stress response.

Stress, Personality, Coping, and Illness

1. Stress is a system of interdependent processes that are moderated by the nature, intensity, and duration of the stressor and the coping efficacy of the affected individual, all of which in turn mediate the psychologic and physiologic response to stress.
2. Many studies have linked psychologic distress with altered immune function, and evidence strengthens the association of stress with potential for illness in humans.
3. Adaptive coping strategies, especially those that are problem focused and those that encourage seeking social support, are beneficial during stressful experiences.

Aging and Stress: Stress-Age Syndrome

1. With aging, sometimes a set of neurohormonal and immune alterations develop; these changes have been defined recently as stress-age syndrome.
2. These stress-related alterations of aging can influence the course of developing stress reactions and lower adaptive reserve and coping.