Homeostasis and Stress

Homeostasis – dynamic process of regulation

anabolism and catabolism

positive and negative actions

Stress – an event that threatens or causes a change in homeostasis – people adapt to stress differently; if well then homeostasis is restored, if not illness results
Seyle’s Contributions to Stress Research

Found that harmful stimuli, no matter the source, resulted in a suite of outcomes (enlarged adrenal glands, decrease in size of lymph organs, and GI tract ulcerations – he called these stimuli **STRESSORS**

The suite of outcomes he referred to as the **GENERAL ADAPTATION SYNDROME (GAS)**: consists of three parts

1. alarm reaction
2. stage of resistance
3. stage of exhaustion
Seyle’s Contributions to Stress Research

- General Adaptation Syndrome
  - Alarm (fight-or-flight response)
Seyle’s Contributions to Stress Research

– Resistance – allows the body to return to homeostasis

  • Habituation – learning that the source of the stressor is not harmful – one can learn or train themselves for this, desensitization (biofeedback)

– Exhaustion

  • Body can no longer return to homeostasis
  • Medical care typically needed to aid the process

Many of Seyle’s concepts were questioned and have led to modern concepts of stress and the responses to it
Current Concepts

Stress system activation is designed to improve an organism’s ability to regain homeostasis and decrease the risk of exhaustion.
Current Concepts

- Neuroendocrine Interactions
  - Catecholamine Release
    - Look at Table 2-3 for effects

Stress Response of Body Tissues

- Adrenals
  - Catecholamines
    - Sympathetic pathways
      - Adrenocorticotropic hormone
        - Inhibit
          - Cortical steroids
      - Anterior pituitary
        - Excite receptors
          - STRESSORS (internal or external stimuli)
      - Hypothalamus
        - Sympathetic pathways
          - Stress Response of Body Tissues
            - Gluconeogenesis
            - Protein catabolism
            - Inhibition of glucose uptake
            - Suppression of protein synthesis
            - Stabilization of vascular reactivity
            - Immune response suppression
          - Enhanced blood coagulation
            - Increased respiration
            - Insulin suppression
            - Lipolysis
            - Glycogenolysis
            - Vasomotor changes
            - Elevation of cardiac output
Current Concepts

• Hypothalamic-Pituitary-Adrenal Axis
  
  – During stress several hormones are released
  
  • Aldosterone
    
    – Increases reabsorption of sodium
    – Increases secretion of potassium
    – Water follows sodium
      
      » Blood volume increases
      » Blood pressure increases

  • ADH
    
    – Decreases urine production
    – Increases blood volume
    – Increases blood pressure
Current Concepts

- CRH – results in the release of ACTH

- ACTH – increases the secretion of hormones from the adrenal cortex – aldosterone, testosterone, and cortisol
  - Cortisol – has wide ranging effects that can result in many health problems
    » Acts similarly to norepinephrine but effects persist longer (hours to days) – norepinephrine important in alarm stage; cortisol important in resistance and exhaustion stages
    » Stimulates gluconeogenesis (especially from amino acids)
    » Acts as a permissive hormone for the action of other hormones that increase blood levels of glucose
      
      epinephrine
      glucagon
      growth hormone

    » Greatly effects protein metabolism
      
      anabolic effect – liver
      catabolic effect - muscle, lymphoid tissue, adipose tissue, skin and bone
Current Concepts

» GI Tract

promotes gastric secretion (opposite the action of norepinephrine),
increasing the risk of ulcers

» Immunosuppression

reduces the response of all immune cells (name them!)
results in atrophying of lymphoid structures

All of these effects in small doses are adaptive but if continued
over long periods plays a strong role in stress-disease process

• Additional Hormones Associated with Stress

  – GH (somatotropin)

    • Affects protein, lipid and carbohydrate metabolism
    • Normally increases after exercise or psychological stimulus
      (fear)
    • Usually increases along with cortisol
Current Concepts

- Prolactin – like GH increases as a result of physical and psychological extreme stimuli

- Estrogen – not exactly sure

- Testosterone – may increase the stress response

• Stress Response and Endorphin Release

• Stress Response and the Immune System – not clearly understood but many factors are involved and several hypotheses and models are used
Current Concepts

- Stress Response and Disease

NERVOUS SYSTEM
- Neuropsychological manifestations
- Nervous tic
- Fatigue
- Loss of motivation
- Anxiety
- Overeating
- Depression
- Insomnia

INTEGUMENTARY SYSTEM
- Eczema
- Psoriasis
- Neurodermatitis
- Acne
- Hair loss

RESPIRATORY SYSTEM
- Increased respiration
- Asthma
- Hay fever

CARDIOVASCULAR SYSTEM
- Disturbances of heart rate and rhythm
- Hypertension
- Stroke
- Coronary artery disease

IMMUNE SYSTEM
- Immunodeficiency
- Immunosuppression
- Autoimmune disease

GASTROINTESTINAL SYSTEM
- Gastritis
- Irritable bowel syndrome
- Diarrhea
- Nausea and vomiting
- Ulcerative colitis

ENDOCRINE SYSTEM
- Hyperglycemia
- Diabetes mellitus

GENITOURINARY SYSTEM
- Diuresis
- Irritable bladder
- Impotence
- Frigidity
- Menstrual irregularity

MUSCULOSKELETAL SYSTEM
- Tension headache
- Muscle contraction backache
- Rheumatoid arthritis
- Inflammatory diseases of connective tissue
Current Concepts

• Stress Response and Age
  – Children
    • Hospitalization
    • Separation from parents
    • Loss
    • Pain
  – Aged
    • Aging itself
    • Stress may augment age related changes
    • Psychological, and social changes
      – Retirement with possible decreased income
      – Death of friends and relatives
Stress and Stressors

• Stress – very complicated
  – Strength and duration of stressor
  – Genetic makeup
  – Previous dealings with stressor
  – Coping strategies

• Stressors – anything that can produce stress
  – External – ex. Air pollution
  – Internal – ex. High blood pressure, fear of public speaking
  – General stressors
    • Extreme hot or cold
    • Chemical – tobacco smoke
    • Biological – bacteria
    • Social – overcrowding, war
    • Psychological - depression
Stress and Stressors

- Eventually prolonged stress will result in non-functionality (ex. Person with diabetes in a wartime situation)

- Response to a particular stressor will vary with age
  - Blood levels of bilirubin
  - Loss

- Scope of stressor – can be wide or narrow
  - Burn from an oven
  - Widow shortly after losing her husband (loss of income, coping mechanism, assistance in home care), having had heart surgery, etc.
Culture, Coping and Adaptation

- Culture – the combined customs, attitudes, values, and shared beliefs within a society
  - American Culture – emphasizes several characteristics that are in conflict with stress and successful ways of coping and adaptation
    - Going it alone, succeeding against all odds
    - Heroic ideal - sports, politics, religion, entertainment, business, education
  - Coping – based in the resolution of the problem at hand and the emotional perception of the problem – potential outcomes
    - Resolution of the stressful situation
    - Adaptation to the stressor
    - Exacerbation of the stressful experience
Culture, Coping and Adaptation

- Adaptation – biopsychological process of change in response to new or altered circumstances – can be either a positive or negative change