# *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-flee." (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 blood stream. 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.