Endocrine System

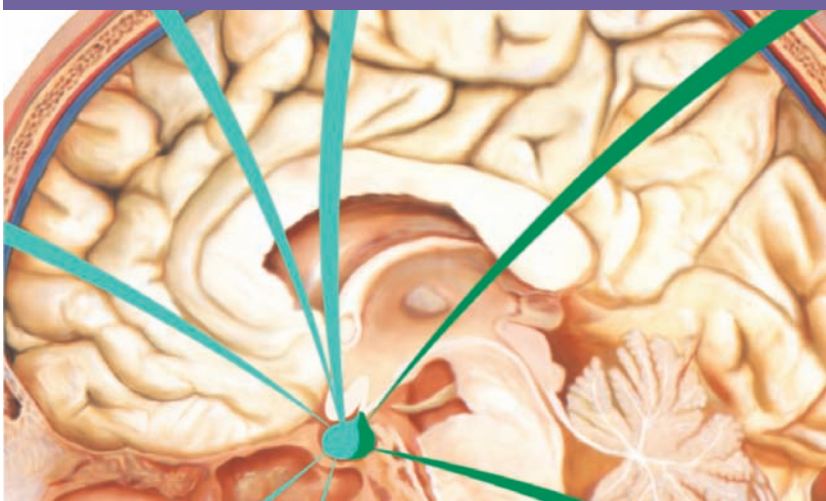
CHAPTER 13

Chapter Outline

Objectives

Upon completion of this chapter, you will be able to:

- Locate and describe the structures of the endocrine system.
- Describe the functional relationship between the endocrine system and other body systems.
- Recognize, pronounce, spell, and build words related to the endocrine system.
- Describe pathological conditions, diagnostic and therapeutic procedures, and other terms related to the endocrine system.
- Explain pharmacology related to the treatment of endocrine disorders.
- Demonstrate your knowledge of this chapter by completing the learning and medical record activities.



Anatomy and Physiology

The primary function of the endocrine system is to keep the body in **homeostasis,** the body's internal state of equilibrium that is maintained so all body systems can function most effectively. Thus, the endocrine system comprises a network of ductless glands, which have a rich blood supply that enables the **hormones** they produce to enter the bloodstream and influence body functions.

Hormones are chemicals produced by glands that cause a specific effect at a **target.** A target, also known as a *target cell,* is programmed with receptors to respond to a unique hormone. Although hormones travel throughout the entire body in blood and lymph, they affect only targets that have specific receptors for the hormone. Once bound to the receptor, the hormone initiates a specific biological effect. Hormones control diverse activities. such as growth, metabolism, reproduction, energy level, and sexual characteristics.

Although the nervous system provides many of the same functions as the endocrine system, it is designed to act instantaneously by transmitting electrical impulses to specific body locations. It is one of the most complicated systems of the body. Nonetheless, the endocrine and nervous systems work together like an interlocking supersystem to control many intricate activities of the body.

This chapter discusses the structure and functions of hormones and the **pituitary, thyroid, parathyroid, adrenal, pancreatic,** and **pineal glands.** (See Figure 13–1.) (See Chapter 9, Blood, Lymph, and Immune Systems, for information on the function of the **thymus;** Chapter 11, Genitourinary System, for information on the **testes;** and Chapter 12, Female Reproductive System, for information on the **ovaries.**)

Endocrine System

The **endocrine** system includes glands that secrete hormones directly into the bloodstream rather than though a duct (**exocrine glands**).

Although a given hormone travels anywhere in the body that blood does, it affects only a specific target. Hormones influence their target cells by chemically binding to specific receptors. Only the target cells for a given hormone have receptors that bind and recognize that hormone. The receptors initiate specific biological effects when the hormones bind to them. For example, thyroid-stimulating hormone (TSH) binds to receptors on cells of the thyroid gland, but it does not bind to cells of the ovaries because ovarian cells do not have TSH receptors.

The release of a hormone by an endocrine gland to a target is determined by the body's need for the hormone at any given time and is regulated to avoid overproduction (**hypersecretion**) or underproduction (**hyposecretion**). Unfortunately, there are times when the body's regulating mechanism does not operate properly and hormone levels become excessive or deficient, causing various disorders.

Pituitary Gland

The (1) **pituitary gland,** or **hypophysis**, is a pea-sized organ located at the base of the brain. It is known as the ***master gland*** because it regulates many body activities and stimulates other glands to secrete their own specific hormones. (See Figure 13–2.) The pituitary gland consists of two distinct portions, an anterior lobe (**adenohypophysis**) and a posterior lobe (**neurohypophysis**). The anterior lobe, triggered by the action of the hypothalamus, produces at least six hormones. The posterior lobe stores and secretes two hormones produced by the hypothalamus: antidiuretic hormone (ADH) and oxytocin. These hormones are released into the bloodstream as needed. (See Table 13–1.)

Thyroid Gland

The (2) **thyroid gland** is the largest gland of the endocrine system. An H-shaped organ located in the neck just below the larynx, this gland is composed of two large lobes that are separated by a strip of tissue called an **isthmus**. Thyroid hormone (TH) is the body's major metabolic hormone. TH increases the rate of oxygen consumption and thus the rate at which carbohydrates, proteins, and fats are metabolized. TH is actually two active iodine-containing hormones, **thyroxine (T_4)** and **triiodothyronine (T_3).** Thyroxine is the major hormone secreted by the thyroid; most triiodothyronine is formed at the target tissues by conversion of T_4 to T_3. Except for the adult brain, spleen, testes, uterus, and the thyroid gland itself, thyroid hormone affects virtually every cell in the body. TH also influences growth hormone and plays an important role in maintaining blood pressure. (See Table 13–2.)

Parathyroid Glands

The (3) **parathyroid glands** consist of at least four separate glands located on the posterior surface of the lobes of the thyroid gland. The only hormone known to be secreted by the parathyroid

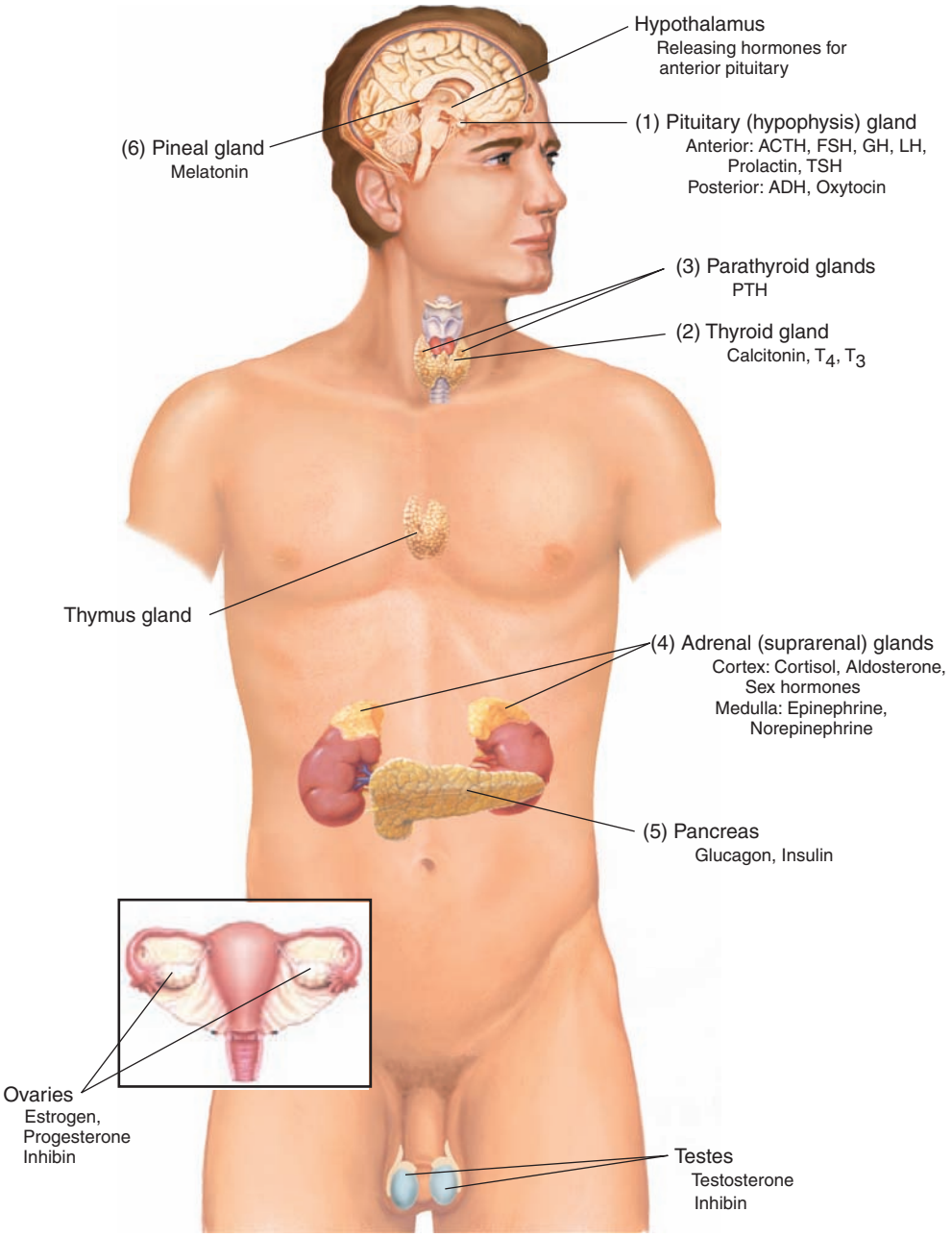


Figure 13-1. Locations of major endocrine glands.

glands is parathyroid hormone (PTH). PTH helps to regulate calcium balance by stimulating three target organs: bones, kidneys, and intestines. (See Table 13–3.) Because of PTH stimulation, calcium and phosphates are released from bones, increasing concentration of these substances in blood. Thus, calcium that is necessary for the proper functioning of body tissues is available in the bloodstream. At the same time, PTH enhances the absorption of calcium and phosphates from foods in the intestine, causing a rise in blood levels of calcium and phosphates. PTH causes the kidneys to conserve blood calcium and to increase the excretion of phosphates in the urine.

Adrenal Glands

The (4) **adrenal glands** are paired organs covering the superior surface of the kidneys. Because of their location, the adrenal glands are also known as ***suprarenal glands.*** Each adrenal gland is divided

Anatomy and Physiology Key Terms

This section introduces important endocrine system terms and their definitions. Word analyses for selected terms are also provided.

Term	Definition
antagonistic ăn-tăg-ō-NĬST-ĭk	Acting in opposition; mutually opposing
electrolytes ē-LĔK-trō-līts	Mineral salts (sodium, potassium, and calcium) that carry an electrical charge in solution ***A proper balance of electrolytes is essential to the normal functioning of the entire body.***
glucagon GLOO-kă-gŏn	Hormone produced by pancreatic alpha cells that increases the blood glucose level by stimulating the liver to change stored glycogen (a starch form of sugar) to glucose ***Glucagon opposes the action of insulin and is used to reverse hypoglycemic reactions in insulin shock.***
glucose GLOO-kōs	Simple sugar that is the end product of carbohydrate digestion ***Glucose is the primary source of energy for living organisms.***
homeostasis hō-mē-ō-STĀ-sĭs *homeo-:* same, alike *-stasis:* standing still	Relative constancy or balance in the internal environment of the body, maintained by processes of feedback and adjustment in response to external or internal changes
hormones HOR-mōnz	Chemical substances produced by specialized cells of the body that are released slowly in minute amounts directly into the bloodstream ***Hormones are produced primarily by endocrine glands and are carried through the bloodstream to the target organ.***
insulin ĬN-sŭ-lĭn	Hormone produced by pancreatic beta cells that acts to remove sugar (glucose) from the blood by promoting its storage in tissues as carbohydrates (glycogen)
sympathomimetic sĭm-pă-thō-mĭm-ĔT-ĭk	Agent that mimics the effects of the sympathetic nervous system ***Epinephrine and norepinephrine are sympathomimetic hormones because they produce effects that mimic those brought about by the sympathetic nervous system.***
target	Structure, organ, or tissue to which something is directed ***In the endocrine system, a target is the structure, organ, or tissue on which a hormone exerts its specific effect.***

Pronunciation Help

Long Sound	ā—rate	ē—rebirth	ī—isle	ō—over	ū—unite
Short Sound	ă—alone	ĕ—ever	ĭ—it	ŏ—not	ŭ—cut

into two sections, each of which has its own structure and function. The outer adrenal cortex makes up the bulk of the gland and the adrenal medulla makes up the inner portion. Although these regions are not sharply divided, they represent distinct glands that secrete different hormones.

Adrenal Cortex

The adrenal cortex secretes three types of steroid hormones:

1. **Mineralocorticoids,** mainly aldosterone, are essential to life. These hormones act mainly through the kidneys to maintain the balance

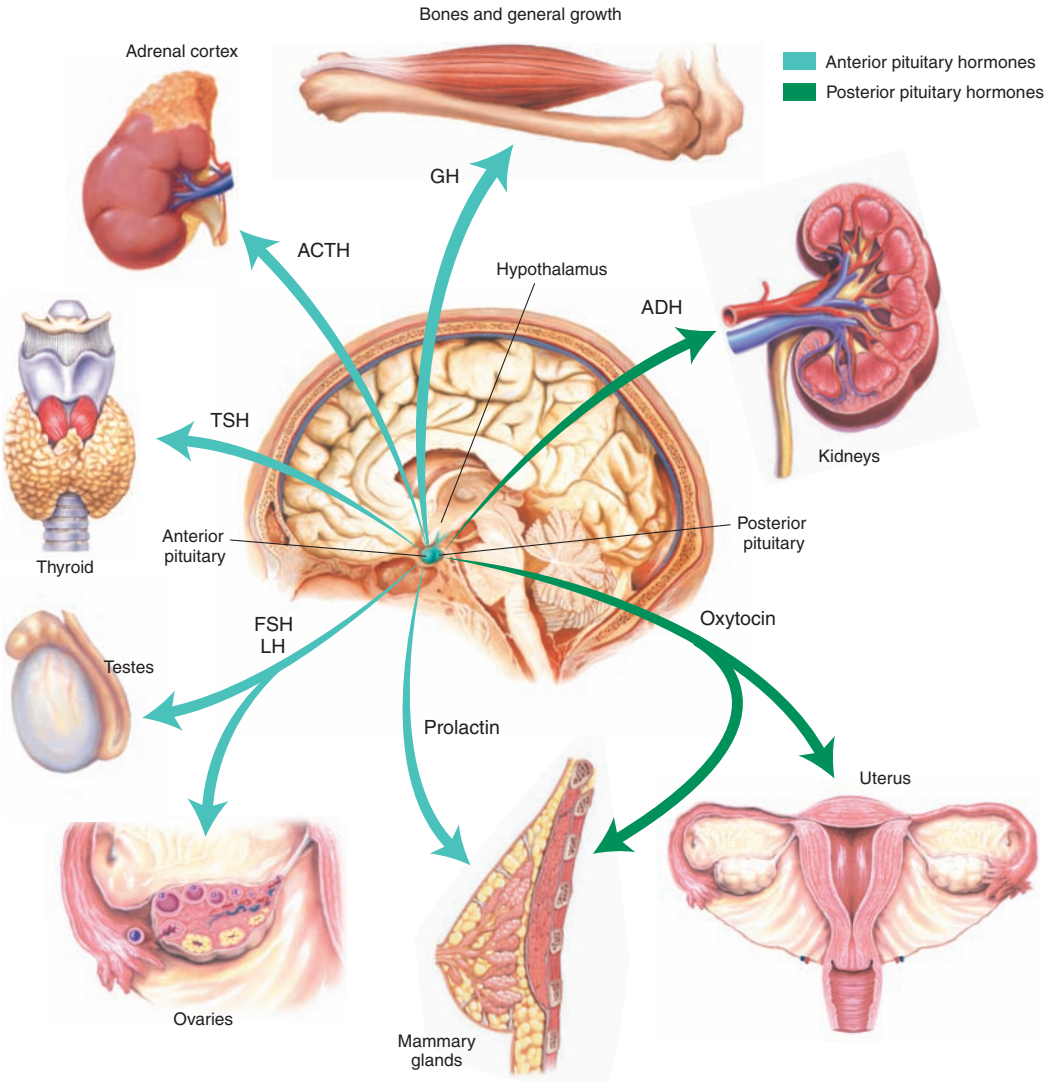


Figure 13-2. Hormones secreted by the anterior and posterior pituitary gland, along with target organs.

Table 13-1 Pituitary Hormones

This table identifies pituitary hormones, their target organs and functions, and associated disorders.

Hormone	Target Organ and Functions	Disorders
Anterior Pituitary Hormones (Adenohypophysis)		
Adrenocorticotropic hormone (ACTH)	• Adrenal cortex—promotes secretions of some hormones by adrenal cortex, especially cortisol	• Hyposecretion is rare. • Hypersecretion causes Cushing disease.
Follicle-stimulating hormone (FSH)	• Ovaries—in females, stimulates egg production; increases secretion of estrogen	• Hyposecretion causes failure of sexual maturation.
	• Testes—in males, stimulates sperm production	• Hypersecretion has no known significant effects.

(continued)

Table 13-1 Pituitary Hormones—cont'd

Hormone	Target Organ and Functions	Disorders
Growth hormone (GH) or somatotropin	• Bone, cartilage, liver, muscle, and other tissues—stimulates somatic growth; increases use of fats for energy	• Hyposecretion in children causes pituitary dwarfism. • Hypersecretion in children causes gigantism; hypersecretion in adults causes acromegaly.
Luteinizing hormone (LH)	• Ovaries—in females, promotes ovulation; stimulates production of estrogen and progesterone • Testes—in males, promotes secretion of testosterone	• Hyposecretion causes failure of sexual maturation. • Hypersecretion has no known significant effects.
Prolactin	• Breast—in conjunction with other hormones, promotes lactation	• Hyposecretion in nursing mothers causes poor lactation. • Hypersecretion in nursing mothers causes galactorrhea.
Thyroid-stimulating hormone (TSH)	• Thyroid gland—stimulates secretion of thyroid hormone	• Hyposecretion in infants causes cretinism; hyposecretion in adults causes myxedema. • Hypersecretion causes Graves disease, indicated by exophthalmos. (See Figure 13–3.
Posterior Pituitary Hormones (Neurohypophysis)		
Antidiuretic hormone (ADH)	• Kidney—increases water reabsorption (water returns to the blood)	• Hyposecretion causes diabetes insipidus. • Hypersecretion causes syndrome of inappropriate antidiuretic hormone (SIADH).
Oxytocin	• Uterus—stimulates uterine contractions; initiates labor • Breast—promotes milk secretion from the mammary glands	• Unknown

Figure 13-3. Exophthalmos caused by Graves disease.

Table 13-2 Thyroid Hormones

This table identifies thyroid hormones, their functions, and associated disorders.

Hormone	Functions	Disorders
Calcitonin	• Regulates calcium levels in the blood in conjunction with parathyroid hormone • Secreted when calcium levels in the blood are high in order to maintain homeostasis	• The most significant effects are exerted in childhood when bones are growing and changing dramatically in mass, size, and shape. • At best, calcitonin is a weak hypocalcemic agent in adults.
Thyroxine (T_4) and triiodothyronine (T_3)	• Increases energy production from all food types • Increases rate of protein synthesis	• Hyposecretion in infants causes cretinism; hyposecretion in adults causes myxedema. • Hypersecretion causes Graves disease, indicated by exophthalmos. (See Figure 13–3.)

Table 13-3 Parathyroid Hormones

This table identifies parathyroid hormones, their target organs and functions, and associated disorders.

Hormone	Target Organ and Functions	Disorders
Parathyroid hormone (PTH)	• Bones—increases the reabsorption of calcium and phosphate from bone to blood • Kidneys—increases calcium absorption and phosphate excretion • Small intestine—increases absorption of calcium and phosphate	• Hyposecretion causes tetany. • Hypersecretion causes osteitis fibrosa cystica

of sodium and potassium (**electrolytes**) in the body. More specifically, aldosterone causes the kidneys to conserve sodium and excrete potassium. At the same time, it promotes water conservation and reduces urine output.

2. **Glucocorticoids,** mainly cortisol, influence the metabolism of carbohydrates, fats, and proteins. The glucocorticoid with the greatest activity is cortisol. It helps regulate the concentration of glucose in the blood, protecting against low blood sugar levels between meals. Cortisol also stimulates the breakdown of fats in adipose tissue and releases fatty acids into the blood. The increase in fatty acids causes many cells to use relatively less glucose.
3. **Sex hormones,** including androgens, estrogens, and progestins, help maintain secondary sex characteristics, such as development of the breasts and adult distribution of hair.

Adrenal Medulla

The adrenal medulla cells secrete two closely related hormones, epinephrine (**adrenaline**) and norepinephrine (**noradrenaline**). Both hormones are activated when the body responds to crisis situations, and are considered **sympathomimetic** agents because they produce effects that mimic those

brought about by the sympathetic nervous system. Because hormones of the adrenal medulla merely intensify activities set into motion by the sympathetic nervous system, their deficiency is not a problem.

Of the two hormones, epinephrine is secreted in larger amounts. In the physiological response to stress, epinephrine is responsible for maintaining blood pressure and cardiac output, keeping airways open wide, and raising blood glucose levels. All these functions are useful for frightened, traumatized, injured, or sick persons. Norepinephrine reduces the diameter of blood vessels in the periphery (vasoconstriction), thereby raising blood pressure. (See Table 13–4.)

Table 13-4 Adrenal Hormones

This table identifies adrenal hormones, their target organs and functions, and associated disorders.

Hormone	Target Organ and Functions	Disorders
Adrenal Cortex Hormones		
Glucocorticoids (mainly cortisol)	• Body cells—promote gluconeogenesis; regulate metabolism of carbohydrates, proteins, and fats; and help depress inflammatory and immune responses	• Hyposecretion causes Addison disease. • Hypersecretion causes Cushing syndrome. (See Figure 13–4.)
Mineralocorticoids (mainly aldosterone)	• Kidneys—increase blood levels of sodium and decrease blood levels of potassium in the kidneys	• Hyposecretion causes Addison disease. • Hypersecretion causes aldosteronism.

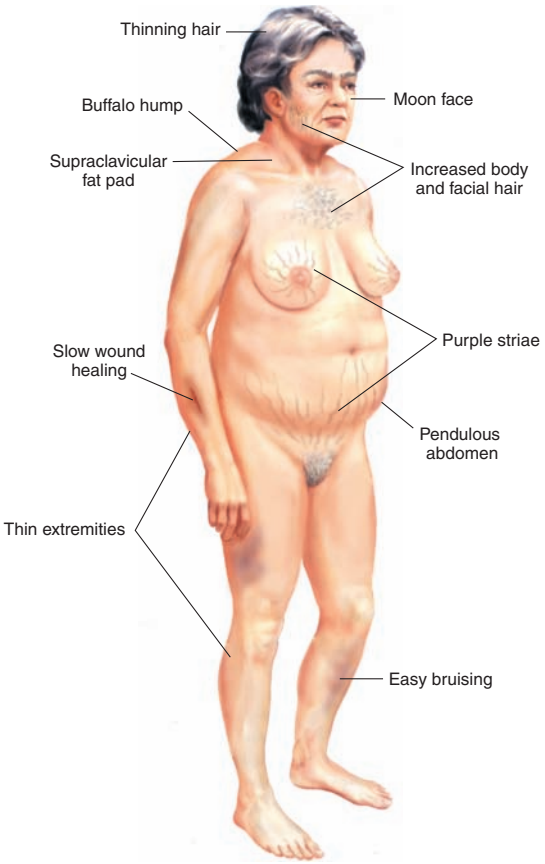


Figure 13-4. Physical manifestations of Cushing syndrome.

Table 13-4 Adrenal Hormones—cont'd

Hormone	Target Organ and Functions	Disorders
Sex hormones (any of the androgens, estrogens, or related steroid hormones) produced by the ovaries, testes, and adrenal cortices	• In females, possibly responsible for female libido and source of estrogen after menopause (Otherwise, effects in adults are insignificant.)	• Hypersecretion of adrenal androgen in females leads to virilism (development of male characteristics). • Hypersecretion of adrenal estrogen and progestin secretion in males leads to feminization (development of femi nine characteristics). • Hyposecretion has no known significant effects.
Adrenal Medullary Hormones		
Epinephrine and norepinephrine	• Sympathetic nervous system target organs—hormone effects mimic sympathetic nervous system activation (sympathomimetic), increase metabolic rate and heart rate, and raise blood pressure by promoting vasoconstriction	• Hyposecretion has no known significant effects. • Hypersecretion causes prolonged "fight-or-flight" reaction and hypertension.

Table 13-5 Pancreatic Hormones

This table identifies pancreatic hormones, their target organs and functions, and associated disorders.

Hormone	Target Organ and Functions	Disorders
Glucagon	• Liver and blood—raises blood glucose level by accelerating conversion of glycogen into glucose in the liver (glycogenolysis) and other nutrients into glucose in the liver (gluconeogenesis) and releasing glucose into blood (glycogen to glucose)	• Persistently low blood glucose levels (hypoglycemia) may be caused by deficiency in glucagon.
Insulin	• Tissue cells—lowers blood glucose level by accelerating glucose transport into cells and the use of that glucose for energy production (glucose to glycogen)	• Hyposecretion of insulin causes diabetes mellitus. • Hypersecretion of insulin causes hyperinsulinism.

Pancreas

The (5) **pancreas** lies inferior to the stomach in a bend of the duodenum. It functions as an exocrine and endocrine gland. A large pancreatic duct runs through the gland, carrying enzymes and other exocrine digestive secretions from the pancreas to the small intestine. The endocrine portion of the pancreas consists of groups of cells called ***islets of Langerhans.*** The islets secrete two distinct types of hormones: alpha cells that produce **glucagon** and beta cells that produce **insulin.** Both hormones play important roles in carbohydrate metabolism.

When blood **glucose** levels are low (**hypoglycemia**), glucagon stimulates the release of glucose from storage sites in the liver. Because the liver converts stored glycogen to glucose (**glycogenolysis**), the blood glucose level rises. The overall effect, therefore, is a rise in the blood glucose level. When blood glucose levels are high (**hyperglycemia**), the pancreatic beta cells are stimulated to produce insulin. This insulin production causes glucose to enter body cells to be used for energy and acts to clear glucose from the blood by promoting its storage as glycogen. Insulin and glucagon function **antagonistically** so that normal secretion of both hormones ensures a blood glucose level that fluctuates within normal limits. (See Table 13–5.)

Pineal Gland

The (6) **pineal gland,** which is shaped like a pine cone, is attached to the posterior part of the third ventricle of the brain. Although the exact functions of this gland have not been established, there is evidence that it secretes the hormone melatonin. It is believed that melatonin may inhibit the activities of the ovaries. When melatonin production is high, ovulation is blocked, and there may be a delay in puberty.

Connecting Body Systems–Endocrine System

The main function of the endocrine system is to secrete hormones that have a diverse effect on cells, tissues, organs, and organ systems. Specific functional relationships between the endocrine system and other body systems are summarized below.

Blood, lymph, and immune

- Hormones from the thymus stimulate lymphocyte production.
- Glucocorticoids depress the immune response and inflammation.

Cardiovascular

- Hormones influence heart rate, contraction strength, blood volume, and blood pressure.
- Estrogen helps maintain vascular health in women.

Digestive

- Hormones help control digestive system activity.
- Hormones influence motility and glandular activity of the digestive tract, gallbladder secretion, and secretion of enzymes from the pancreas.
- Insulin and glucagon adjust glucose metabolism in the liver.

Female reproductive

- Hormones play a major role in the development and function of the reproductive organs.
- Hormones influence the menstrual cycle, pregnancy, parturition, and lactation.
- Sex hormones play a major role in the development of secondary sex characteristics.
- Hormone oxytocin triggers contraction of the pregnant uterus and then later stimulates the release of breast milk.

Genitourinary

- Hormones play a major role in the development and function of the reproductive organs.
- Hormones play a role in sexual development, sex drive, and gamete production.

Integumentary

- Hormones regulate activity of the sebaceous glands, distribution of subcutaneous tissue, and growth of hair.
- Hormones stimulate melanocytes to produce skin pigment.
- Estrogen hormone increases skin hydration.

Musculoskeletal

- Hormone secretions influence blood flow to muscles during exercise.
- Hormones influence muscle metabolism, mass, and strength.
- Hormones from the pituitary and thyroid glands and the gonads stimulate bone growth.
- Hormones govern blood calcium balance.

Nervous

- Several hormones play an important role in the normal maturation and function of the nervous system.

Respiratory

- Hormones stimulate red blood cell production when the body experiences a decrease in oxygen.
- Epinephrine influences ventilation by dilating the bronchioles; epinephrine and thyroxine stimulate cell respiration.

It is time to review anatomy by completing Learning Activity 13–1.

Medical Word Elements

This section introduces combining forms, suffixes, and prefixes related to the endocrine system. Word analyses are also provided.

Element	Meaning	Word Analysis
Combining Forms		
adren/o	adrenal glands	**adren/o**/megaly (ăd-rēn-ō-MĔG-ă-lē): enlargement of adrenal glands *-megaly:* enlargement
adrenal/o		**adrenal**/ectomy (ăd-rē-năl- ĔK-tō-mē): excision of (one or both) adrenal glands *-ectomy:* excision, removal
calc/o	calcium	hyper/**calc**/emia (hī-pĕr-kăl-SĒ-mē-ă): excessive calcium in the blood *hyper-:* excessive, above normal *-emia:* blood condition
crin/o	secrete	endo/**crin/o**/logy (ĕn-dō-krĭn-ŎL-ō-jē): study of endocrine glands (and their functions) *endo-:* in, within *-logy:* study of
gluc/o	sugar, sweetness	**gluc/o**/genesis (gloo-kō-JĔN- ĕ-sĭs): forming or producing glucose *-genesis:* forming, producing, origin
glyc/o		hypo/**glyc**/emia (hī-pō-glī-SĒ-mē-ă): abnormally low level of glucose in the blood *hypo-:* under, below *-emia:* blood condition ***Hypoglycemia is usually caused by administration of too much insulin, excessive secretion of insulin by the islet cells of the pancreas, or dietary deficiency.***
glycos/o		**glycos**/uria (glī-kō-SŪ-rē-ă): abnormal amount of glucose, in the urine *-uria:* urine
home/o	same, alike	**home/o**/stasis (hō-mē-ō-STĀ-sĭs): state of equilibrium in the internal environment of the body *-stasis:* standing still
kal/i	potassium (an electrolyte)	**kal**/emia (kă-LĒ-mē-ă): potassium in the blood *-emia:* blood condition
pancreat/o	pancreas	**pancreat/o**/tomy (păn-krē-ă-TŎT-ō-mē): incision of the pancreas *-tomy:* incision
parathyroid/o	parathyroid glands	**parathyroid**/ectomy (păr-ă-thī-royd-ĔK-tō-mē): excision of (one or more of the) parathyroid glands *-ectomy:* excision, removal
thym/o	thymus gland	**thym**/oma (thī-MŌ-mă): tumor of the thymus gland *-oma:* tumor ***A thymoma is a rare neoplasm of the thymus gland. Treatment includes surgical removal, radiation therapy, or chemotherapy.***

(continued)

Medical Word Elements—cont'd

Element	Meaning	Word Analysis
thyr/o	thyroid gland	**thyr/o**/megaly (thī-rō-MĔG-ă-lē): enlargement of the thyroid gland *-megaly:* enlargement
thyroid/o		hyper/**thyroid**/ism (hī-pĕr-THĪ-royd-ĭzm): condition of excessive thyroid gland (function) *hyper-:* excessive, above normal *-ism:* condition
toxic/o	poison	**toxic/o**/logist (tŏks-ĭ-KŎL-ō-jĭst): specialist in the study of poisons *-logist:* specialist in study of ***Toxicologists also study the effects of toxins and antidotes used for treatment of toxic disorders.***
Suffixes		
-crine	secrete	endo/**crine** (ĔN-dō-krĭn): secrete internally or within *endo-:* in, within
-dipsia	thirst	poly/**dipsia** (pŏl-ē-DĬP-sē-ă): excessive thirst *poly-:* many, much ***Polydipsia is one of the three "polys" (polyphagia and polyuria) associated with diabetes.***
-gen	forming, producing, origin	andr/o/**gen** (ĂN-drō-jĕn): any steroid hormone that increases masculinization *andr/o:* male
-toxic	poison	thyr/o/**toxic** (thī-rō-TŎKS-ĭk): pertaining to toxic activity of the thyroid gland *thyr/o:* thyroid gland
-uria	urine	glycos/**uria** (glī-kō-SŪ-rē-ă): glucose in the urine *glycos:* sugar, sweetness
Prefixes		
eu-	good, normal	**eu**/thyr/oid (ū-THĪ-royd): resembling a normal thyroid gland *thyr/o:* thyroid gland *-oid:* resembling
exo-	outside, outward	**exo**/crine (ĔKS-ō-krĭn): secrete outwardly *-crine:* secrete ***Exocrine glands secrete their products outwardly through excretory ducts***
hyper-	excessive, above normal	**hyper**/glyc/emia (hī-pĕr-glī-SĒ-mē-ă): excessive glucose in the blood *glyc:* sugar, sweetness *-emia:* blood condition ***Abnormally high blood glucose levels are found in patients with diabetes mellitus or those treated with drugs such as prednisone.***

Medical Word Elements—cont'd		
Element	**Meaning**	**Word Analysis**
hypo-	under, below	**hypo**/insulin/ism (hī-pō-ĬN-sŭ-lĭn-ĭzm): condition of deficiency of insulin *-ism:* condition ***Hypoinsulinism is a characteristic of type 1 diabetes mellitus.***
poly-	many, much	**poly**/uria (pŏl-ē-Ū-rē-ă): excessive urination *-uria:* urine ***Some causes of polyuria are diabetes, use of diuretics, excessive fluid intake, and hypercalcemia.***

It is time to review medical word elements by completing Learning Activity 13–2. For audio pronunciations of the above-listed key terms, you can visit www.davisplus.fadavis.com/gylys/systems *to download this chapter's Listen and Learn! exercises or use the book's audio CD (if included).*

Pathology

Disorders of the endocrine system are caused by underproduction (**hyposecretion**) or overproduction (**hypersecretion**) of hormones. In general, hyposecretion is treated with drug therapy in the form of hormone replacement. Hypersecretion is generally treated by surgery. Most hormone deficiencies result from genetic defects in the glands, surgical removal of the glands, or production of poor-quality hormones.

Pituitary Disorders

Pituitary disorders are related to hypersecretion or hyposecretion of growth hormone, which leads to body-size abnormalities. Abnormal variations of ADH secretion lead to disorders in the composition of blood and marked electrolyte imbalance.

Thyroid Disorders

Thyroid gland disorders are common and may develop at any time during life. They may be the result of a developmental problem, injury, disease, or dietary deficiency. One form of hypothyroidism that develops in infants is called ***cretinism.*** If not treated, this disorder leads to mental retardation, impaired growth, low body temperatures, and abnormal bone formation. Usually these symptoms do not appear at birth because the infant has received thyroid hormones from the mother's blood during fetal development. When hypothyroidism develops during adulthood, it is known as ***myxedema.*** The characteristics of this disease are edema, low blood levels of T_3 and T_4, weight gain, cold intolerance, fatigue, depression, muscle or joint pain, and sluggishness.

Hyperthyroidism results from excessive secretions of T_3, T_4, or both. Two of the most common disorders of hyperthyroidism are Graves disease and toxic goiter. **Graves disease** is considerably more prevalent and is characterized by an elevated metabolic rate, abnormal weight loss, excessive perspiration, muscle weakness, and emotional instability. Also, the eyes are likely to protrude (**exophthalmos**) because of edematous swelling in the tissues behind them. (See Figure 13–3.) At the same time, the thyroid gland is likely to enlarge, producing **goiter.** (See Figure 13–5.)

Figure 13-5. Enlargement of the thyroid gland in goiter.

It is believed that **toxic goite**r may occur because of excessive release of thyroid-stimulating hormone (TSH) from the anterior lobe of the pituitary gland. Overstimulation by TSH causes thyroid cells to enlarge and secrete extra amounts of hormones. Treatment for **hyperthyroidism** may involve drug therapy to block the production of thyroid hormones or surgical removal of all or part of the thyroid gland. Another method for treating this disorder is to administer a sufficient amount of radioactive iodine to destroy the thyroid secretory cells.

Parathyroid Disorders

As with the thyroid gland, dysfunction of the parathyroids is usually characterized by inadequate or excessive hormone secretion.

Insufficient production of parathyroid hormone (PTH), called ***hypoparathyroidism,*** can be caused by primary parathyroid dysfunction or elevated blood calcium levels. This condition can result from an injury or from surgical removal of the glands, sometimes in conjunction with thyroid surgery. The primary effect of hypoparathyroidism is a decreased blood calcium level (**hypocalcemia**). Decreased calcium lowers the electrical threshold, causing neurons to depolarize more easily, and increases the number of nerve impulses, resulting in muscle twitches and spasms (**tetany**).

Excessive production of PTH, called ***hyperparathyroidism,*** is commonly caused by a benign tumor. The increase in PTH secretion leads to demineralization of bones (**osteitis fibrosa cystica**), making them porous (**osteoporosis**) and highly susceptible to fracture and deformity. When this condition is the result of a benign glandular tumor (**adenoma**) of the parathyroid, the tumor is removed. Treatment may also include orthopedic surgery to correct severe bone deformities. Excess PTH also causes calcium to be deposited in the kidneys. When the disease is generalized and all bones are affected, this disorder is known as **von Recklinghausen disease.** Renal symptoms and kidney stones (**nephrolithiasis**) may also develop.

Disorders of the Adrenal Glands

As discussed, the adrenal glands consist of the adrenal cortex and adrenal medulla. Each has its own structure and function as well as its own set of associated disorders.

Adrenal Cortex

The adrenal cortex is mainly associated with Addison disease and Cushing syndrome.

Addison disease

Addison disease, a relatively uncommon chronic disorder caused by a deficiency of cortical hormones, results when the adrenal cortex is damaged or atrophied. Atrophy of the adrenal glands is probably the result of an autoimmune process in which circulating adrenal antibodies slowly destroy the gland. The gland usually suffers 90% destruction before clinical signs of adrenal insufficiency appear. Hypofunction of the adrenal cortex interferes with the body's ability to handle internal and external stress. In severe cases, the disturbance of sodium and potassium metabolism may be marked by depletion of sodium and water through urination, resulting in severe chronic dehydration. Other clinical manifestations include muscle weakness, anorexia, gastrointestinal symptoms, fatigue, hypoglycemia, hypotension, low blood sodium (**hyponatremia**), and high serum potassium (**hyperkalemia**). If treatment for this condition begins early, usually with adrenocortical hormone therapy, the prognosis is excellent. If untreated, the disease will continue a chronic course with progressive but relatively slow deterioration. In some patients, the deterioration may be rapid.

Cushing syndrome

Cushing syndrome is a cluster of symptoms produced by excessive amounts of cortisol, adrenocorticotropic hormone (ACTH), or both circulating in the blood. (See Figure 13–4.) Causes of this excess secretion include:

- long-term administration of steroid drugs (glucocorticoids) in treating such diseases as rheumatoid arthritis, lupus erythematosus, and asthma
- adrenal tumor resulting in excessive production of cortisol
- Cushing disease, a pituitary disorder caused by hypersecretion of ACTH from an adenoma in the anterior pituitary gland

Regardless of the cause, Cushing syndrome alters carbohydrate and protein metabolism and electrolyte balance. Overproduction of mineralocorticoids and glucocorticoids causes blood glucose concentration to remain high, depleting tissue protein. In addition, sodium retention causes increased fluid in tissue that leads to edema. These metabolic changes produce weight gain and may cause structural changes, such

as a moon-shaped face, grossly exaggerated head and trunk, and pencil-thin arms and legs. Other symptoms include fatigue, high blood pressure, and excessive hair growth in unusual places (**hirsutism**), especially in women. The treatment goal for this disease is to restore serum cortisol to normal levels. Nevertheless, treatment varies with the cause and may necessitate radiation, drug therapy, surgery, or a combination of these methods.

Adrenal Medulla

No specific diseases can be traced directly to a deficiency of hormones from the adrenal medulla. However, medullary tumors sometimes cause excess secretions. The most common disorder is a neoplasm known as ***pheochromocytoma***, which produces excessive amounts of epinephrine and norepinephrine. Most of these tumors are encapsulated and benign. These hypersecretions produce high blood pressure, rapid heart rate, stress, fear, palpitations, headaches, visual blurring, muscle spasms, and sweating. Typical treatment consists of antihypertensive drugs and surgery.

Pancreatic Disorders

Diabetes is a general term that, when used alone, refers to diabetes mellitus (DM). It is by far the most common pancreatic disorder. DM is a chronic metabolic disorder of impaired carbohydrate, protein, and fat metabolism due to insufficient production of insulin or the body's inability to utilize insulin properly. When body cells are deprived of glucose, their principal energy fuel, they begin to metabolize proteins and fats. As fat is metabolized, ketones are produced and enter the blood, causing a condition called ***ketosis***. Hyperglycemia and ketosis are responsible for the host of troubling and commonly life-threatening symptoms of diabetes mellitus. Insulin is an essential hormone that prepares body cells to absorb and use glucose as an energy source. When insulin is lacking, sugar does not enter cells but returns to the bloodstream with a subsequent rise in its concentration in the blood (hyperglycemia). When blood glucose levels reach a certain concentration, sugar "spills" into the urine and is expelled from the body (glucosuria), along with electrolytes, particularly sodium. Sodium and potassium losses result in muscle weakness and fatigue. Because glucose is unavailable to cells, cellular starvation results and leads to hunger and an increased appetite (polyphagia.)

Although genetics and environmental factors, such as obesity and lack of exercise, seem significant in the development of this disease, the cause of diabetes is not always clear. (See Table 13–5.) Diabetes mellitus occurs in two primary forms:

- ***Type 1 diabetes*** is usually diagnosed in children and young adults and was previously called ***juvenile diabetes***. In type 1 diabetes, the body does not produce sufficient insulin. Treatment includes injection of insulin to maintain a normal level of glucose in the blood. (See Table 13–6.)
- ***Type 2 diabetes*** is the most common form and is distinctively different from type 1. Its onset was typically later in life but it has become more prevalent in children as the incidence of obesity has increased. Risk factors include a family history of diabetes and obesity. In type 2 diabetes, the body is deficient in producing sufficient insulin or the body's cells are resistant to insulin action in target tissues. Hyperglycemia that results may cause cell starvation and, over time, may damage the kidneys, eyes, nerves, or heart. Treatment for type 2 diabetes includes exercise, diet, weight loss, and, if needed, insulin or oral antidiabetic agents. Oral antidiabetic agents activate the release of pancreatic insulin and improve the body's sensitivity to insulin. (See Table 13–6.)

Complications

Diabetes is associated with a number of primary and secondary complications. Patients with type 1 diabetes usually report rapidly developing symptoms. With type 2 diabetes, the patient's symptoms are usually vague, long standing, and develop gradually.

Primary complications of type 1 diabetes include **diabetic ketoacidosis (DKA).** DKA, also referred to as ***diabetic acidosis*** or ***diabetic coma***, may develop over several days or weeks. It can be caused by too little insulin, failure to follow a prescribed diet, physical or emotional stress, or undiagnosed diabetes.

Secondary complications due to long-standing diabetes emerge years after the initial diagnosis (Dx). Common chronic complications include diabetic retinopathy and diabetic nephropathy. In diabetic retinopathy, the retina's blood vessels are destroyed, causing visual loss and, eventually, blindness. In diabetic nephropathy, destruction of the kidneys causes renal insufficiency and commonly requires hemodialysis or renal transplantation.

Gestational diabetes may occur in women who are not diabetic, but develop diabetes during pregnancy. That is, they develop an inability to metabolize carbohydrates (glucose intolerance) with resultant hyperglycemia. Gestational diabetes most

Table 13-6 Clinical Manifestations of Diabetes

According to the American Diabetes Association, the following signs and symptoms are manifestations of type 1 and type 2 diabetes.

Type 1 Diabetes

Type 1 diabetes may be suspected if any one of the associated signs and symptoms appears. Children usually exhibit dramatic, sudden symptoms and must receive prompt treatment. Signs and symptoms that signal type 1 diabetes can be remembered using the mnemonic ***CAUTION***. Type 1 diabetes is characterized by the sudden appearance of:

- **C**onstant urination (polyuria) and glycosuria
- **A**bnormal thirst (polydipsia)
- **U**nusual hunger (polyphagia)
- **T**he rapid loss of weight
- **I**rritability
- **O**bvious weakness and fatigue
- **N**ausea and vomiting.

Type 2 Diabetes

Many adults may have type 2 diabetes with none of the associated signs or symptoms. The disease is commonly discovered during a routine physical examination. In addition to any of the signs and symptoms associated with type 1 diabetes, those for type 2 diabetes can be remembered using the acronym ***DIABETES:***

- **D**rowsiness
- **I**tching
- **A** family history of diabetes
- **B**lurred vision
- **E**xcessive weight
- **T**ingling, numbness, and pain in the extremities
- **E**asily fatigued
- **S**kin infections and slow healing of cuts and scratches, especially of the feet.

often resolves after childbirth (**parturition**); however, this places women at risk of the development of type 2 diabetes later in life.

Oncology

Oncological disorders of the endocrine system vary based on the organ involved and include pancreatic cancer, pituitary tumors, and thyroid carcinoma.

Pancreatic Cancer

Most carcinomas of the pancreas arise as epithelial tumors (**adenocarcinomas**) and make their presence known by obstruction and local invasion. Because the pancreas is richly supplied with nerves, pain is a prominent feature of pancreatic cancer, whether it arises in the head, body, or tail of the organ.

The prognosis in pancreatic cancer is poor, with only a 2% survival rate in 5 years. Pancreatic cancer is the fourth leading cause of cancer death in the United States. The highest incidence is among people ages 60 to 70. The etiology is unknown, but cigarette smoking, exposure to occupational chemicals, a diet high in fats, and heavy coffee intake are associated with an increased incidence of pancreatic cancer.

Pituitary Tumors

Pituitary tumors are generally not malignant; however, because their growth is invasive, they are considered neoplastic and are usually treated as such. Initial signs and symptoms include weight changes, intolerance to heat or cold, headache, blurred vision, and, commonly, personality changes, dementia, and

seizures. Tomography, skull radiographs, pneumoencephalography, angiography, and computed tomography scans assist in diagnosis. Depending on the size of the tumor and its location, different treatment modalities are employed. Treatments include surgical removal, radiation, or both.

Thyroid Carcinoma

Cancer of the thyroid gland, or ***thyroid carcinoma***, is classified according to the specific tissue that is affected. In general, however, all types share many predisposing factors, including radiation, prolonged TSH stimulation, familial disposition, and chronic goiter. The malignancy usually begins with a painless, commonly hard nodule or a nodule in the adjacent lymph nodes accompanied with an enlarged thyroid. When the tumor is large, it typically destroys thyroid tissue, which results in symptoms of hypothyroidism. Sometimes the tumor stimulates the production of thyroid hormone, resulting in symptoms of hyperthyroidism. Treatment includes surgical removal, radiation, or both.

Diagnostic, Symptomatic, and Related Terms

This section introduces diagnostic, symptomatic, and related terms and their meanings. Word analyses for selected terms are also provided.

Term	Definition
acromegaly ăk-rō-MĔG-ă-lē *acr/o:* extremity *-megaly:* enlargement	Chronic metabolic disorder characterized by a gradual, marked enlargement and thickening of the bones of the face and jaw ***Acromegaly afflicts middle-aged and older persons and is caused by overproduction of growth hormone (GH). Treatment includes radiation, pharmacological agents, or surgery, which commonly involves partial resection of the pituitary gland.***
diuresis dī-ū-RĒ-sĭs *di-:* double *ur:* urine *-esis:* condition	Increased formation and secretion of urine ***Diuresis occurs in such conditions as diabetes mellitus, diabetes insipidus, and acute renal failure. Alcohol and coffee are common diuretics that increase formation and secretion of urine.***
glucagon GLOO-kă-gŏn	Hormone secreted by the pancreatic alpha cells ***Glucagon increases the blood glucose level by stimulating the liver to change stored glycogen to glucose. Glucagon opposes the action of insulin. It is used as an injection in diabetes to reverse hypoglycemic reactions and insulin shock.***
glucose GLOO-kōs	Simple sugar that is the end product of carbohydrate digestion ***Glucose is found in many foods, especially fruits, and is a major source of energy. The determination of blood glucose levels is an important diagnostic test in diabetes and other disorders.***
glycosuria glī-kō-SŪ-rē-ă *glycos:* sugar, sweetness *-uria:* urine	Presence of glucose in the urine or abnormal amount of sugar in the urine
Graves disease	Multisystem autoimmune disorder characterized by pronounced hyperthyroidism usually associated with enlarged thyroid gland and exophthalmos (abnormal protrusion of the eyeball) (See Figure 13-3.)
hirsutism HĔR-soot-ĭzm	Excessive distribution of body hair, especially in women ***Hirsutism in women is usually caused by abnormalities of androgen production or metabolism.***

(continued)

Diagnostic, Symptomatic, and Related Terms—cont'd

Term	Definition
hypercalcemia hī-pĕr-kăl-SĒ-mē-ă *hyper–:* excessive, above normal *calc:* calcium *–emia:* blood	Excessive amount of calcium in the blood
hyperkalemia hī-pĕr-kă-LĒ-mē-ă *hyper–:* excessive, above normal *kal:* potassium (an electrolyte) *–emia:* blood	Excessive amount of potassium in the blood ***Hyperkalemia is most commonly a result of defective renal excretion of potassium.***
hypervolemia hī-pĕr-vŏl-Ē-mē-ă *hyper–:* excessive, above normal *vol:* volume *–emia:* blood	Abnormal increase in the volume of circulating fluid (plasma) in the body ***Hypervolemia commonly results from retention of large amounts of sodium and water by the kidneys. Signs and symptoms of hypervolemia include weight gain, edema, dyspnea, tachycardia, and pulmonary congestion.***
hyponatremia hī-pō-nă-TRĒ-mē-ă *hypo–:* under, below, deficient *natr:* sodium (an electrolyte) *–emia:* blood	Abnormal condition of low sodium in the blood
insulinoma ĭn-sū-lĭn-Ō-mă *insulin:* insulin *–oma:* tumor	Tumor of the islets of Langerhans of the pancreas
obesity ō-BĒ-sĭ-tē	Excessive accumulation of fat that exceeds the body's skeletal and physical standards, usually an increase of 20 percent or more above ideal body weight ***Obesity may be due to excessive intake of food (exogenous) or metabolic or endocrine abnormalities (endogenous).***
morbid obesity ō-BĒ-sĭ-tē	Body mass index (BMI) of 40 or greater, which is generally 100 or more pounds over ideal body weight ***Morbid obesity is a disease with serious psychological, social, and medical ramifications and one that threatens necessary body functions such as respiration.***
panhypopituitarism păn-hī-pō-pĭ-TŪ-ĭ-tăr-ĭzm *pan–:* all *hyp/o:* under, below, deficient *pituitar:* pituitary gland *–ism:* condition	Total pituitary impairment that brings about a progressive and general loss of hormonal activity
pheochromocytoma fē-ō-krō-mō-sī-TŌ-mă	Small chromaffin cell tumor, usually located in the adrenal medulla

Diagnostic, Symptomatic, and Related Terms—cont'd

Term	Definition
thyroid storm THĪ-royd *thyr:* thyroid gland *-oid:* resembling	Crisis of uncontrolled hyperthyroidism caused by the release into the bloodstream of increased amount of thyroid hormone; also called *thyroid crisis* or *thyrotoxic crisis* ***Thyroid storm may occur spontaneously or be precipitated by infection, stress, or thyroidectomy performed on a patient who is inadequately prepared with antithyroid drugs. Thyroid storm is considered a medical emergency and, if left untreated, may be fatal.***
virile VĬR-ĭl	Masculine or having characteristics of a man
virilism VĬR-ĭl-ĭzm	Masculinization in a woman or development of male secondary sex characteristics in the woman

It is time to review pathological, diagnostic, symptomatic, and related terms by completing Learning Activity 13–3.

Diagnostic and Therapeutic Procedures

This section introduces procedures used to diagnose and treat endocrine disorders. Descriptions are provided as well as pronunciations and word analyses for selected terms.

Procedure	Description
Diagnostic Procedures	
Clinical	
exophthalmometry ĕk-sŏf-thăl-MŎM-ĕ-trē *ex-:* out, out from *ophthalm/o:* eye *-metry:* act of measuring	Test that measures the degree of forward displacement of the eyeball (exophthalmos) as seen in Graves disease (See Figure 13-3.) ***The test is administered with an instrument called an exophthalmometer, which allows measurement of the distance from the center of the cornea to the lateral orbital rim.***
Laboratory	
fasting blood glucose GLOO-kōs	Test that measures blood glucose levels after a 12-hour fast
glucose tolerance test (GTT) GLOO-kōs	Test that measures the body's ability to metabolize carbohydrates by administering a standard dose of glucose and measuring glucose levels in the blood and urine at regular intervals ***GTT is commonly used to help diagnose diabetes or other disorders that affect carbohydrate metabolism.***
insulin tolerance test ĬN-sŭ-lĭn	Test that determines insulin levels in serum (blood) by administering insulin and measuring blood glucose levels in blood at regular intervals ***In hypoglycemia, glucose levels may be lower and return to normal more slowly.***

(continued)

Diagnostic and Therapeutic Procedures—cont'd

Procedure	Description
protein-bound iodine (PBI) Ī-ō-dīn	Test that measures the concentration of thyroxine in a blood sample ***The PBI test provides an index of thyroid activity.***
thyroid function test (TFT) THĪ-royd	Test that detects an increase or decrease in thyroid function ***The TFT measures levels of thyroid-stimulating hormone (TSH), triiodothyronine (T_3), and thyroxine (T_4).***
total calcium KĂL-sē-ŭm	Test that measures calcium to detect bone and parathyroid disorders ***Hypercalcemia can indicate primary hyperparathyroidism; hypocalcemia can indicate hypoparathyroidism.***
Radiographic	
computed tomography (CT) kŏm-PŪ-tĕd tō-MŎG-ră-fē *tom/o:* to cut *-graphy:* process of recording	Imaging technique that rotates an x-ray emitter around the area to be scanned and measures the intensity of transmitted rays from different angles ***In a CT scan, the computer generates a detailed cross-sectional image that appears as a slice. CT scan is used to detect disease and tumors in soft body tissues, such as the pancreas, thyroid, and adrenal glands, and may be used with or without a contrast medium.***
magnetic resonance imaging (MRI) măg-NĔT-ĭk RĔZ-ĕn-ăns ĬM-ĭj-ĭng	Noninvasive imaging technique that uses radio waves and a strong magnetic field rather than an x-ray beam to produce multiplanar cross-sectional images ***MRI is the method of choice for diagnosing a growing number of diseases because it provides superior soft-tissue contrast, allows multiple plane views, and avoids the hazards of ionizing radiation. MRI is used to identify abnormalities of pituitary, pancreatic, adrenal, and thyroid glands.***
radioactive iodine uptake (RAIU) rā-dē-ō-ĂK-tĭv Ī-ō-dīn	Administration of radioactive iodine (RAI) orally or intravenously (IV) as a tracer to test how quickly the thyroid gland takes up (uptake) iodine from the blood ***Results of the radioactive iodine uptake (RAIU) test are used to determine thyroid function.***
thyroid scan THĪ-royd *thyr:* thyroid gland *-oid:* resembling	After injection of a radioactive substance, a scanner detects radioactivity and visualizes the thyroid gland ***Thyroid scanning is used to identify pathological formations such as nodules and tumors.***
Therapeutic Procedures	
Surgical	
microneurosurgery of the pituitary gland mī-krō-nū-rō-SĔR-jĕr-ē, pĭ-TŪ-ĭ-tār-ē	Microdissection of a tumor using a binocular surgical microscope for magnification
parathyroidectomy păr-ă-thī-royd-ĔK-tō-mē *para-:* near, beside; beyond *thyroid:* thyroid gland *-ectomy:* excision, removal	Excision of one or more of the parathyroid glands, usually to control hyperparathyroidism

Diagnostic and Therapeutic Procedures—cont'd	
Procedure	**Description**
pinealectomy pĭn-ē-ăl-ĔK-tō-mē	Removal of the pineal body
thymectomy thī-MĔK-tō-mē *thym:* thymus gland *-ectomy:* excision, removal	Excision of the thymus gland
thyroidectomy thī-royd-ĔK-tō-mē *thyroid:* thyroid gland *-ectomy:* excision, removal	Excision of the thyroid gland ***Thyroidectomy is performed for goiter, tumors, or hyperthyroidism that does not respond to iodine therapy and antithyroid drugs.***
partial	Method of choice for removing a fibrous, nodular thyroid
subtotal	Removal of most of the thyroid to relieve hyperthyroidism

Pharmacology

Common disorders associated with endocrine glands include hyposecretion and hypersecretion of hormones. When deficiencies of this type occur, natural and synthetic hormones, such as insulin and thyroid agents, are prescribed. These agents normalize hormone levels to maintain proper functioning and homeostasis. Therapeutic agents are also available to regulate various substances in the body, such as glucose levels in diabetic patients. Hormone replacement therapy (HRT), such as synthetic thyroid and estrogen, treat these hormonal deficiencies. Although specific drugs are not covered in this section, hormonal chemotherapy drugs are used to treat certain cancers, such as testicular, ovarian, breast, and endometrial cancer. (See Table 13–7.)

Table 13-7 Drugs Used to Treat Endocrine Disorders

This table lists common drug classifications used to treat endocrine disorders, their therapeutic actions, and selected generic and trade names.

Classification	Therapeutic Action	Generic and Trade Names
antidiuretics	Reduce or control excretion of urine.	**vasopressin** văs-ō-PRĔS-ĭn Pitressin, Pressyn
antithyroids	Treat hyperthyroidism by impeding the formation of T_3 and T_4 hormone. *Antithyroids are administered in preparation for a thyroidectomy and in thyrotoxic crisis.*	**methimazole** měth-ĬM-ă-zōl Tapazole **strong iodine solution** Ī-ō-dīn Lugol's solution

(continued)

Table 13-7 Drugs Used to Treat Endocrine Disorders—cont'd

Classification	Therapeutic Action	Generic and Trade Names
corticosteroids	Replace hormones lost in adrenal insufficiency (Addison disease). *Corticosteroids are also widely used to suppress inflammation, control allergic reactions, reduce rejection in transplantation, and treat some cancer.*	**cortisone** KOR-tĭ-sōn Cortisone acetate **hydrocortisone** hī-drō-KOR-tĭ-sōn A-Hydrocort, Cortef
growth hormone replacements	Increase skeletal growth in children and growth hormone deficiencies in adults *Growth hormones increase spinal bone density and help manage growth failure in children.*	**somatropin (recombinant)** sō-mă-TRŌ-pĭn Humatrope, Norditropin
insulins	Lower blood glucose by promoting its entrance into body cells and converting glucose to glycogen (a starch-storage form of glucose). *Insulin links with an insulin receptor on the cell membrane, and transports glucose inside the cell where it is metabolized. Type 1 diabetes must always be treated with insulin. Insulin can also be administered through an implanted pump which infuses the drug continuously. Type 2 diabetes that cannot be controlled with oral antidiabetics may require insulin to maintain a normal level of glucose in the blood.*	**regular insulin** ĬN-sŭ-lĭn Humulin R*, Novolin R **NPH insulin** ĬN-sŭ-lĭn Humulin N, Novolin N, Humulin
oral antidiabetics	Treat type 2 diabetes mellitus by stimulating the pancreas to produce more insulin and decrease peripheral resistance to insulin. *Antidiabetic drugs are not insulin and they are not used in treating type 1 diabetes mellitus.*	**glipizide** GLĬP-ĭ-zīd Glucotrol, Glucotrol XL **glyburide** GLĪ-bū-rīd DiaBeta, Glynase
thyroid supplements	Replace or supplement thyroid hormones *Each thyroid supplement contains T_3, T_4, or a combination of both. Thyroid supplements are also used to treat some types of thyroid cancer.*	**levothyroxine** lē-vō-thī-RŎK-sēn Levo-T, Levoxyl, Synthroid **liothyronine** lī-ō-THĪ-rō-nēn Cytomel, Triostat

*The trade name for all human genetically produced insulins is *Humulin*. Traditionally, insulin has been derived from beef or pork pancreas. Human insulin is genetically produced using recombinant DNA techniques to avoid the potential for allergic reaction.

Abbreviations

This section introduces endocrine-related abbreviations and their meanings.

Abbreviation	Meaning	Abbreviation	Meaning
ACTH	adrenocorticotropic hormone	**MSH**	melanocyte-stimulating hormone
ADH	antidiuretic hormone (vasopressin)	**NPH**	neutral protamine Hagedorn (insulin)
BMI	body mass index	**PBI**	protein-bound iodine
BMR	basal metabolic rate	**PRL**	prolactin
DI	diabetes insipidus; diagnostic imaging	**PGH**	pituitary growth hormone
DKA	diabetic ketoacidosis	**PTH**	parathyroid hormone; also called *parathormone*
DM	diabetes mellitus	**RAI**	radioactive iodine
FSH	follicle-stimulating hormone	**RAIU**	radioactive iodine uptake
GH	growth hormone	**T_3**	triiodothyronine (thyroid hormone)
HRT	hormone replacement therapy	**T_4**	thyroxine (thyroid hormone)
K	potassium (an electrolyte)	**TFT**	thyroid function test
LH	luteinizing hormone	**TSH**	thyroid-stimulating hormone
mg/dl, mg/dL	milligrams per deciliter		

It is time to review procedures, pharmacology, and abbreviations by completing Learning Activity 13–4.

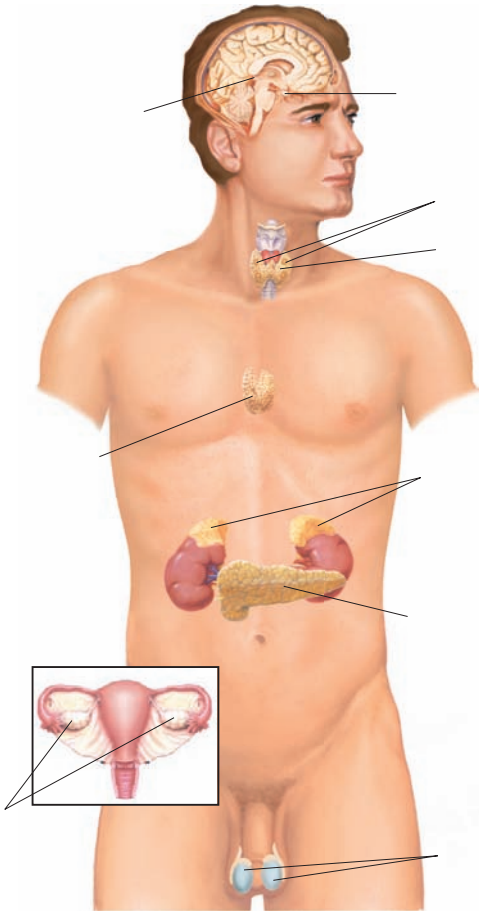
LEARNING ACTIVITIES

The activities that follow provide review of the endocrine system terms introduced in this chapter. Complete each activity and review your answers to evaluate your understanding of the chapter.

Learning Activity 13-1

Identifying Endocrine Structures

Label the following illustration using the terms listed below.



adrenal (suprarenal) glands	*parathyroid glands*	*testes*
ovaries	*pineal gland*	*thymus gland*
pancreas	*pituitary (hypophysis) gland*	*thyroid gland*

Check your answers by referring to Figure 13–1 on page 395. Review material that you did not answer correctly.

DavisPlus.fadavis.com

Enhance your study and reinforcement of word elements with the power of Davis Plus. Visit www.davisplus.fadavis.com/gylys/systems *for this chapter's flash-card activity. We recommend you complete the flash-card activity before completing activity 13–2 below.*

Learning Activity 13-2

Building Medical Words

Use *glyc/o* (sugar) to build words that mean:

1. blood condition of excessive glucose _____
2. blood condition of deficiency of glucose _____
3. formation of glycogen _____

Use *pancreat/o* (pancreas) to build words that mean:

4. inflammation of the pancreas _____
5. destruction of the pancreas _____
6. disease of the pancreas _____

Use *thyr/o* or *thyroid/o* (thyroid gland) to build words that mean:

7. inflammation of the thyroid gland _____
8. enlargement of the thyroid _____

Build surgical words that mean:

9. excision of a parathyroid gland _____
10. removal of the adrenal gland _____

Check your answers in Appendix A. Review material that you did not answer correctly.

Correct Answers _____ × 10 = _____ Score

Learning Activity 13-3

Matching Pathological, Diagnostic, Symptomatic, and Related Terms

Match the following terms with the definitions in the numbered list.

Addison disease	*glycosuria*	*myxedema*
cretinism	*hirsutism*	*pheochromocytoma*
Cushing syndrome	*hyperkalemia*	*type 1 diabetes*
diuresis	*hyponatremia*	*type 2 diabetes*
exophthalmic goiter	*insulin*	*virile*

1. _____ having characteristics of a man; masculine
2. _____ hypothyroidism acquired in adulthood
3. _____ increased excretion of urine
4. _____ excessive growth of hair in unusual places, especially in women
5. _____ hypothyroidism that appears as a congenital condition and is commonly associated with other endocrine abnormalities
6. _____ hormone produced by beta cells of the pancreas
7. _____ caused by deficiency in the secretion of adrenocortical hormones
8. _____ characterized by protrusion of the eyeballs, increased heart action, enlargement of the thyroid gland, weight loss, and nervousness
9. _____ excessive amount of potassium in the blood
10. _____ small chromaffin cell tumor, usually located in the adrenal medulla
11. _____ insulin-dependent diabetes mellitus; occurs most commonly in children and adolescents (juvenile onset)
12. _____ decreased concentration of sodium in the blood
13. _____ abnormal presence of glucose in the urine
14. _____ metabolic disorder caused by hypersecretion of the adrenal cortex resulting in excessive production of glucocorticoids, mainly cortisol
15. _____ non-insulin-dependent diabetes mellitus; occurs later in life (maturity onset)

Check your answers in Appendix A. Review material that you did not answer correctly.

Correct Answers _____ × 6.67 = _____ Score

Learning Activity 13-4

Matching Procedures, Pharmacology, and Abbreviations

Match the following terms with the definitions in the numbered list.

antithyroids	*growth hormone*	*protein-bound iodine*
CT scan	*GTT*	*RAIU*
corticosteroids	*Humulin*	*T_3*
exophthalmometry	*MRI*	*T_4*
FBS	*oral antidiabetics*	*thyroid scan*

1. _____ measures circulating glucose level after a 12-hour fast
2. _____ measures thyroid function and monitors how quickly ingested iodine is taken into the thyroid gland
3. _____ replacement hormones for adrenal insufficiency (Addison disease)
4. _____ increases skeletal growth in children
5. _____ radioactive compound is administered and localizes in the thyroid gland; used to detect thyroid abnormalities
6. _____ thyroxine
7. _____ used to treat type 2 diabetes
8. _____ diagnostic test used to determine hypoglycemia, hyperglycemia, and adjustments in insulin dosage
9. _____ used to treat hyperthyroidism by impeding the formation of T_3 and T_4 hormone
10. _____ test to measure the concentration of thyroxine in a blood sample
11. _____ triiodothyronine
12. _____ noninvasive imaging technique that uses radio waves and a strong magnetic field to produce multiplanar cross-sectional images
13. _____ test that measures the degree of forward displacement of the eyeball as seen in Graves disease
14. _____ imaging technique achieved by rotating an x-ray emitter around the area to be scanned and measuring the intensity of transmitted rays from different angles; used to detect disease in soft body tissues, such as the pancreas, thyroid, and adrenal glands
15. _____ trade name for all human genetically produced insulins

Check your answers in Appendix A. Review any material that you did not answer correctly.

Correct Answers _____ × 6.67 = _____ Score

MEDICAL RECORD ACTIVITIES

The two medical records included in the activities that follow use common clinical scenarios to show how medical terminology is used to document patient care. Complete the terminology and analysis sections for each activity to help you recognize and understand terms related to the endocrine system.

Medical Record Activity 13-1

Consultation Note: Hyperparathyroidism

Terminology

Terms listed below come from *Consultation Note: Hyperparathyroidism* that follows. Use a medical dictionary such as *Taber's Cyclopedic Medical Dictionary,* the appendices of this book, or other resources to define each term. Then review the pronunciations for each term and practice by reading the medical record aloud.

Term	Definition
adenoma ăd-ĕ-NŌ-mă	
claudication klăw-dĭ-KĀ-shŭn	
diabetes mellitus dī-ă-BĒ-tēz MĔ-lĭ-tŭs	
endocrinologist ĕn-dō-krĭn-ŎL-ō-jĭst	
hypercalciuria hī-pĕr-kăl-sē-Ū-rē-ă	
hyperparathyroidism hī-pĕr-păr-ă-THĪ-roy-dĭzm	
impression ĭm-PRĔSH-ŭn	
osteoarthritis ŏs-tē-ō-ăr-THRĪ-tĭs	
parathyroid păr-ă-THĪ-royd	
peripheral vascular disease pĕr-ĬF-ĕr-ăl VĂS-kū-lăr	

Listen and Learn Online! *will help you master the pronunciation of selected medical words from this medical record activity. Visit* www.davisplus.com/gylys/systems *to find instructions on completing the* Listen and Learn Online! *exercise for this section and to practice pronunciations.*

CONSULTATION NOTE: HYPERPARATHYROIDISM

Consultation Note

Day, Phyllis 5/25/xx
Med Record: P25882

HISTORY OF PRESENT ILLNESS: This 66-year-old former blackjack dealer is under evaluation for hyperparathyroidism. Surgery evidently has been recommended, but there is confusion as to how urgent this is. She has a 13-year history of type 1 diabetes mellitus, a history of shoulder pain, osteoarthritis of the spine, and peripheral vascular disease with claudication. She states her 548-pack/year smoking history ended 3-1/2 years ago. Her first knowledge of parathyroid disease was about 3 years ago when laboratory findings revealed an elevated calcium level. This subsequently led to the diagnosis of hyperparathyroidism. She was further evaluated by an endocrinologist in the Lake Tahoe area, who determined that she also had hypercalciuria, although there is nothing to suggest a history of kidney stones.

IMPRESSION: Hyperparathyroidism and hypercalciuria, probably a parathyroid adenoma

PLAN: Patient advised to make a follow-up appointment with her endocrinologist.

Juan Perez, MD
Juan Perez, MD

D: 05-25-xx
T: 05-25-xx
jp:lg

Analysis

Review the medical record *Consultation Note: Hyperparathyroidism* to answer the following questions.

1. What is an adenoma?

2. What does the physician suspect caused the patient's hyperparathyroidism?

3. What type of laboratory findings revealed parathyroid disease?

4. What is hypercalciuria?

5. If the patient smoked 548 packs of cigarettes per year, how many packs did she smoke in an average day?

Medical Record Activity 13-2

SOAP Note: Diabetes Mellitus

Terminology

Terms listed below come from *SOAP Note: Diabetes Mellitus* that follows. Use a medical dictionary such as *Taber's Cyclopedic Medical Dictionary,* the appendices of this book, or other resources to define each term. Then review the pronunciations for each term and practice by reading the medical record aloud.

Term	Definition
Accu-chek ĂK-ū-chĕk	
morbid obesity MOR-bĭd ō-BĒ-sĭ-tē	
obesity, exogenous ō-BĒ-sĭ-tē, ĕks-ŎJ-ĕ-nŭs	
polydipsia pŏl-ē-DĬP-sē-ă	
polyphagia pŏl-ē-FĀ-jē-ă	
polyuria pŏl-ē-Ū-rē-ă	

Listen and Learn Online! *will help you master the pronunciation of selected medical words from this medical record activity. Visit* www.davisplus.com/gylys/systems *to find instructions on completing the* Listen and Learn Online! *exercise for this section and to practice pronunciations.*

SOAP NOTE: DIABETES MELLITUS

Emergency Department Record

Date: 2/4/xx
Patient: Pleume, Roberta
Age: 68

Time Registered: 1445 hours
Physician: Samara Batichara, MD
Patient ID#: 22258

Chief Complaint: Frequent urination, increased hunger and thirst.

S: This 200-pound patient was admitted to the hospital because of a 10-day history of polyuria, polydipsia, and polyphagia. She has been very nervous, irritable, and very sensitive emotionally and cries easily. During this period, she has had headaches and has become very sleepy and tired after eating. On admission, her Accu-Chek was 540 mg/dL. Family history is significant in that both parents and two sisters have type 1 diabetes.

O: Physical examination was essentially negative. The abdomen was difficult to evaluate because of morbid obesity.

A: Diabetes mellitus; obesity, exogenous.

P: Patient admitted to the hospital for further evaluation.

Samara Batichara, MD
Samara Batichara, MD

D: 02-04-xx
T: 02-04-xx

sb:lb

Analysis

Review the medical record *SOAP Note: Diabetes Mellitus* to answer the following questions.

1. How long has this patient been experiencing voracious eating?

2. Was the patient's obesity due to overeating or metabolic imbalance?

3. Why did the doctor experience difficulty in examining the patient's abdomen?

4. Was the patient's blood glucose above or below normal on admission?

5. What is the reference range for fasting blood glucose?