The purpose of this article is to provide an overview about psychological diseases and immune system. It focuses on the importance and ubiquity of human psychoneuroimmunology in understanding the role of psychological factors in health and disease. The science that deals with the interaction of psychological disease and immune system is called psychoneuroimmunology, a relatively new discipline in the constellation of sciences. It integrates aspects of psychology, neuroscience, endocrinology, and immunology so focuses on the interactions between the psyche, nervous system, endocrine system and immune system (Ader, 1981, 1991). The connection between brain and immune system is completed by the autonomic nervous system and the hypothalamic-pituitary-adrenal axis. The nervous system activity and endocrine functions influence the immune system which protects organisms from infection with layered defenses of increasing specificity. Disorders in the immune system can cause various diseases. Immunodeficiency diseases occur when the immune system is less active than normal, resulting in recurring and life-threatening infections. Immunodeficiency can either be
the result of a genetic disease or be produced by pharmaceuticals or an infection, such as the acquired immune deficiency syndrome (AIDS) that is caused by the retrovirus HIV. Psychosocial environment affects the health of an individual, while depression, stress and schizophrenia have been implicated in causing a deficient immune system. Further, perceived mood is also considered to play a role in immune system. This article is an attempt to focus on immune system and its network in the development of psychological diseases.

The immune system is quite complex structure. Its memory capacity is almost unlimited (Gray, 1992). It can remember and store information about millions of different enemies and pathogens. The immune system consists of a varied network of cells, tissues, and organs. These elements work in tandem to protect and defend body from harmful pathogens. The term pathogen refers to harmful organism such as bacteria, parasites, viruses, and fungi. Since human body provides an ideal environment for many pathogens, they try to enter in the body and weaken the body defense system. It is the immune system’s responsibility to keep them away and destroy them when need arises. These pathogens are the source of many diseases such as pneumonia which is caused by bacteria. AIDS and influenza are caused by viruses, and malaria is caused by parasites. These foreign agents are also called antigens.

Immune system has to work on two fronts. First is identification of pathogens and next is elimination of those pathogens. Once pathogens are detected immune system must destroy them in some ways. Different pathogens need to be destroyed differently. The component of immune system which destroys pathogens is called effectors. One of the important features of immune system is its ability to distinguish between the body’s own cells (self) and foreign cells (nonself). The body’s immune defenses and cells that keep self marker molecules coexist peacefully. Whenever immune defenders come across cells or
organisms that keep markers that say ‘foreign,’ they react and destroy them. Whenever immune system fails to differentiate between self and nonself cells, it results into two unpleasant conditions. In one situation where immune system makes mistake of self for nonself, it launches an attack against the body’s own cells or tissues. The situation is called an autoimmune disease. Some forms of arthritis and diabetes are autoimmune diseases. In other situation, the immune system reacts to a harmless foreign substance such as ragweed pollen. The result is allergy. This kind of antigen is called an allergen.

The organs of the immune system are spread throughout the body e.g., lymphoid organs that are the reservoir of lymphocytes, and small white blood cells that are the key players in the immune system. Bone marrow is the source of all blood cells. The thymus is an organ that lies behind the breastbone; lymphocytes known as T lymphocytes, or just “T cells,” mature in the thymus. Lymphocyte can travel throughout human body through blood vessels.

Structure of Immune System

The immune system is multilayered structure with different level of defense. Skin is the first barrier to infections. Skin can not be penetrated by most of the organisms unless there is some kind of opening such as cut and scratch. The next barrier is physiological, where conditions such as pH value and temperature provide inappropriate environment to pathogens to survive. In human body, there are generally two types of immune system: innate immune system and adaptive immune system (Hofmyer, 2005). Both systems work together to prevent foreign organism to enter and destroy them even if they enter.

Innate Immune System

The innate immune system refers to what we are born with and it is nonspecific. It recognizes and responds to pathogens in
general way. It does not change or adapt. It does not provide long lasting defense against harmful microorganism. However, it provides rapid and first line of defense in case of foreign attack. Innate immunity consists of chemical reaction called complement. It also involves endocytic and phagocytic systems. There are several types of phagocytes. Monocytes are phagocytes that circulate in the blood. Granulocytes are also another kind of immune cells. They contain granules filled with chemicals which help to destroy microorganisms. Neutrophil, Eosinophil, and Basophil are also granulocytes. They perform specialized role in the immune system. Endocytic and phagocytic systems contain macrophages which are also called roaming ‘scavengers’ that identify and destroy extra cellular molecules and materials. Thus they remove the harmful organism from the body. Apart from that, acid (pH < 7.0) of skin secretions inhibits bacterial growth. Hair follicles secrete sebum that keeps lactic acid and fatty acids both of which inhibit the growth of some pathogenic bacteria and fungi. Saliva, tears, nasal secretions, and perspiration contain lysozyme, an enzyme that destroys Gram positive bacterial cell walls causing cell lysis. Another cell involved in innate immunity is the natural killer cells. Inflammation is the first reaction of the immune system to infection.

Adaptive or Acquired Immunity

Unlike innate immune system, adaptive immune response takes days to activate. It recognizes and responds to pathogens in specific way. Adaptive immune system has memory that produces quicker and stronger response next time in reaction to foreign agent.

The cells of adaptive immune system are special types of leukocytes. They are called lymphocytes. The major lymphocyte cells are B cells and T cells. They are generally derived from Pluripotential hemopoietic stem cells in the bone marrow. Humoral immune responses are produced by B cells whereas cell mediated
immune responses are produced by T cells. There are two subtypes of T cells, the killer T cells and the helper T cells. Both B and T cells have receptors that recognize specific target. T cells identify “non-self” target. Killer T cells identify only antigen which coupled to Class I MHC (Major Histocompatibility Complex) whereas helper T recognize antigen coupled with class II MHC. MHC molecules are proteins recognized by T cells while distinguishing between self and non-self. These two mechanisms of antigen reflect different roles of the two types of T cells.

Killer T cells are also called cytotoxic T lymphocyte (CTL). These cells directly attack other cells that carry specific foreign or abnormal molecules on their surface. CTL are very adept and useful to attack viruses because viruses hide from other parts of immune system easily grow inside the infected cells. CTL easily identifies the small fragment of these virus that protruding from the cell membrane and launch attack on them.

The zndtype of T cells, Helper T cells coordinate immune responses by communicating with other cells. Some helper T cells stimulate B cell, other microbe gobbling cell, phagocytes and still others activate other T cells.

Natural Killer (NK) cells are another kind of lethal lymphocyte. The major difference between natural killer cells and killer T cells is that killer T cells search for antigen fragment bound to self- MHC molecules, while NK cells recognize cells which lack self- MHC molecules.

Unlike T cells, B cells are antigen specific. They work by secreting substance called antibodies in the body’s fluid. Antibodies kill antigen circulating in the bloodstream. Each B cell is supposed to make one specific antibody.

**Immune System and Nervous System**

There are mainly two pathways that connect the brain and the immune system. These are autonomic nervous system and the
hypothalamic-pituitary-adrenal axis (HPA). The communication between these two pathways is completed by chemical messengers which are released by nerve cells called endocrine organs, and immune cells (Altman, 1997). The nervous system influences immune system both directly and indirectly. The direct effect is produced by the snapping of neurons with white blood cells in lymphoid tissues, whereas indirect effect is via blood borne neurotransmitters and hormones.

Hypothalamus is one of the important organs in the interaction between nervous system and immune system. It plays very crucial role in stimulating endocrine gland. The connections between the hypothalamus and the immune system are bi-directional. The brain not only transmits information to the immune system, but also receives information back from it. This is the basis of neuron-modulation of immune function. When the hypothalamus gets the message from cortical centres that there is a threat, it acts on the adrenal glands through the sympathetic nerves and indirectly through the pituitary gland via the blood stream, causing the adrenals to release corticosteroids, epinephrine, and nor-epinephrine. Corticosteroids perform a variety of functions; they have anti-inflammatory effects, raise blood sugar, inhibit allergic reactions, mobilize fat and prepare the body for action in other ways. Epinephrine and nor-epinephrine also prepare the body by acting on the heart, blood vessels, and back again on the brain. As a result of sympathetic nervous system activation and release of epinephrine and nor-epinephrine, a number of body events occur such as increased blood pressure, increased respiratory rate, increased heart rate etc.

**Neuro-endocrine Interaction**

Endocrine system is a chemical communication network that sends and receives messages through out the nervous system via the bloodstream. Although it is not a structure of the brain itself,
the endocrine system is intimately tied to the hypothalamus. The function of the endocrine system is to secrete hormones, chemicals that circulate through the blood and affect the functioning or growth of other parts of the body.

Releasing factor from hypothalamus activates the anterior pituitary gland which secretes a number of hormones such as growth hormone, prolactin, adrenocorticotropic hormone, thyroid stimulating hormones etc. Adrenal gland consists of adrenal cortex and the adrenal medulla. When adrenocorticotropic hormone stimulates the adrenal cortex, it secretes cortico-steriod. Adrenal cortex also secretes aldosterone which is triggered by pituitary stimulation. The adrenal medulla is stimulated directly by sympathetic nervous system. Adrenal gland thus plays a very important role to the body’s response to stressful stimuli through the production and release of stress hormones.

**Neuroendocrine-Immune Interactions**

Peripheral nervous system stimulates both primary and secondary lymphoid organs. These can be noradrenergic (sympathetic nervous system), cholinergic (parasympathetic system), or peptidergic (secreting neuropeptides) (Felten & Felten, 1991). Sympathetic nerve fibers stimulate not only lymphoid but also blood vessels, and muscle tissues throughout the body. Bone marrow is basically noradrenergic whereas thymus can be stimulated by noradrenergic, cholinergic, and peptidal fibers. Lymph nodes receive stimulation from noradrenergic and peptidergic fibers. Hypothalamus activates sympathetic nervous system which further, activates not only secondary lymphoid organs but also vessels and other organs in the body. Denervation or chemical blockade of sympathetic fibers changes immune responses in negative way (Madden & Livnat, 1991). The splanchnic nerves of the sympathetic system excite the adrenal gland that results into the secretion of catecholamines and enkephalins directly into the bloodstream. Thus, one can conclude
that there is a direct and two ways interactions between neuron-endocrine and immune system.

**Psychological Factors and Immune Function**

The endocrine system provides a kind of gateway for psychological influences on health and well being. Stress and depression can stimulate the release of pituitary and adrenal hormones. These have multiple effects on immune function (Rabin, 1999).

Stress can be defined as a process in which environmental demands strain an organisms adaptive capacity, resulting in both psychological as well as biological changes that could place a person at risk for illness (Cohen, Kessler & Gordon, 1995). External stress (e.g., death of a love done) is a cognitive sensory stimulus with initial processing through the peripheral and central nervous systems. Internal sensory in-put, or noncognitive stress (e.g., viral infection), is received by the immune system, which relays this information to the neuro-endocrine system (Blalock, 1984).

Internal factors such as stress have been implicated in causing a deficient immune system because of the nature of the body’s response in dealing with this problem. The capabilities of the immune system are diminished after frequent activation of the autonomic nervous system in the case of chronic stresses (Herbert & Cohen, 1993). NK cells are believed to be important component of the immune system’s surveillance. Stress can compromise immune systems’s ability to identify invader cells. Perceived mood also plays a role in immune system effectiveness. Positive mood and attitude is supposed to correlate with an increased ability of the immune system in fighting diseases. Correlations were observed in the number of lymphocyte cells and the person’s level of optimism.
In case of external factors, the social environment plays a very important role in immune functioning. If a person has an effective social support web, it increases the immune systems’ abilities (Cohen, 1988). The cardiovascular system could also have a positive response to this type of social support. Having positive social support could aid in blood pressure regulation, thus reducing the probability of a heart or related disease.

Stress can come in many forms. Anxiety, depression and life events can also cause stress. Stress can also trigger a major depressive disorder. The stress exposure can cause the glucocorticoid hormone to be overly active which causes a depletion of norepinephrine levels in locus coeruleus neurons. It has an effect of slowing the attentiveness within the individual. They become emotionless and inactive (Salzano, 2003).

Perceived stress is quite possibly a cause in and of itself as well. One person may see a stressor as a far greater problem than another individual who may not feel the same degree of ‘stress’ from the stressor. If an individual experiences great anxiety because of constant thought about a stressor, their fight or flight mechanism could be in perpetual heightened response. Just thinking about the stressor could set off the elevated response. These stresses amount to a constant initiating of the response multiple times a day if the thoughts preoccupy the individual.

Negative mood also affects immune system adversely. Individuals with negative mood is characterized by lowered NK activity, higher numbers of white blood cells, and lowered numbers of NK, B, T, helper T cells (Herbert & Cohen, 1993). Similarly, researches have shown that good interpersonal relationships are critical for the maintenance of health (Cohen, 1988; House et al., 1988). Glaser et al., (1985), Kiecolt-Glaser et al., (1984) have reported that individuals higher in self-reported loneliness had lower NK activity and higher levels of herpes virus antibody than those who described themselves as less lonely.
CONCLUSION

A well functioning immune system is must for the well-being and health of an individual. Compromised immune system influences incidence and severity of various disorders and diseases. Psychoneuroimmunology involves two way interactions between neuroendocrine and immune system. As mentioned above there is ample evidence that prove interactions of cells of these systems: the immune system’s interaction with the hypothalamic-pituitary-adrenal axis, the action of lymphoid organs by the autonomic nervous system, and the secretion of and receptors for identical chemical substances. Stress affects the body in a number of ways. Chronic stress has more deleterious effects than acute stress on immunological functioning. Psychoneuroimmunology holds promises to understand the interplay of psychological functioning, health and wellbeing. Thus it is concluded that the neuro-endocrine and immune systems form a regulatory network. This network is fundamental to the normal development and function of individuals from conception till death. This regulatory system also plays a role in host protection against pathological attack. This regulatory system also helps in regeneration and healing of human body.

REFERENCES


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