Homeostasis, Adaptation, and Stress

Chapter 5
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Objectives:
- By the end of this lecture students should be able to:
  - Explain homeostasis.
  - List four categories that affect homeostasis.
  - Identify the purpose of adaptation and two possible outcomes of unsuccessful adaptation.
  - Differentiate between sympathetic and parasympathetic adaptive responses.
  - Define stress.
  - List 10 factors that affect stress response.

Objectives continue:
- Name three levels of prevention that apply to the reduction of stress-related disorders.
- Explain psychological adaptation and two possible outcomes.
- Discuss the stages of the general adaptation syndrome.
- List eight nursing activities helpful to the care of clients prone to stress.
- List four approaches for preventing, reducing, or eliminating a stress response.
Definitions:

- **Homeostasis:**
  - Is relatively stable stat of physiologic equilibrium.

- **Holism:**
  - The sum of physical, emotional, social, and spiritual health.

- **Adaptation:**
  - How the organism responds to change. It requires the use of self protective properties and mechanisms for regulating homeostasis.

Stressors based on the principles of holism:

- Physiologic
- Psychological
- Social
- Spiritual

Physiologic Adaptation

- **Neurotransmitters**
  - Common neurotransmitters include:
    - Serotonin —— stabilize mood, induce sleep and regulate temperature
    - Norepinephrine —— Heighten arousal and raise energy
    - Acetylcholine together with dopamine —— promote coordination of movement
Physiologic Adaptation

- Neurotransmitters Continue:
  - Gamma-aminobutyric acid inhibits the excitatory neurotransmitters such as norepinephrine and dopamine (catecholamines)
  - Substance P transmits the pain sensation
  - Endorphins and enkephalins interrupt the transmission of substance P and promote sense of well-being.

Nervous System

- Peripheral nervous system
  - Autonomic NS
  - Somatic NS
- Central nervous system
  - Brain
  - Spinal cord
  - Sympathetic (Arousing)
  - Parasympathetic (Calming)
  - Cortex
  - Subcortex

Central nervous system:

- Involves the brain and spinal cord
- The brain divided into:
  - Cortex
  - Subcortex
Central nervous system:

- **Reticular Activating System**
  A Network of nerves passes, is the communication link between the body and mind.
  It sends massages to the cortex on both conscious and unconscious level.

### Autonomic Nervous System

<table>
<thead>
<tr>
<th>Target Structure</th>
<th>Sympathetic effect</th>
<th>Parasympathetic effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye</td>
<td>Dilates pupil</td>
<td>Constricts pupil</td>
</tr>
<tr>
<td>Sweat glands</td>
<td>Increase perspiration</td>
<td>None</td>
</tr>
<tr>
<td>Heart</td>
<td>Increases rate and force of contraction</td>
<td>Decrease rate and force of contraction</td>
</tr>
<tr>
<td>Skeletal muscle</td>
<td>Increase tone</td>
<td>Decrease tone</td>
</tr>
<tr>
<td>Liver</td>
<td>Release of glucose</td>
<td>None</td>
</tr>
<tr>
<td>Adrenal medulla</td>
<td>Stimulated</td>
<td>None</td>
</tr>
<tr>
<td>Digestive glands</td>
<td>Inhibits secretions</td>
<td>Stimulates secretions</td>
</tr>
<tr>
<td>Bronchial muscle</td>
<td>Relaxed (bronchodilation)</td>
<td>Contracted</td>
</tr>
<tr>
<td>Digestive motility</td>
<td>Decreased</td>
<td>Increased</td>
</tr>
<tr>
<td>Kidney</td>
<td>Decreased filtration</td>
<td>None</td>
</tr>
<tr>
<td>Bladder muscle</td>
<td>Inhibition (suppresses urination)</td>
<td>Stimulated (urge to urinate)</td>
</tr>
<tr>
<td>Salivary glands</td>
<td>Inhibit secretions</td>
<td>Increases salivation</td>
</tr>
<tr>
<td>Blood vessels in skin</td>
<td>Constrict causing pale appearance</td>
<td>Dilate blush or flush appearance</td>
</tr>
</tbody>
</table>
Autonomic Nervous System

Endocrine System

A group of glands located throughout the body

Endocrine System

- The pituitary gland:
  - Is the master gland located in the brain. It produces hormones that influence other endocrine glands.
  - It is connected to the hypothalamus, a subcortical structure.
  - The cortex stimulate the hypothalamus then activate the pituitary gland
- Feedback Loop:
  - Is the mechanism that control hormone production
  - It can be negative or positive
  - When one hormone decreases the releasing gland is stimulated. In a positive feedback the opposite occurs.
  - Homeostasis is maintained when hormones are released as needed.

http://www.biologymad.com/NervousSystem/nervoussystemintro.htm
Stress
- Is the physiologic and behavioral responses to disequilibrium.

Factors That Affect Response to Stress
- Intensity, number, duration of stressor(s)
- Physical health status
- Life experiences; coping strategies
- Social support; personal beliefs
- Attitudes
- Values

Physiologic Stress Response
- General Adaptation Syndrome
  - Collective physiologic processes in response to a stressor
- Alarm Stage
- Stage of Resistance
- Stage of Exhaustion

Alarm Stage
- Fight or Flight Response
- Sympathetic nervous system release Norepinephrine then the hypothalamus release corticotropin releasing factor which stimulate the pituitary gland to secrete adrenocorticotropic hormone which in turn stimulate the adrenal cortex to secrete cortisol.
- Cortisol increase blood glucose to meet the energy requirements of the body
- Prolonged elevation of norepinephrine, epinephrine, and cortisol predispose the client to stress related disorders
Alarm Stage Continue

- Actions of Cortisol:
  - Increase blood glucose level to meet the energy demand
  - Increase breakdown of proteins
  - Increase fat mobilization and use of fatty acids
  - Anti-inflammatory effect by decreasing capillary permeability thus reduce swollen, decrease phagocytosis by the white blood cells, suppress the immune system, reduce fever, reduce eosinophils, white blood cells active during infection and allergic reaction
  - Increase norepinephrine during trauma and stress

Stage of Resistance

- Restoration to normalcy
- Neuroendocrine hormones compensate for the physiologic changes
- Return to homeostasis

Stage of Exhaustion

- One or more adaptive/resistive mechanisms no longer protect the person under stress
- Stress continues, resistance failed, physical and mental deterioration leads to illness, and death.
Stages of General Adaptation Syndrome:

Psychological Stress Response

- Coping mechanisms:
  - Unconscious tactics used by humans to defend the psyche and to prevent their ego from feeling inadequate
  - Overuse of coping mechanisms for long time may have maladaptive effects

Coping Strategies

- Stress reduction activities used consciously to help people deal with stress provoking events.
- They can be therapeutic and non-therapeutic
Coping Strategies Continue
- Examples of Therapeutic Coping Strategies
  - Seeking professional assistance
  - Using problem-solving techniques
  - Use of assertive behavior
  - Practicing relaxation techniques
  - Comfort from others

Stress-Related Disorders
- An autoimmune (self-attacking) response
- Failure to respond, Immunosuppression
- Weakened immune response which put the person at risk for infection and cancer.

Nursing Implications
- Identify the stressors
- Assess the client’s response to stress
- Eliminate or reduce the stressors
- Prevent additional stressor
- Promote the client’s physiologic adaptive responses
- Support the client’s psychological coping strategies
- Assist in maintaining a network of social support
- Implement stress reduction and stress management techniques
Nursing Implications

Assessment of Stressors

Prevention of stressors:
- Primary prevention eliminating the potential for illness by maintaining good nutrition, maintaining body weight and blood pressure
- Secondary prevention include screening for risk factors and early diagnosis of disease
- Tertiary prevention include rehab and appropriate management of disease

Nursing Implications

Stress reduction techniques
- Provide adequate explanation, keep client and family informed, demonstrate confidence when providing care, remain calm during crises being available and respond promptly to the client for assistance, encourage family interaction, advocating and referring client and family to organizations that provide assistance.

Nursing Implications

Stress Management Techniques
- Endorphins
  - Natural body chemicals that produce effect similar to opiate.
- Sensory Manipulation
- Adaptive activities
  - Alternative Thinking
  - Alternative Behaviors
  - Alternative Lifestyle