Endocrine System

Chapter 18

Introduction

- The endocrine system consists of cells, tissues, & organs that secrete hormones into the blood
- **Hormone** – an organic substance secreted by a cell that has an effect on the metabolic activity of another cell or tissue
- **Target cells** – cells that are affected by the hormone
  - Have specific receptors for the hormones
- Types of hormones
  - Steroid
  - Amino acid derivative
  - Peptide

How Hormones Work

- Activation of **2nd messengers**
  - Hormone (first messenger) binds to receptor on cell membrane
  - Receptor/hormone complex activates another substance in the cell (2nd messenger)
  - Triggers cell’s response

How Hormones Work

- Activation of **genes**
  - Hormone crosses cell membrane
  - Hormone binds to a receptor
  - Cytoplasm
  - Nucleus
  - Receptor/hormone complex binds to DNA
  - Alters gene activity

The Hypothalamus & Endocrine Regulation

- Sympathetic neurons
  - Adrenal medulla
- Releases hormones
  - **Antidiuretic hormone (ADH)**
  - **Oxytocin**
- Secretes regulatory hormones
  - Anterior pituitary gland
  - Releasing factors
  - Inhibiting factors

Overview of the Endocrine System
The Pituitary Gland
- aka hypophysis
  - Located in sella turcica
  - Infundibulum connects to hypothalamus
  - Master gland of the endocrine system
- 2 parts
  - Posterior pituitary = neurohypophysis
  - Anterior pituitary = adenohypophysis

Hypophyseal Portal System
- Median eminence
  - Neurons secrete regulatory factors
- 2 capillary beds
  - #1 in hypothalamus
    - RFs diffuse in
  - #2 in anterior pituitary
    - RFs diffuse out
- Portal veins connect the capillary beds

Posterior Pituitary
- Neurohypophysis is nervous tissue
  - Cell bodies in the hypothalamus make hormones
  - Axons run down the infundibulum
    - Carry hormones to axon terminals
  - Axon terminals in the posterior pituitary store hormones

Posterior Pituitary Produces 2 Hormones
- Antidiuretic hormone (ADH)
  - Target – kidneys
  - Effect – reabsorption of water
- Oxytocin
  - Targets – reproductive organs
  - Effects – contractions of smooth muscles (labor contractions, milk ejection; ductus deferens, prostate gland – ejaculations)

Anterior Pituitary Hormones
- Gonadotropins stimulate growth & development of gonads
  - Follicle stimulating hormone (FSH) stimulates gametes
    - Targets – follicle cells (females), testes (males)
    - Effects – follicle development & estrogen secretion (females), sperm maturation (males)
  - Luteinizing hormone (LH)
    - Targets – follicle cells (females), interstitial cells of testes (males)
    - Effects – ovulation, formation of corpus luteum, secretion of progesterone (females), testosterone secretion (males)

Anterior Pituitary Hormones
- Thyroid stimulating hormone (TSH)
  - Target – thyroid gland
  - Effect – triggers the release of thyroid hormones
- Adrenocorticotropic hormone (ACTH)
  - Target – adrenal cortex
  - Effect – cells that produce glucocorticoids (steroid hormones)
Anterior Pituitary Hormones

- **Prolactin**
  - Target: breast
  - Effect: stimulates milk production

- **Growth hormone**
  - Target: all cells
  - Effect: stimulates growth in general and the skeletal system in particular

- **Melanocyte stimulating hormone (MSH)**
  - Target: melanocytes
  - Effect: increases melanin production and distribution

The Thyroid Gland

- **Location**
  - Inferior to thyroid cartilage

- **Thyroid follicles make thyroid hormones**
  - Tyrosine + iodine
  - T₄ (thyroxine) or (T₃) (triiodothyronine)
  - Target cells: most cells

- **Effect of thyroid hormones**
  - Increase energy utilization, oxygen consumption, growth, development

Control of Thyroid Hormones

- **C cells**
  - Produce calcitonin (CT)
  - Targets: bone, kidneys
  - Effect: lowers blood calcium levels

The Parathyroid Glands

- **Location**
  - Posterior surfaces of thyroid gland

- **Principal cell**
  - **Chief cells** produce parathyroid hormone (PTH)

- **Target cells**
  - Bone, kidneys, intestines

- **Effect**
  - Increases blood calcium levels
The Thymus Gland
- Location – posterior to the sternum
- Produces thymosins
  - Enhance lymphocyte production
- Development
  - Childhood – large
  - Puberty – largest
  - Adulthood – decreases in size

The Adrenal Glands
- Location – on top of the kidney
- Structure
  - Capsule
  - Cortex

The Adrenal Medulla
- Secretes epinephrine & norepinephrine
- Target – most cells
- Effect - stimulates heart beat & tissue metabolism, increases alertness, prepares body to deal with emergencies

The Adrenal Cortex
- Zona glomerulosa secretes mineralocorticoids, mostly aldosterone
  - Target – kidneys
  - Effect – increases blood sodium, decreases blood potassium
- Zona fasciculata – secretes glucocorticoids (cortisol, corticosterone)
  - Target – most cells
  - Effect – conserve blood glucose, anti-inflammatory effects
- Zona reticulareas – secretes androgens
  - Effects are uncertain

The Pancreas
- Location – between the spleen and the duodenum
- Functions – both exocrine and endocrine
- Endocrine cells are in the Islets of Langerhans

Islets of Langerhans
- Alpha cells secrete glucagon
  - Targets – liver, adipose tissues
  - Effect – increase blood sugar levels
- Beta cells secrete insulin
  - Targets - most cells
  - Effect - decrease blood sugar levels
- Diabetes mellitus
The Pineal Gland

- Location = epithalamus
- Pinealocytes secrete melatonin
  - Derived from serotonin
  - Light inhibits production
  - Regulates circadian rhythms
  - Target = hypothalamus
  - Effects = Inhibits FSH & LH secretion

The Testes

- Divided into internal compartments containing seminiferous tubules
  - Spermatogenesis

Seminiferous Tubules

- Interstitial cells secrete androgens; testosterone
  - Derived from male secondary sex characteristics & behaviors
- Some interstitial cells secrete inhibin
  - Target = anterior pituitary
  - Effect = inhibits secretion of FSH

The Ovaries – Follicle Cells

- Estrogen
  - Targets = most cells
  - Effects = follicle maturation; female secondary sex characteristics and behaviors
- Inhibin
  - Target = anterior pituitary
  - Effect = inhibits secretion of FSH

The Ovaries – Corpus Luteum

- Progesterone
  - Targets – uterus, mammary glands
  - Effects – prepare uterus for implantation, mammary glands for secretion
- Relaxin
  - Targets – pubic symphysis, uterus, mammary glands
  - Effects – loosens pubic symphysis, relaxes cervical muscles, stimulates mammary gland development

Hormonal Regulation of the Female Reproductive System

http://www.healthsquare.com/fgwh/whch17.htm