The Endocrine System

PART B

ESSENTIALS OF HUMAN ANATOMY & PHYSIOLOGY
EIGHTH EDITION

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Thyroid Gland

- Found at the base of the throat
- Consists of two lobes and a connecting isthmus
- Produces two hormones
  - Thyroid hormone
  - Calcitonin
Thyroid Hormone

- Major metabolic hormone
- Targets every cell in the body!
- Composed of two active iodine-containing hormones
  - Thyroxine ($T_4$) – secreted by thyroid follicles
  - Triiodothyronine ($T_3$) – conversion of $T_4$ at target tissues
Goiter
Graves’ Disease
Parathyroid Glands

- Tiny masses on the posterior of the thyroid
- Secrete parathyroid hormone
  - Stimulate osteoclasts to remove calcium from bone
  - Stimulate the kidneys and intestine to absorb more calcium
- Raise calcium levels in the blood
Calcitonin

- Decreases blood calcium levels by causing its deposition on bone
- Antagonistic to parathyroid hormone
- Produced by C (parafollicular) cells
Adrenal Glands

- Two glands
  - Cortex – outer glandular region in three layers
  - Medulla – inner neural tissue region
- Sits on top of the kidneys
Hormones of the Adrenal Cortex

- Mineralocorticoids (mainly aldosterone)
  - Produced in outer adrenal cortex
  - Regulate mineral content in blood, water, and electrolyte balance
  - Target organ is the kidney
Hormones of the Adrenal Cortex

- Glucocorticoids (including cortisone and cortisol)
  - Produced in the middle layer of the adrenal cortex
  - Promote normal cell metabolism
  - Help resist long-term stressors
  - Released in response to increased blood levels of ACTH
Hormones of the Adrenal Cortex

- Sex hormones
  - Produced in the inner layer of the adrenal cortex
  - Androgens (male) and some estrogen (female)
Hormones of the Adrenal Medulla

- Produces two similar hormones (catecholamines)
  - Epinephrine
  - Norepinephrine

- These hormones prepare the body to deal with short-term stress
Roles of the Hypothalamus and Adrenal Glands in the Stress Response

**Short-term stress response**
1. Increased heart rate
2. Increased blood pressure
3. Liver converts glycogen to glucose and releases glucose to blood
4. Dilation of bronchioles
5. Changes in blood flow patterns leading to increased alertness and decreased digestive and kidney activity
6. Increased metabolic rate

**Long-term stress response**
1. Retention of sodium and water by kidneys
2. Increased blood volume and blood pressure

**More prolonged**
- ACTH
- Corticotrophic cells of anterior pituitary
- Releasing hormone
- Adrenal gland
- Mineralocorticoids
- Glucocorticoids

**Short-term**
- Hypothalamus
- Nerve impulses
- Spinal cord
- Preganglionic sympathetic fibers
- Adrenal medulla
- Catecholamines (epinephrine and norepinephrine)
Pancreatic Islets

- The pancreas is a mixed gland
- The islets of the pancreas produce hormones
  - Insulin – allows glucose to cross plasma membranes into cells (produced in beta cells)
  - Glucagon – allows glucose to enter the blood (produced in alpha cells)
  - These hormones are antagonists that maintain blood sugar homeostasis
Pancreatic Islets

Figure 9.13
Pancreatic Hormones and Blood Sugar

Figure 9.14

Insulin-secreting cells of the pancreas activated; release insulin into the blood

Elevated blood sugar levels

Stimulus: rising blood glucose levels (e.g., after eating four jelly doughnuts)

Rising blood glucose levels return blood sugar to homeostatic set point; stimulus for glucagon release diminishes

Liver breaks down glycogen stores and releases glucose to the blood

Uptake of glucose from blood is enhanced in most body cells

Liver takes up glucose and stores it as glycogen

Blood glucose levels decline to set point; stimulus for insulin release diminishes

Stimulus: declining blood glucose levels (e.g., after skipping a meal)

Low blood sugar levels

Glucagon-releasing cells of pancreas activated; release glucagon into blood; target is the liver

Homeostasis: Normal blood glucose levels (90 mg/100ml)
Pineal Gland

- Found on the third ventricle of the brain
- Secretes melatonin
  - Helps establish the body’s wake and sleep cycles
  - May have other as-yet-unsubstantiated functions
Thymus

- Located posterior to the sternum
- Largest in infants and children
- Produces thymosin
  - Matures some types of white blood cells
  - Important in developing the immune system
Hormones of the Ovaries

- **Estrogens**
  - Produced by ovarian follicles or the placenta
  - Stimulates the development of secondary female characteristics
  - Matures female reproductive organs
  - Helps prepare the uterus to receive a fertilized egg
  - Helps maintain pregnancy
  - Prepares the breasts to produce milk
Hormones of the Ovaries

- Progesterone
  - Produced by the corpus luteum
  - Acts with estrogen to bring about the menstrual cycle
  - Helps in the implantation of an embryo in the uterus
Hormones of the Testes

- Produce several androgens
- Testosterone is the most important androgen
  - Responsible for adult male secondary sex characteristics
  - Promotes growth and maturation of male reproductive system
- Required for sperm cell production
Endocrine Function of the Placenta

- Produces hormones that maintain pregnancy
- Some hormones play a part in the delivery of baby
- Produces HCG in addition to estrogen, progesterone, and other hormones
Other Hormone-Producing Tissues and Organs

- Parts of the small intestine
- Parts of the stomach
- Kidneys
- Heart
- Many other areas have scattered endocrine cells