



Impact of Stress on Physiology of Endocrine System and on Immune System: A Review

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Abstract: Stress is a condition of the body which change the equilibrium between the body and its environment. Stress is either short term or long term. short term stress may lasts for few hours but long term lasts for few months. long term stress causes many health problems like respiratory infections, lack of sleep, poor diet etc. Many hormones involve in the stress response like cortisol, epinephrine, norepinephrine, gonadotropins. Immune system also affected with stress. Stress weakened the immune system. Stress causes an increase in the white blood cells (WBC) in the blood. This review discusses the effect of stress on hormones and on immune system. Chronic or long-term stress can suppress the pathological and protective immune responses While short-term stress can increase the expression of pathological and protective immune responses.

Keywords: Stress, Hormone, Immune System, Short-Term Stress, Long-Term Stress

1. Introduction

Stress is an response of an organisms to environmental conditions. It is also defined as stress is a situation which alter the equilibrium between a body and its environment. Stress can also be define as it is an aspects of internal and external disturbance, and stimulus perception by an living organism or on physiological response to the stimulus on the body of organism [24, 30]. Various stressful conditions occur in day to day life like some medical disorders, work pressure, psychological stress, High performance jobs, respiratory infections, poor diet, lack of sleep, physical stress. Long term stress causes many health effects. These effects are mediated through the action of stress on immune system [1, 12, 13, 27]. There are two major systems are working on stress: Autonomic nervous system and Hypothalamic-Pituitary adrenal (HPA). Cortisol influence the immunological, psychological and metabolic functions of the body which is regulated by Hypothalamic-pituitary adrenal axis.

Chronic stress or long term stress can be harmful because it lasts for several weeks or months and short term stress may lasts for few minutes to hours [9, 23]. It is associated with inflammatory state which causes fat accumulation. Such chronic inflammatory stress can cause detrimental effects on various organs and systems such as liver, cardiovascular

system which enhance secretion of fibrinogen and C-reactive protein, hypertension, atherosclerosis, and cardiac dysfunction [18]. Many hormones have been playing role in stress response these are epinephrine, norepinephrine, Gonadotropins, growth hormone, glucocorticoids and thyroid hormones. Several studies shown that glucocorticoids and catecholamines induce rapid changes in leukocyte distribution because these hormones are mediators of the effects of stress [7, 19, 25].

2. Changes in Endocrine System During Stress

Many researchers worked on functions, effects and relation between hormones and brain and their effect on behaviour and emotions (28, 26). Various hormonal changes occur in the body in response to stress. It enhanced the secretion of various hormones including:

Catecholamines (Epinephrine and Norepinephrine)

Catecholamine are released from adrenal glands. Primary function of adrenal gland is to manage stress. Catecholamines stimulates the pituitary-adrenal axis. Stimulation of catecholamines leads to increase in sodium retention, increased glucose, increased cardiac output, bronchiolar dilation and cutaneous vasoconstriction [21].

When stress occur the fight or flight system stays on and adrenal gland continue the release large amount of adrenal hormones such as adrenalin and cortisol. Due to excess release of adrenal hormones blood pressure and heart beat elevated and immune system is weakened.

Growth Hormone

The level of growth hormone increased upto ten fold during stress. Due to increase in the level of growth hormone metabolic activity of the body enhance.

Thyroid Hormones

During stress the level of T3 (Triiodothyronine) and T4 (Thyroxine) decreases. Due to the action of glucocorticoids on Central Nervous System (CNS), stress inhibits the Thyroid stimulating hormone (TSH) secretion [22].

Gonadotropins

There is decrease in the secretion of gonadal hormones in the body due to stress which leads to disruption in the normal functioning of menstrual cycle in females and lead to disturbances in the normal function of reproductive system [6].

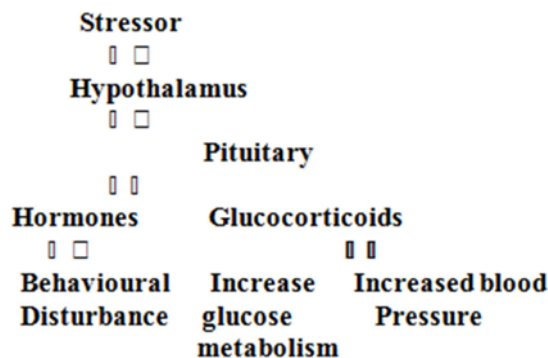


Figure 1. Body's Response to Stress.

3. Effect of Stress on Immune System

Immune system and neuroendocrine system are interlinked and communicate with each other. This relationship between the two systems regulate the cell mediated and humoral responses [32, 33]. Stress influence the body's response to infection. Peptide hormone produced from immune cells and endocrine system are interact through ligand receptors to each other [4]. Stress causes an increase in white blood cells in the blood. Immune cells produce β -endorphin, dynorphins and enkephalins [5].

Stress prepare the immune system for infection that may imposed by a medical procedure. Stress can enhance the primary and secondary immune response. Intensity of stress may be measure by the level of stress hormones and by some physiological changes in the body such as increase in blood pressure, heart beat etc.

Some researchers demonstrated short term stress during primary or secondary antigen exposure significantly increases the immune response in their preclinical studies [15, 16, 29, 36]. Pro-inflammatory diseases such as cardiovascular disease, dermatitis, and asthma, autoimmune

diseases such as arthritis and multiple sclerosis are frequently observed due to enhancement of immunoprotective responses of short-term stress [2, 3, 8, 34, 38].

Chronic or long-term stress can cause immunosuppression which can delay wound healing, increases susceptibility to infections, suppress the response of vaccines and can cause cancer [10, 14, 20, 31, 35]. In comparison to short-term stress, long-term or chronic stress has been shown to decrease the immune function and sometimes it dysregulate the immune function [37]. Some of the researchers studied that some of the hormones such as corticosterone and epinephrine are important mediators of short-term stress induced immuno-enhancement. If adrenal gland were removed then it eliminates the glucocorticoid and epinephrine stress response, and also eliminate the stress-induced enhancement of cell-mediated immunity. If the administration of epinephrine is low then it significantly enhance the immune response [17].

Rheumatoid arthritis a inflammatory disease may be mediated by immunosuppression that is normally functional by sympathetic nerves that innervates the inflamed tissue and also driven by the cortisol through cytokine-induced activation of the hypothalamic-pituitary-adrenal axis [11].

4. Conclusion

This review focusing on the effect of stress on endocrine system and on immune system. As a adaptive response to stress there are various changes in the hormones level. These changes required for the fight or flight response to stress. Long term stress may lead to various immunological and endocrine disorders.

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