

# Stress and Disease

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## Stress

- A person experiences stress when a demand exceeds a person's coping abilities, resulting in reactions such as disturbances of cognition, emotion, and behavior that can adversely affect well-being

## Dr. Hans Selye

- Worked to discover a new sex hormone
- Injected ovarian extracts into rats
- Witnessed structural changes
  - Enlargement of the adrenal gland
  - Thymic and other lymphoid structure atrophy
  - Development of bleeding ulcers in the stomach and duodenal lining
- Dr. Selye witnessed these changes with many agents. He called these stimuli "stressors."

## General Adaptation Syndrome (GAS)

- Three stages
  - Alarm stage
    - Arousal of body defenses
  - Stage of resistance or adaptation
    - Mobilization contributes to fight or flight
  - Stage of exhaustion
    - Progressive breakdown of compensatory mechanisms
    - Onset of disease
- GAS Activation
  - Alarm stage
    - Stressor triggers the hypothalamic-pituitary-adrenal (HPA) axis
      - Activates sympathetic nervous system
  - Resistance stage
    - Begins with the actions of adrenal hormones
  - Exhaustion stage
    - Occurs only if stress continues and adaptation is not successful

## Stress Response

- Nervous system
- Endocrine system
- Immune system

## Psychologic Mediators and Specificity

- Reactive response
- Anticipatory response
- Conditional response



## Psychoneuroimmunologic Regulation

- Interactions of consciousness, the brain and spinal cord, and the body's defense mechanisms
- Immune modulation by psychosocial stressors leads directly to health outcomes
- Corticotropin-releasing hormone (CRH) is released from the hypothalamus

## Neuroendocrine Regulation

- Catecholamines
  - Released from chromaffin cells of the adrenal medulla
    - Epinephrine released
  - Mimic direct sympathetic stimulation
- Cortisol (hydrocortisone)
  - Activated by adrenocorticotropic hormone (ACTH)
  - Stimulates gluconeogenesis
  - Elevates the blood glucose level
  - Powerful anti-inflammatory and immunosuppressive agent



## Cortisol and Immune System

- Glucocorticoids and catecholamines
  - Decrease cellular immunity while increasing humoral immunity
  - Increase acute inflammation

## Stress-Induced Hormone Alterations

- $\beta$ -Endorphins
  - Proteins found in the brain that have pain-relieving capabilities
  - Released in response to stressor
  - Inflamed tissue activates endorphin receptors
  - Hemorrhage increases levels, which inhibits blood pressure increases and delay compensatory changes

## Stress-Induced Hormone Alterations

- Growth hormone (somatotropin)
  - Produced by the anterior pituitary and by lymphocytes and mononuclear phagocytic cells
  - Affects protein, lipid, and carbohydrate metabolism and counters the effects of insulin
  - Enhances immune function
  - Chronic stress decreases growth hormone
- Prolactin
  - Released from the anterior pituitary
  - Necessary for lactation and breast development
  - Prolactin levels in the plasma increase as a result of stressful stimuli

### **Stress-Induced Hormone Alterations - continued**

- Oxytocin
  - Produced by the hypothalamus during childbirth and lactation
  - Produced during orgasm in both sexes
  - May promote reduced anxiety
- Testosterone
  - Secreted by Leydig cells in testes
  - Regulates male secondary sex characteristics and libido
  - Testosterone levels decrease because of stressful stimuli
  - Exhibits immunosuppressive activity

### **Role of Immune System**

- Stress directly related to proinflammatory cytokines
- Link between stress, immune function, and disease
- Immune system affected by neuroendocrine factors
- Stress response decreases T cell cytotoxicity and B cell function

### **Stress, Personality, Coping, and Illness**

- A stressor for one person may not be a stressor for another
- Psychologic distress
  - General state of unpleasant arousal after life events that manifests as physiologic, emotional, cognitive, and behavior changes

### **Aging and Stress**

- Stress-age syndrome
  - Excitability changes in the limbic system and hypothalamus
  - Increased catecholamines, ADH, ACTH, and cortisol
  - Decreased testosterone, thyroxine, and other hormones
  - Alterations of opioid peptides
  - Immunodepression
  - Alterations in lipoproteins
  - Hypercoagulation of the blood
  - Free radical damage of cells

