Stress Psychophysiology

Chapter 2

Introduction

• This chapter covers the process & structures activated during the physiological response to stress.

• Two stress pathways are available; one for short term stressors, and one for long term stressors.
  – The stress response begins in the brain (perceived stressor/demand).
  – The brain then activates two pathways that stimulate specific organs and glands throughout the body.
  – The stimulated organs are now prepared to help the person "fight-or-flight." (adaptive energy/"vital energy")

The Brain

• Cerebral Cortex
  – Provides for abstract functioning/thinking.

• Diencephalon
  – Part of the “subcortex”, it is composed of the thalamus and hypothalamus.

• Thalamus
  – Transfers nerve messages (sensory) received from the body to the cerebral cortex or to the hypothalamus.

• Hypothalamus
  – Activates the endocrine system and the autonomic nervous system during the stress response.
The Brain’s Internal Connections

• Limbic System
  – Is the connection between the diencephalon and other stress-related structures; it is considered the “seat of emotions.”

• Reticular Activating System (RAS)
  – Nerve connections between the cerebral cortex and the subcortex, especially the diencephalon (mind-body connection).

The Brain’s Connections to the Body

• Endocrine System
  – System of glands that secrete hormones.

• Nervous System
  – Nerves carry electrical impulses from the body the brain or from the brain to the body.

• Autonomic Nervous System
  – A part of the nervous system that controls involuntary bodily functions such as heart rate and blood pressure.

The Brain’s Involvement in the Stress Response

• To activate the stress response, a sensory nerve transmits a message to the brain.
• The message is passed along the RAS, stimulating the limbic system (emotions) and the thalamus.
• The thalamus then stimulates the hypothalamus.
• The hypothalamus, in turn, activates the endocrine system and the sympathetic nervous system. This action is what initiates the stress reactivity.
Actions of the Hypothalamus

• The anterior (front) portion of the hypothalamus stimulates the pituitary gland by secreting two hormones.
  – Corticotropin Releasing Factor (CRF)
  – Thyrotropic Hormone Releasing Factor (TRF)
• The anterior hypothalamus also stimulates the pituitary by way of a direct nerve connection.
• The posterior (back) portion of the hypothalamus directly activates the sympathetic nervous system.

Actions of the Pituitary Gland

• Under the influence of CRF, the pituitary gland will secrete adrenocorticotropic hormone (ACTH) into the bloodstream. ACTH stimulates the adrenal gland.
• Under the influence of TRF, the pituitary gland will secrete thyrotropic hormone (TTH) into the bloodstream. TTH stimulates the thyroid gland.
• When stimulated by the nerves from the hypothalamus, the pituitary gland will secrete the hormones vasopressin (ADH) and oxytocin into the bloodstream, which act directly on the blood vessels.

Actions of the Adrenal Gland (outside part)

• Influenced by ACTH, the adrenal cortex (outer portion of the adrenal gland) will release two types of hormones, glucocorticoids and mineralocorticoids.
• The primary glucocorticoid is cortisol, which is responsible for providing the body with increased energy (more glucose and fat are released into the bloodstream).
• The primary mineralocorticoid is aldosterone, which is responsible for increasing blood volume, and therefore it is partially responsible for raising blood pressure.
### Actions of the Adrenal Gland (inside part)

- The **adrenal medulla** (inner portion of the Adrenal Gland) is stimulated by a nerve pathway from the **sympathetic nervous system**.
- The **adrenal medulla** secretes the hormones **epinephrine** (adrenalin) and **norepinephrine** directly into the bloodstream.
- Some functions of these two hormones include:
  - accelerating the heart rate
  - dilation of the coronary arteries and bronchial tubes
  - constricting blood vessels in the skin and muscles of the extremities

### Actions of the Thyroid Gland

- When stimulated by TTH, the **thyroid gland** secretes **thyroxin** into the bloodstream.
- Some functions of **thyroxin** include:
  - increasing the basal metabolic rate
  - increasing gastrointestinal motility
  - increasing depth of respiration
  - increasing heart rate and blood pressure
  - increasing anxiety
  - decreasing feelings of tiredness

### Autonomic Nervous System

- The **autonomic nervous system** (ANS) is a system of nerves that control the involuntary functions of the body.
- The two components of the ANS are the **sympathetic nervous system** and the **parasympathetic nervous system**.
- Generally speaking, the **sympathetic system** is responsible for expending energy (stress reactivity); the **parasympathetic system** is responsible for conserving energy (relaxation response).
How Stress Reactivity Influences Our Body’s Functions

- Your body experiences stress-related changes to the:
  - Cardiovascular System
  - Gastrointestinal System
  - Muscles
  - Skin
  - Immune System

Cardiovascular Changes Due to Stress Reactivity

- Increased heart rate
- Increased blood volume / blood pressure
- Constriction of certain blood vessels
- Dilation of coronary arteries
- Increased force of heart contraction
- Increased blood glucose, free fatty acids, and cholesterol

Gastrointestinal Changes Due to Stress Reactivity

- Decreased saliva (dry mouth)
- Contraction of the esophagus (difficulty swallowing)
- Increased hydrochloric acid in the stomach
- Change in peristalsis
Other Changes Due to Stress Reactivity

- Skeletal muscles increased tension (bracing)
- Smooth muscles increase contraction
- Increased perspiration (galvanic skin response)
- Decreased temperature of the skin
- Immune system is weakened (see chapter 3)

Conclusions

- Stress reactivity originates in the brain.
- Once stimulated by the thalamus, the hypothalamus activates the endocrine system and sympathetic nervous system pathways.
- The hormones from the endocrine system and the nerves from the sympathetic nervous system drastically alter the body’s normal physiology.
- The net result is that the body is prepared to make a physical response — FIGHT or FLEE.