CHAPTER 15

The Endocrine System

After studying this chapter, you will be able to:

15.1 Name the parts of the endocrine system and discuss the function of each part
15.2 Define combining forms used in building words that relate to the endocrine system
15.3 Identify the meaning of related abbreviations
15.4 Name the common diagnoses, clinical procedures, and laboratory tests used in treating disorders of the endocrine system
15.6 List and define the major pathological conditions of the endocrine system
15.7 Define surgical terms related to the endocrine system
15.8 Recognize common pharmacological agents used in treating disorders of the endocrine system

Structure and Function

The endocrine system is a group of glands that act as the body’s master regulator (Figure 15-1a). It regulates many bodily functions as diagrammed in Figure 15-1b. It helps to maintain homeostasis by regulating the production of chemicals that affect most functions of the body. It secretes substances that aid the nervous system in reacting to stress, and it is an important regulator of growth and development. The endocrine system is made up of various glands and other tissue that secrete hormones, specialized chemicals, into the bloodstream to be circulated throughout the body. The hormones are effective only in specific target cells, cells that have receptors that recognize a compatible hormone. A group of such cells forms target tissue. Minute amounts of hormones can initiate a strong reaction in some target cells.

Unlike exocrine glands, which secrete substances into ducts directed toward a specific location, endocrine glands secrete hormones into the bloodstream and are also known as ductless glands. Some endocrine glands are also exocrine glands. For example, as an endocrine gland, the pancreas secretes insulin, and as an exocrine gland, it releases digestive juices through ducts to the small intestine.

The hormones that are secreted by the endocrine glands go directly into intercellular spaces. From there, the hormones diffuse directly into the blood and are carried throughout the body. Each hormone may then bind to a cell that has specific receptors for that hormone, triggering a reaction in the cell. Such a cell is called a target organ cell. Hormones are the main regulators of
metabolism growth and development, reproduction, and many other body activities. Hormones make the difference between normalcy and many kinds of abnormalities such as dwarfism, gigantism, and sterility. They are important not only for the healthy survival of each one of us but also for the survival of the human species. Each type of hormone is transported differently throughout the body according to its chemical properties. Hormone release is triggered
by various factors including age and various diseases of the endocrine glands. Tumors or other abnormalities frequently cause a gland to secrete too much or too little hormone. Production of too much hormone by a diseased gland is called hypersecretion. If too little hormone is produced, the condition is called hyposecretion. Hormones are removed from the bloodstream by kidney functions (which is why urine can be tested for trace hormones).

Prostaglandins (PGs) or tissue hormones are important and extremely powerful substances found in a wide variety of tissues. They play an important role in communication and the control of many body functions but do not meet the definition of a typical hormone. The term tissue hormone is appropriate because in many instances a prostaglandin is produced in a tissue and then travels only a short distance to act on cells within that tissue. Typical hormones influence and control activities of widely separated organs; typical prostaglandins influence activities of closely neighboring cells. The prostaglandins in the body are divided into several groups, although the best known include prostaglandin A (PGA), prostaglandin E (PGE), and prostaglandin F (PGF). They have profound effects on many body functions. They influence respiration, blood pressure, the reproductive systems, and gastrointestinal secretions.

**Hypothalamus**

The hypothalamus, located in the brain superior to the pituitary gland, is a part of the nervous system that also serves as an endocrine gland because it analyzes the body's condition and directs the release of hormones that regulate pituitary hormones. The two hormones produced by the hypothalamus are ADH (antidiuretic hormone) and oxytocin. These hormones are then released by the pituitary gland. In addition to ADH and oxytocin, the hypothalamus also produces substances called releasing hormones (allowing the secretion of other hormones to take place) or inhibiting hormones (preventing the secretion of other hormones). These substances are produced in the hypothalamus and then travel directly through a specialized blood capillary system to the anterior section of the pituitary gland, where they cause the release of anterior pituitary hormones or, in a number of instances, inhibit their production and their release into the general circulation. The combined nervous and endocrine functions of the hypothalamus allow it to play a dominant role in the regulation of many body functions related to homeostasis. Examples include the regulation of body temperature, blood pressure, heartbeat, metabolism of fats and carbohydrates, appetite, thirst, and sugar levels in the blood.

**Pineal Gland**

The pineal gland is a small, pine-cone shaped gland near the roof of the third ventricle of the brain. It produces a number of hormones in very small quantities, with melatonin being the most significant. Melatonin is a hormone that inhibits the hormones that affect the ovaries, and it is thought to be involved in regulating the onset of puberty and the menstrual cycle in women. Because the pineal gland receives and responds to sensory information from the optic nerves, it is sometimes called the third eye. The pineal gland uses information regarding changing light levels to adjust its output of melatonin; melatonin levels increase during the night and decrease during the day. This is why the pineal gland is also believed to affect sleep.
**Pituitary Gland**

The pituitary gland, is a small but mighty structure. Although no larger than a pea, it is really two endocrine glands. One is called the anterior pituitary gland or adenohypophysis, and the other is called the posterior pituitary gland or neurohypophysis. Differences between the two glands are suggested by their names—adeno- means “gland,” and neuro- means “nervous.” The adenohypophysis has the structure of an endocrine gland, whereas the neurohypophysis has the structure of nervous tissue. The hormones secreted from these two glands serve very different functions from each other. The pituitary gland is located deep in the cranial cavity at the base of the brain in an area called the sella turcica. The protected location of this dual gland suggests its importance to the functioning of the human body. A stemlike structure, the pituitary stalk, attaches the gland to the undersurface of the brain. More specifically, the stalk attaches the pituitary body to the hypothalamus. The pituitary is considered the body’s master gland regulating or aiding in the secretion of essential hormones. Table 15-1 describes the functions of all parts of the endocrine system.

**Thyroid Gland**

The thyroid gland lies in the neck just below the larynx and consists of a left lobe and a right lobe sitting on either side of the trachea. The two lobes are connected by the isthmus, a narrow strip of tissue on the ventral surface of the trachea. Above the thyroid gland sits the thyroid cartilage, a large piece of cartilage that covers the larynx and produces the protrusion on the neck known as the Adam’s apple. The thyroid gland secretes two thyroid hormones, thyroxine or T4 and triiodothyronine or T3. It also secretes the hormone calcitonin. Of the two thyroid hormones, T4 is the more abundant; however, T3 is the more potent and is considered by physiologists to be the principal thyroid hormone. Thyroid secretions control metabolism (the chemical changes in cells that provide energy for vital processes and activities and through which new material is assimilated) and blood calcium concentrations. Of the thyroid hormones, T4

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**MORE ABOUT . . .**

**Biological Rhythms**

All living things have biological cycles determined by nature. Humans are considered to have three basic biological rhythms or biorhythms—ultradian, infradian, and circadian. Ultradian rhythms are those cycles (heartbeat, respiration) that are shorter than 24 hours. Infradian rhythms are those cycles (menstrual, ovulation) that are longer than 24 hours. Circadian rhythms occur in the 24-hour sleep-wake periods. Most of these cycles are affected by two things—factors outside the body and factors inside the body. Factors outside the body can include almost any environmental changes, such as light and dark, weather, physical activity, stress, and so on. Factors inside the body are affected mostly by hormones released from the endocrine system. People with rhythm disorders (like insomnia) are sometimes treated with hormone supplements. In addition, some health care practitioners believe that understanding and regulating the body’s biorhythms may be a key to maintaining health. There are many Internet sites that promote personal software for mapping your own biorhythms. Many of these are not based on scientific understanding of body rhythms.
Table 15-1: Endocrine Glands, Their Secretions, and Their Functions

<table>
<thead>
<tr>
<th>Endocrine Gland or Tissue</th>
<th>Hormone</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>hypothalamus</td>
<td>pituitary-regulating hormones</td>
<td>either stimulate or inhibit pituitary secretions</td>
</tr>
<tr>
<td>neurohypophysis (pituitary gland—posterior)</td>
<td>antidiuretic hormone (ADH), vasopressin oxytocin</td>
<td>increase water reabsorption</td>
</tr>
<tr>
<td>adrenohypophysis (pituitary gland—anterior)</td>
<td>growth hormone (GH), somatotrophic hormone (STH)</td>
<td>stimulate bone and muscle growth; regulate some metabolic functions, such as the rate that cells utilize carbohydrates and fats</td>
</tr>
<tr>
<td>adenohypophysis (pituitary gland—anterior)</td>
<td>thyroid-stimulating hormone (TSH) adrenocorticotropic hormone (ACTH)</td>
<td>stimulates thyroid gland to secrete hormones stimulates secretion of adrenal cortex hormones</td>
</tr>
<tr>
<td>adenohypophysis (pituitary gland—anterior)</td>
<td>follicle-stimulating hormone (FSH), luteinizing hormone (LH)</td>
<td>stimulate development of ova and production of female hormones; stimulates maturing of ova; secretion of estrogen, triggers ovulation; stimulates the production of melanin; in males, stimulates the secretion of testosterone; in the male stimulate testes to grow and secrete sperm stimulates breast development and milk production stimulates uterine contractions and lactation stimulates the production of melanin</td>
</tr>
<tr>
<td>prolactin</td>
<td>melanocyte-stimulating hormone (MSH)</td>
<td></td>
</tr>
<tr>
<td>thyroid</td>
<td>thyroxine (T4); triiodothyronine (T3) calcitonin</td>
<td>regulates metabolism; stimulates growth lowers blood calcium as necessary to maintain homeostasis</td>
</tr>
<tr>
<td>parathyroid</td>
<td>parathormone, parathyroid hormone (PTH)</td>
<td>increase blood calcium as necessary to maintain homeostasis</td>
</tr>
<tr>
<td>adrenal medulla</td>
<td>epinephrine (adrenaline), norepinephrine (noradrenaline)</td>
<td>work with the sympathetic nervous system to react to stress</td>
</tr>
<tr>
<td>adrenal cortex</td>
<td>glucocorticoids (cortisol, corticosteroids, corticosterone), mineralocorticoids (aldosterone), gonadocorticoids (androgens)</td>
<td>affect metabolism, growth, and aid in electrolyte and fluid balances</td>
</tr>
<tr>
<td>pancreas (in islets of Langerhans)</td>
<td>insulin, glucagon</td>
<td>maintain homeostasis in blood glucose concentration</td>
</tr>
<tr>
<td>pineal gland</td>
<td>melatonin</td>
<td>affects sexual functions and wake-sleep cycles; aids in developing skin pigment</td>
</tr>
<tr>
<td>ovaries</td>
<td>estrogen (estradiol, the most powerful estrogen), progesterone</td>
<td>promote development of female sex characteristics, menstrual cycle, reproductive functions</td>
</tr>
<tr>
<td>testes</td>
<td>androgen, testosterone</td>
<td>promote development of male sex characteristics, sperm production; also stimulate female sex drive</td>
</tr>
<tr>
<td>thymus gland</td>
<td>thymosin, thymic humoral factor (THF), factor thymic serum (FTS)</td>
<td>aid in development of T cells and some B cells; function not well understood</td>
</tr>
</tbody>
</table>

contains four atoms of iodine, and one molecule of $T_3$, as its name suggests, contains three iodine atoms. For $T_4$ to be produced in adequate amounts, the diet must contain sufficient iodine. Most endocrine glands do not store their hormones but secrete them directly into the blood as they are produced. The
The thyroid gland is different in that it stores considerable amounts of the thyroid hormones in the form of a material that is stored in the follicles of the gland, and when the thyroid hormones are needed, they are released directly into the blood. T4 and T3 influence every one of the trillions of cells in the human body. They make the cells speed up their release of energy from foods and even normal mental and physical growth and development is dependant on normal thyroid functioning. The third thyroid hormone, calcitonin, is secreted from the outside surface of thyroid cells and it decreases the concentration of calcium in the blood by first acting on bone to inhibit calcium breakdown there. It is a hormone that helps maintain homeostasis of blood calcium by preventing a harmful excess of calcium in the blood from accumulating, a condition called hypercalcemia.

Parathyroid Glands

The parathyroid glands are four oval-shaped glands located on the dorsal (back) side of the thyroid gland. The parathyrroids help regulate calcium and phosphate levels, two elements also necessary to maintain homeostasis. The parathyroid glands secrete parathyroid hormone (PTH). Parathyroid hormone increases the concentration of calcium in the blood, the opposite effect of the thyroid gland's calcitonin. This is a matter of life-and-death importance because our cells are extremely sensitive to changing amounts of blood calcium. For example, if there is too much blood calcium, brain cells and heart cells soon do not function normally; a person becomes mentally disturbed and the heart may even stop. However, with too little blood calcium, nerve cells become overactive, sometimes to such a degree that they overstimulate the production of electrical impulses to the muscles causing the muscles to go into spasms.

Thymus Gland

The thymus gland is considered an endocrine gland because it secretes a hormone and is ductless; however, it is also an essential part of the immune system. It is located in the mediastinum (behind the sternum and between the two lungs), and in infants it may extend up into the neck as far as the lower edge of the thyroid gland. It secretes the hormone thymosin, which causes the production of certain white blood cells called T lymphocytes. These T cells protect the body against foreign microorganisms, thus helping to fight infections. The thymus gland is extremely important to the development of an immune response. (Chapter 13 discusses the immune system.)

Adrenal Glands

The adrenal glands (or suprarenal glands) are a pair of glands. Each of the glands sits atop a kidney. Each gland consists of two parts—the adrenal cortex (the outer portion) and the adrenal medulla (the inner portion). The adrenal cortex makes up the bulk of the adrenal gland. Its cells are organized into three layers, each secreting and essential hormone. Hormones secreted from the adrenal cortex include aldosterone, which regulates sodium reabsorption and potassium excretion by the kidneys; cortisol, also known as hydrocortisone, which helps the body during stressful situations and helps maintain the proper glucose concentration in the blood between meals as well as helps reduce the inflammatory response causing swelling; and androgens, sex hormones which stimulate the development of male sexual characteristics and in adult women, stimulate the female sex drive.
The adrenal medulla, or inner portion of the adrenal gland, secretes a class of hormones called catecholamines, specifically epinephrine and norepinephrine. These hormones help the body resist stress. They prolong and intensify changes in body function brought about by the stimulation of the sympathetic subdivision of the autonomic nervous system. The adrenal glands are sympathomimetic, imitative of the sympathetic nervous system. In Chapter 8, The Nervous System, a unique reaction called the “fight or flight” response is discussed.

**Pancreas**

The pancreas has a dual role in that it is part of the digestive system where its cells produce digestive enzymes known as pancreatic juice, and it is also part of the endocrine system where its pancreatic islets (also known as the islets of Langerhans) produce the hormones insulin and glucagon. These hormones help in maintaining a proper level of blood glucose. Within the pancreas, the islets of Langerhans, specialized hormone-producing cells, secrete insulin to lower blood sugar when blood sugar levels are high and glucagon to raise blood sugar levels when they are low. Insulin is produced by beta cells in the islets of Langerhans, and glucagon is produced by alpha cells in the islets. When blood sugar levels get too high in the body, the beta cells release insulin into the bloodstream. Insulin allows the glucose in the blood to be transformed in the liver into glycogen, which is stored animal starch. The glucose is also moved into the muscle cells and adipose tissue. When blood glucose levels fall, such as between meals or during the night, the secretion of insulin decreases. If levels fall too low, alpha cells secrete glucagon which stimulates the liver to convert the stored glycogen into glucose, thus raising blood glucose levels. Figure 15-2 shows the glucagon/glucose production process.
The pancreas is both an endocrine and an exocrine gland. The islets of Langerhans serve its endocrine functions, and the remaining cells its exocrine ones (as discussed in the digestive system in Chapter 14).

Ovaries

The ovaries, or female gonads, are paired glands about the size of unshelled almonds and are found in the female pelvic region, one on either side of the uterus at the top of each fallopian tube. (Chapter 10 describes the female reproductive system.) These organs produce eggs, or ova, as exocrine glands and as endocrine glands produce the female sex hormones estrogen and progesterone. Estrogen causes the development of the female reproductive structures: the fallopian tubes, uterus, and vagina. It also causes the development of the breasts, fat deposits on the hips and thighs, bone development resulting in broad hips, a higher pitched voice, and onset of the menstrual cycle.

Testes

The testes (testicles) or male gonads, are paired oval glands located in the scrotum, a sac on the outside of the male body. Externally, it appears as a single pouch of skin, but is actually separated into two sacs internally by a septum. Each sac contains a single testis. As an exocrine gland, the testes produce spermatozoa, which fertilize ova. As an endocrine gland, the testes produce male sex hormones called androgens, the most important of which is testosterone. Testosterone is the “masculinizing hormone” and is responsible for the development of the male reproductive structures, and at puberty, the enlargement of the testes and penis. It also promotes external male characteristics such as beard and chest hair growth, deepening of the voice, muscular development, bone growth resulting broad shoulders and narrow hips. It promotes the development of the male sexual drive and aggressiveness. (Chapter 11 describes the male reproductive system.)

**Vocabulary Review**

In the previous section you learned terms related to the endocrine system. Before going on to the exercises, review the terms below and refer to the previous section if you have any questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. The etymologies (word histories) are for your information only. You do not need to memorize them.

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam’s apple</td>
<td>Protrusion in the neck caused by a fold of thyroid cartilage.</td>
</tr>
<tr>
<td><strong>adenohypophysis</strong></td>
<td>Anterior lobe of the pituitary gland.</td>
</tr>
<tr>
<td>adeno-, gland + hypophysis</td>
<td></td>
</tr>
<tr>
<td>adrenal cortex</td>
<td>Outer portion of the adrenal gland; helps control metabolism, inflammations, sodium and potassium retention, and effects of stress.</td>
</tr>
<tr>
<td>adrenal gland</td>
<td>One of two glands, each of which is situated on top of each kidney.</td>
</tr>
<tr>
<td>Term</td>
<td>Meaning</td>
</tr>
<tr>
<td>------</td>
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</tr>
<tr>
<td>adrenaline [æ-DRÉ-nā-līn]</td>
<td>Epinephrine; secreted by adrenal medulla.</td>
</tr>
<tr>
<td>adrenal medulla [mē-DUL-lă]</td>
<td>Inner portion of adrenal glands; releases large quantities of hormones during stress.</td>
</tr>
<tr>
<td>adrenocorticotropic [ā-DRÉ-nō-KŎR-tĭ-kō-TRŌ-pĭk] hormone (ACTH) adreno-, adrenal glands + cortico(steroid) + -tropic, turning</td>
<td>Hormone secreted by anterior pituitary; involved in the control of the adrenal cortex.</td>
</tr>
<tr>
<td>aldosterone [āl-DŌS-tĕr-ŏn]</td>
<td>Hormone secreted by adrenal cortex; mineralocorticoid.</td>
</tr>
<tr>
<td>alpha [ĀL-fă] cells</td>
<td>Specialized cells that produce glucagon in the pancreas.</td>
</tr>
<tr>
<td>androgen [ĀN-drō-jĕn] andro-, man + -gen, producing</td>
<td>Any male hormone, such as testosterone.</td>
</tr>
<tr>
<td>antidiuretic [ĀN-tē-di-yū-RĒT-ĭk] hormone (ADH) anti-, against + diuretic</td>
<td>Posterior pituitary hormone that increases water reabsorption.</td>
</tr>
<tr>
<td>beta [BĀ-tă] cells</td>
<td>Specialized cells that produce insulin in the pancreas.</td>
</tr>
<tr>
<td>calcitonin [kāl-sē-TŎ-nĭn] calci-, calcium + Greek tomos, a stretching</td>
<td>Hormone secreted by the thyroid gland and other endocrine glands; helps control blood calcium levels.</td>
</tr>
<tr>
<td>catecholamines [kāt-ē-KŎL-ă-mĕnz]</td>
<td>Hormones, such as epinephrine, released in response to stress.</td>
</tr>
<tr>
<td>cortisol [KŎR-tĭ-sŏl]</td>
<td>Hydrocortisone.</td>
</tr>
<tr>
<td>ductless gland</td>
<td>Endocrine gland.</td>
</tr>
<tr>
<td>electrolyte [ē-LĔK-trō-lĭt]</td>
<td>Any substance that conducts electricity and is decomposed by it.</td>
</tr>
<tr>
<td>endocrine [ĒN-dŏ-kĕn] gland endo-, within + -crine, secreting</td>
<td>Gland that secretes substances into the bloodstream instead of into ducts.</td>
</tr>
<tr>
<td>epinephrine [ĒP-i-NĔF-rĭn] epi-, upon + nephr-, kidney + -ine, chemical compound</td>
<td>Hormone released by the adrenal medulla in response to stress; adrenaline.</td>
</tr>
<tr>
<td>exocrine [ĒK-sŏ-kĕn] gland exo-, external + -crine</td>
<td>Any gland that releases substances through ducts to a specific location.</td>
</tr>
<tr>
<td>follicle-stimulating hormone (FSH)</td>
<td>Hormone released by the anterior pituitary to aid in production of ova and sperm.</td>
</tr>
<tr>
<td>gland Latin glans, acorn</td>
<td>Any organized mass of tissue secreting or excreting substances.</td>
</tr>
<tr>
<td>glucagon [GLŬ-kă-gŏn]</td>
<td>Hormone released by the pancreas to increase blood sugar.</td>
</tr>
<tr>
<td>Term</td>
<td>Meaning</td>
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<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>glycogen [GLI-kə-jēn] glycogen + -gen</td>
<td>Converted glucose stored in the liver for future use.</td>
</tr>
<tr>
<td>growth hormone (GH)</td>
<td>Hormone released by the anterior pituitary for stimulating growth.</td>
</tr>
<tr>
<td>hormone [HŌR-mōn]</td>
<td>Substance secreted by glands and carried in the bloodstream to various parts of the body.</td>
</tr>
<tr>
<td>hypo-, beneath + thalamus</td>
<td>Gland in the nervous system that releases hormones to aid in regulating pituitary hormones.</td>
</tr>
<tr>
<td>inhibiting factor</td>
<td>Substance in a hormone that prevents the secretion of other hormones.</td>
</tr>
<tr>
<td>insulin [ĪN-sū-lin]</td>
<td>Substance released by the pancreas to lower blood sugar.</td>
</tr>
<tr>
<td>isthmus [ĪS-mūs]</td>
<td>Narrow band of tissue connecting the two lobes of the thyroid gland.</td>
</tr>
<tr>
<td>luteinizing [LŪ-te-in-ĬZ-ing] hormone (LH)</td>
<td>Hormone released to aid in maturation of ova and ovulation in the female; and aids in the secretion of testosterone in males.</td>
</tr>
<tr>
<td>melatonin [mēl-ă-TŌN-ĭn]</td>
<td>Hormone released by the pineal gland; affects sexual function and sleep patterns.</td>
</tr>
<tr>
<td>metabolism [mē-TĀB-ŏ-lĭzm]</td>
<td>The chemical changes in cells that provide energy for vital processes and activities and through which new material is assimilated.</td>
</tr>
<tr>
<td>ovary [Ō-văr-ĕ] Latin ovum, egg</td>
<td>One of two female reproductive glands that secrete hormones in the endocrine system.</td>
</tr>
<tr>
<td>oxytocin [ōk-sĭ-TŌ-ĭ-sin] Greek oxytokos, swift birth</td>
<td>Hormone released by the posterior pituitary gland to aid in uterine contractions and lactation.</td>
</tr>
<tr>
<td>pancreas [PĀN-kē-ăs] Greek pankreas, sweetbread</td>
<td>Gland of both the endocrine system (blood sugar control) and the digestive system (as an exocrine gland).</td>
</tr>
<tr>
<td>Term</td>
<td>Meaning</td>
</tr>
<tr>
<td>------</td>
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</tr>
<tr>
<td>parathormone [pär-ä-THÖR-mön] (PTH) parath(yroid) + (h)ormone</td>
<td>Parathyroid hormone.</td>
</tr>
<tr>
<td>parathyroid [pär-ä-THĪ-röyd] gland para-, adjacent + thyroid</td>
<td>One of four glands located adjacent to the thyroid gland on its dorsal surface that help maintain levels of blood calcium.</td>
</tr>
<tr>
<td>parathyroid hormone (PTH)</td>
<td>Hormone released by parathyroid glands to help raise blood calcium levels.</td>
</tr>
<tr>
<td>receptor [rē-SĒP-tōr] Latin, receiver</td>
<td>Part of a target cell with properties compatible with a particular substance (hormone).</td>
</tr>
<tr>
<td>releasing factor</td>
<td>Substance in a hormone that allows secretion of other hormones.</td>
</tr>
<tr>
<td>somatotrophic [SO-mₐ-tō-TRŌF-ık] hormone (STH) somato-, sleep + -trophic, nutritional</td>
<td>Hormone secreted by anterior pituitary gland; important in growth and development.</td>
</tr>
<tr>
<td>target cell</td>
<td>Cell with receptors that are compatible with specific hormones.</td>
</tr>
<tr>
<td>testis (pl., testes) [TĒS-tēs (TĒS-tēz)], testicle [TĒS-tē-kl] Latin</td>
<td>One of two male organs that secrete hormones in the endocrine system.</td>
</tr>
<tr>
<td>thymus [THĪ-mūs] gland Greek thymos, sweetbread</td>
<td>Gland that is part of the immune system as well as part of the endocrine system; aids in the maturation of T and B cells.</td>
</tr>
<tr>
<td>thyroid [THĪ-röyd] gland Greek thyreos, oblong shield</td>
<td>Gland with two lobes located on either side of the trachea; helps control blood calcium levels and metabolic functions.</td>
</tr>
<tr>
<td>thyroid-stimulating hormone (TSH)</td>
<td>Hormone secreted by anterior pituitary gland; stimulates release of thyroid hormones.</td>
</tr>
<tr>
<td>thyroxine [thī-RŌK-sēn, -sēn] (T₄)</td>
<td>Compound found in or manufactured for thyroid gland; helps regulate metabolism.</td>
</tr>
<tr>
<td>triiodothyronine [trī-I-ō-dō-THĪ-rō-nēn] (T₃)</td>
<td>Thyroid hormone that stimulates growth.</td>
</tr>
<tr>
<td>vasopressin [vā-sō-PRĒS-īn]</td>
<td>Hormone secreted by pituitary gland; raises blood pressure.</td>
</tr>
</tbody>
</table>
CASE STUDY

Checking the Symptoms

Gail Woods is a 45-year-old woman who has noticed some disturbing symptoms, such as unusual fatigue, since her last checkup. She called her physician, Dr. Tyler, for an appointment. Dr. Tyler examined her and sent her to a lab for several tests.

Critical Thinking
1. Dr. Tyler ordered a urinalysis and blood tests. Why?
2. If Dr. Tyler is able to limit the symptoms to one body system, is he likely to send Gail to a specialist?

STRUCTURE AND FUNCTION EXERCISES

Find a Match

Match each hormone with its function by writing the name of the hormone on the appropriate line.

ADH prolactin insulin aldosterone oxytocin thyroxine testosterone thymosin melatonin epinephrine

3. may affect sleep habits: _____________
4. reacts to stress: _____________
5. decreases urine output: _____________
6. stimulates uterine contractions and lactation: _____________
7. helps transport glucose to cells and decreases blood sugar: _____________
8. stimulates breast development and lactation: _____________
9. affects electrolyte and fluid balances: _____________
10. regulates rate of cellular metabolism: _____________
11. promotes growth and maintenance of male sex characteristics and sperm production: _____________
12. aids in development of the immune system: _____________

Check Your Knowledge

For each of the following words, write C if the spelling is correct. If it is not, write the correct spelling.

13. adenohypophysis _____________
14. adenal _____________
15. hypophisis _____________
16. suparenal _____________
17. sympathomimetic _____________
18. pituatary _____________
19. lutinizing _____________
20. triiodothyronine _____________
CASE STUDY

Getting the Results

Gail’s tests came back with abnormally high blood sugar. Her lab results are shown at right:

Critical Thinking

21. Were any other tests abnormal?
22. What body system is the likely origin of Gail’s abnormal tests?

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### Combining Forms and Abbreviations

The lists below include combining forms and abbreviations that relate specifically to the endocrine system. Pronunciations are provided for the examples.

<table>
<thead>
<tr>
<th><strong>COMBINING FORM</strong></th>
<th><strong>MEANING</strong></th>
<th><strong>EXAMPLE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>aden(o)</td>
<td>gland</td>
<td>adenopathy [ā-dē-NÖP-ă-thē], glandular or lymph node disease</td>
</tr>
<tr>
<td>adren(o), adrenal(o)</td>
<td>adrenal glands</td>
<td>adrenomegaly [ā-drē-nō-MĒG-ă-lē], enlargement of the adrenal glands</td>
</tr>
<tr>
<td>gluc(o)</td>
<td>glucose</td>
<td>glucogenesis [glū-kō-ĴĒN-ē-sīs], production of glucose</td>
</tr>
<tr>
<td>glyc(o)</td>
<td>glycogen</td>
<td>glycolysis [glī-KÖL-i-sīs], conversion of glycogen to glucose</td>
</tr>
<tr>
<td>gonad(o)</td>
<td>sex glands</td>
<td>gonadotropin [gō-NAĐ-ō-trō-pīn], hormone that aids in growth of gonads</td>
</tr>
<tr>
<td>pancreat(o)</td>
<td>pancreas</td>
<td>pancreatitis [pān-krē-ă-TĪ-tīs], inflammation of the pancreas</td>
</tr>
<tr>
<td>parathyroid(o)</td>
<td>parathyroid</td>
<td>parathyroidectomy [pā-rā-thī-rōy-DĒK-tō-mē], excision of the parathyroid glands</td>
</tr>
<tr>
<td>thyr(o), thyroid(o)</td>
<td>thyroid gland</td>
<td>thyrotoxic [thī-rō-TŌK-sīk], having excessive amounts of thyroid hormones</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>ABBREVIATION</strong></th>
<th><strong>MEANING</strong></th>
<th><strong>ABBREVIATION</strong></th>
<th><strong>MEANING</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTH</td>
<td>adrenocorticotropic hormone</td>
<td>IDDM</td>
<td>insulin-dependent diabetes mellitus</td>
</tr>
<tr>
<td>ADH</td>
<td>antidiuretic hormone</td>
<td>LH</td>
<td>luteinizing hormone</td>
</tr>
<tr>
<td>CRH</td>
<td>corticotropin-releasing hormone</td>
<td>MSH</td>
<td>melanocyte-stimulating hormone</td>
</tr>
<tr>
<td>DM</td>
<td>diabetes mellitus</td>
<td>NIDDM</td>
<td>noninsulin-dependent diabetes mellitus</td>
</tr>
<tr>
<td>OT</td>
<td>oxytoxin</td>
<td>PG</td>
<td>prostaglandins</td>
</tr>
<tr>
<td>FSH</td>
<td>follicle-stimulating hormone</td>
<td>PRL</td>
<td>prolactin</td>
</tr>
<tr>
<td>GH</td>
<td>growth hormone</td>
<td>PTH</td>
<td>parathyroid hormone, parathormone</td>
</tr>
<tr>
<td>GTT</td>
<td>glucose tolerance test</td>
<td>STH</td>
<td>somatotropin hormone</td>
</tr>
<tr>
<td>HCG</td>
<td>human chorionic gonadotropin</td>
<td>TSH</td>
<td>thyroid-stimulating hormone</td>
</tr>
</tbody>
</table>
**Combining Forms and Abbreviations Exercises**

**Build Your Medical Vocabulary**

Using the combining forms learned in this chapter, construct five words about the endocrine system that fit the definitions provided.

23. inflammation of a gland: _____________
24. disease of the pancreas: _____________
25. production of glycogen: _____________
26. enlargement of the thyroid gland: _____________
27. beneficial thyroid function: _____________

**Know the Meaning**

Write the definitions for the following terms.

28. adrenalectomy: _____________
29. pancreatectomy: _____________
30. adenoma: _____________
31. gonadotropin: _____________
32. thyromegaly: _____________

**Diagnostic, Procedural, and Laboratory Terms**

A thorough assessment can help to identify an endocrine disorder. The patient with such a disorder, or disease, commonly reports fatigue, weakness, weight changes, mental status changes, polyuria, polydipsia, and abnormalities of sexual maturity and function. A detailed family history can also help uncover a familial tendency toward endocrine disease. The only endocrine glands that can be physically examined (palpated) are the thyroid gland and testes. In many patients, the thyroid gland isn’t palpable. Enlargement or atrophy of these glands can be felt. Severe enlargement can also be seen.

The results of various diagnostic tests can be used to suggest, confirm, or rule out an endocrine disease. Endocrine function can be tested by direct, indirect, and radiographic studies. Direct testing, the most common method of measuring endocrine function, involves measuring the hormone levels in blood or urine. The most often performed tests include those measuring levels of cortisol, PTH, GH, T4 and T3, FSH, LH, oral glucose tolerance testing (GTT), calcium, potassium, phosphorus, glycosolated hemoglobin, and electrolyte studies. A **fasting blood sugar** test and a **glucose tolerance test** are both started after a 10 to 12-hour period where the individual has absolutely nothing by mouth. This includes chewing gum, coffee, cigarettes, bottled water, or even toothpaste. This time of fasting is written by the physician as “NPO” meaning, “non per os”—Latin for “nothing by mouth.” The glucose tolerance test is repeated every hour for 3 to 6 hours, according to the physician’s orders, after the patient ingests a glucose solution. Results of this test analyze how efficiently the body handles sugars and carbohydrates and well it is able to balance itself after ingesting these substances. Diabetic patients often check **blood sugar** or **blood glucose** levels several times a day themselves to track fluctuations in blood sugar and/or to determine
Chapter 15 The Endocrine System

the correct amount of insulin to take. A **postprandial blood sugar** is a test usually taken 2 hours after a meal to determine whether blood sugar levels can return to normal ranges following a meal. A urine test, also called a urinalysis, can be performed to detect the presence of ketones (proteins) and/or types of sugar in the urine, both of which may indicate diabetes. For people already diagnosed with diabetes, a **glycosylated hemoglobin** (A1c or Hemoglobin A1c) test can track the effectiveness of a patient's insulin treatment by detecting the amount of glucose present on the surface of the blood's red cells after a period of 2–3 months. The lower the levels of glycosylated red cells present, the more balanced the patient's blood sugar levels have been.

Computed tomography scanning (CT), regular x-rays, ultrasounds, or magnetic resonance imaging (MRI) may help locate tumors, lesions, cysts, gland atrophy, or abnormal increased size, bone density or frailty in diagnosing an endocrine disorder. Overall endocrine system functioning is evaluated by using the serum or plasma from human blood. Many hormones and electrolytes are present in serum. Endocrine function can be tested in the plasma by using a **radioactive immunoassay**, a test using radioactive iodine to locate various substances in the plasma such as GH (Growth Hormone). Thyroid functioning can be tested in a **thyroid function test**, a blood test for various hormones secreted by the thyroid. A complete blood count (CBC) is used to analyze the overall composition of the entire blood to include the red cells, white cells, and platelets. A basic metabolic profile/panel (BMP) would report the levels of electrolytes and other chemical compounds found in the blood. A **radioactive iodine uptake** is a measure of how quickly ingested iodine is taken into the thyroid gland. A **thyroid scan** is a test for cancer or other abnormality using radionuclide imaging. In diabetics, an ophthalmologic examination may show diabetic retinopathy, a common eye disease in insulin dependent diabetics.

**VOCABULARY REVIEW**

In the previous section you learned terms related to diagnosis, clinical procedures, and laboratory tests. Before going on to the exercises, review the terms below and refer to the previous section if you have any questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. The etymologies (word histories) are for your information only. You do not need to memorize them.

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>blood sugar, blood glucose</td>
<td>Test for glucose in blood.</td>
</tr>
<tr>
<td>fasting blood sugar</td>
<td>Test for glucose in blood following a fast of 12 hours.</td>
</tr>
<tr>
<td>glucose tolerance test (GTT)</td>
<td>Blood test for body’s ability to metabolize carbohydrates; taken after a 10–12-hour fast, then repeated every hour for 4 to 6 hours after ingestion of a sugar solution.</td>
</tr>
<tr>
<td>glycosylated <strong>[GLĪ-kō-sil-ā-tēd]</strong> hemoglobin A1C</td>
<td>Blood test for an average of glucose levels over the previous 2–3 months.</td>
</tr>
<tr>
<td>postprandial <strong>[pōst-PRĀN-dē-āl]</strong> blood sugar</td>
<td>Test for glucose in blood, two hours after a meal.</td>
</tr>
<tr>
<td>Term</td>
<td>Meaning</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>radioactive immunoassay (RIA)</td>
<td>Test for measuring hormone levels in plasma; taken after radioactive solution is ingested.</td>
</tr>
<tr>
<td>radioactive iodine uptake</td>
<td>Test for how quickly the thyroid gland pulls in ingested iodine.</td>
</tr>
<tr>
<td>thyroid function test or study</td>
<td>Test for levels of TSH, T&lt;sub&gt;3&lt;/sub&gt;, and T&lt;sub&gt;4&lt;/sub&gt; in blood plasma to determine thyroid function.</td>
</tr>
<tr>
<td>thyroid scan</td>
<td>Imaging test for thyroid abnormalities.</td>
</tr>
<tr>
<td>urine sugar</td>
<td>Test for diabetes; determined by presence of sugar in urine.</td>
</tr>
</tbody>
</table>

**MORE ABOUT . . .**

**Diabetes and Diet**

For many years, doctors prescribed a high-protein, low-carbohydrate diet for diabetics. In recent years, increased understanding of how food is metabolized by the body has led to changes in diets prescribed for diabetics. Most newly diagnosed diabetics are given a varied diet by a physician or a dietitian that is tailored to their specific needs—current weight, level of diabetes (mild, moderate, severe), and lifestyle. The American Dietetic Association and the American Diabetes Association provide the dietary information on which most diets for diabetics are based. A diabetic’s personalized daily diet might include four fruit exchanges, three protein exchanges, three bread exchanges, and seven vegetable exchanges. Many suppliers of processed food, particularly those foods aimed at the health-conscious consumer, now list exchanges as part of their nutrition labels as shown here.

**Nutrition Facts**

<table>
<thead>
<tr>
<th>Serving Size</th>
<th>1 cup (246g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servings Per Container</td>
<td>about 2</td>
</tr>
</tbody>
</table>

| Amount Per Serving | Calories 100 | Calories from Fat 5 |
|--------------------|--------------|
|                     | % Daily Value* |
| Total Fat 0.5g      | 1%           |
| Saturated Fat 0g    | 0%           |
| Cholesterol 0mg     | 0%           |
| Sodium 430mg        | 18%          |
| Total Carbohydrate 23g | 8%       |
| Dietary Fiber 2g    | 8%           |
| Sugars 1g           |              |
| Protein 4g          |              |

* Percent Daily Values are based on a 2,000 calorie diet

**DIETARY EXCHANGES PER SERVING:**

1 Bread
1 Vegetable

Diet exchanges are based on Exchange Lists for Meal Planning, © 1989, the American Diabetes Assoc., Inc. and the American Dietetic Assoc.
**Pathological Terms**

Body activities, homeostasis, and the response to stress are controlled by two distinct but interconnected systems: the nervous system and the endocrine system. The nervous system (discussed in Chapter 8) creates an immediate but short-lived response. The endocrine system has a slightly slower onset and a longer duration of action, and uses highly specific and powerful hormones to control the body’s response chemically. Certain endocrine glands are stimulated to secrete hormones in response to other hormones and therefore keep the body in balance or homeostasis. Diseases of the endocrine system commonly involve an abnormal increase or decrease in the secretion of hormones. Symptoms of disease vary with the degree of increase or decrease in hormonal secretion and the age of the patient. The remarkable work and importance of hormones is seen in their pathology. Sometimes a minute difference in the amount of hormone can make a huge difference in the seriousness of an illness. Changes in gland size that affect the gland’s production and secretion of a hormone often result from trauma to the gland such as infection, surgical procedures, inflammation, and radiation. Most endocrine illnesses are the result of [hypersecretion](#) ( oversecretion) or [hyposecretion](#) (undersecretion) of one or more hormones. Hypersecretion can be caused by excessive stimulation of a gland by a bacteria, virus, other microorganism or by a tumor affecting an endocrine gland. Diagnosing endocrine disorders requires correctly matching the patient’s symptoms with a specific hormone dysfunction and confirming either the overproduction or underproduction of that specific hormone or group of hormones. After the endocrine problem has been identified and diagnosed, treatment is begun to either decrease the amount of hormone being released by subjecting the patient to radiation therapy, surgical removal of the gland, or reduction of the tumor or lesion stimulating the hypersecretion. In the case of hormone deficit or hyposecretion, hormone supplements or medications may be prescribed to stimulate.
Pituitary Disorders

Hyperpituitarism is a chronic, progressive disease caused by the excessive production and secretion of various pituitary hormones, such as human growth hormone (hGH). Excessive hGH produces two very distinct conditions, acromegaly and gigantism. Acromegaly (chronic hypersecretion of growth hormone (GH) beginning after puberty), causes abnormal overgrowth of the bones in the face, hands, and feet. It is often seen in patients between the ages of 30 and 40. Gigantism is caused by the hypersecretion of GH (somatotropin) before puberty and results in a proportional overgrowth of all body tissue. Symptoms usually appear over time and sexual and mental developments are often effected. Some patients may reach heights over 8 feet tall.

Hypopituitarism is a condition caused by a deficiency or complete absence of some, or any of the pituitary hormones, specifically those hormones produced by the anterior pituitary gland. Because the anterior pituitary gland is responsible for secretion of so many essential hormones, the condition may be very complex affecting several different areas of the body. Patients may experience stunted growth, sexual immaturity, and various metabolic problems. A decrease, or absence of pituitary hormones responsible for stimulating the production and secretion of other hormones in the endocrine system, can result in the atrophy or dysfunction of other endocrine glands. Hyposecretion of GH may result in a condition called dwarfism (Figure 15-3), which is the opposite of gigantism, and which normally occurs in children and results in the child being extremely short but with proportional body structure. The disease may be linked to mental retardation in the patient and other physical defects. Dwarfism may be congenital or the result of a cranial hemorrhage after birth. Head trauma, tumor, or infection may result in the undersecretion of the growth-hormone-releasing-hormone (GH-RH) which is produced by the hypothalamus. The age of the patient, the severity and type of deficiency, and the underlying cause of hypopituitarism will help determine the method of treatment. Treatment may include hormone supplements, including thyroxine, sex hormones, somatropin (hGH) or cortisone; and surgery to remove a tumor if this is the cause of the hormone inhibition.

The therapeutic use of human growth hormone was first shown in 1963. Since that time the number of approved and proposed uses of human growth hormone has grown from one to more than a dozen, and the number of patients being treated with it has increased from a handful to tens of thousands worldwide. The officially approved uses of human growth hormone vary from country to country, but it is commonly used for children with growth hormone deficiency or insufficiency, poor growth due to renal failure, and children born small for gestational age with poor growth past 2 years of age. In adults the approved uses include AIDS-related wasting and growth hormone deficiency (usually due to a pituitary tumor).

In addition to the generally accepted therapeutic uses of human growth hormone, many proposed uses have not been established. Human growth hormone is a potent hormone with a wide variety of effects. The
anabolic actions of human growth hormone have made it attractive for people wishing to reverse the effects of ageing and to promote athletic abilities and muscles development. These last two potential uses have received the most attention as abuse of growth hormone. The classic form of “abuse” of human growth hormone are athletes or bodybuilders who use it as a way to gain an unfair advantage over their competitors. No good evidence or scientific research exists showing that human growth hormone actually works safely for this purpose. In addition to the lack of evidence for effectiveness of human growth hormone for these unsupported uses, it causes side effects such as diabetes, carpal tunnel syndrome, fluid retention, joint and muscle pain, and high blood pressure.

In addition to growth problems, hyposecretion of vasopressin or antidiuretic hormone (ADH) causes a condition known as **diabetes insipidus**. This is not the same as **diabetes mellitus** which is often treated with insulin injections but rather a disease caused by decreased levels of ADH by the posterior pituitary gland which results in extremely large amounts of diluted and colorless urine called **polyuria**. The patient will also experience excessive thirst known as **polydipsia** due to the dehydration caused by the polyuria. The disease may be inherited or the result of injury to the hypothalamus or pituitary gland and is more common in men than women. It can be treated with an antidiuretic medication, such as vasopressin nasal sprays, injections, or an oral medication. Hyposecretion of antidiuretic hormone also causes **syndrome of inappropriate ADH (SIADH)**, which results in excessive water retention.

## Thyroid Disorders

Thyroid diseases may also cause the oversecretion or undersecretion of the primary thyroid hormones, thyroxine (T4) and triiodothyronine (T3). The thyroid gland is the endocrine gland that most often produces disease and a **goiter** is often the first sign of thyroid disease. The term goiter refers to any enlargement of the thyroid gland. Most patients are asymptomatic until they notice a swollen mass appearing under the chin across the area where the thyroid gland is located. As this mass continues to grow, it may begin exerting pressure on the esophagus making the action of swallowing difficult. In extreme cases, the mass may become so large that it even presses on the trachea resulting in dyspnea or shortness of breath. Goiters can be the result of a shortage of iodine in the diet which results in the body not being able to metabolize and use T3 and T4; or inadequate levels of thyroid hormone which causes the anterior pituitary gland to increase secretion of thyrotropin (TSH). The release of TSH stimulates the thyroid gland to produce thyroid hormone but instead the thyroid gland begins to increase in size, thus creating the goiter.

Another hypothyroid condition occurs when the immune system attacks the thyroid gland in the form of an autoimmune disease called **Hashimoto’s thyroiditis**. This is a chronic thyroiditis occurring in women eight times more often than men and is the leading cause of goiter and hypothyroidism. In addition to the symptoms of simple goiter, the patient may also develop weight gain, mental sluggishness, and extreme sensitivity to cold. While the true cause of Hashimoto’s thyroiditis is unknown, a genetic factor is suspected and autoimmune factors have been documented through the discovery that antibodies appear to destroy thyroid tissue resulting
in chronic inflammation of the thyroid gland and the production of scar tissue which enlarges the gland. Treatment for Hashimoto’s is lifelong thyroid hormone replacement therapy. When the thyroid gland becomes overactive, causing hyperthyroidism, a condition known as Graves’ disease will develop. Symptoms of Graves’ disease are consistent with increased T3 and T4, which cause increased metabolic rate, weight loss, insomnia, sweating, rapid heartbeat and palpitations, nervousness, and excitability. Exophthalmos, bulging of the eyes, is also a sign that can occur in some instances of Graves’ disease. General hyperactive behavior, loss of hair, and tremors are also seen. A sudden exacerbation (flare up) of symptoms may be the first sign of thyrotoxicosis also called “thyroid storm.” This is the result of extremely high levels of thyroid hormone and can be a life threatening situation. Treatment is focused on reducing the amount of thyroid hormone being released and is often accomplished by antithyroid medications. In severe cases, a thyroidectomy or radioactive iodine treatments may be necessary.

Hypothyroidism is a very common condition and refers to any state in which thyroid hormone production is below normal. Some symptoms may take years to develop and be noticed. The underactivity of the thyroid gland, causes sluggishness and slow pulse, often resulting in obesity. Patients may also exhibit cold sensitivity, constipation, dry and flaky skin conditions and extreme fatigue. There are several causes for hypothyroidism with hereditary factors at the top of the list. A simple blood test evaluating levels of TSH present in the body can determine whether this condition is present. In most cases, patients will be on lifelong medication such as Synthroid or Levoxyl as replacements or supplements to the low levels of hormone. Another form of hypothyroidism disease is cretinism or congenital hypothyroidism. This disease develops during infancy or early childhood, and is a congenital condition where the thyroid gland is completely absent at birth or the thyroid gland is unable to produce hormones. The child will develop with both mental and physical retardation. A lack of developing muscle will result in the child’s inability to stand and walk. They will have very distinct physical features such as wide-set eyes, puffy eyelids, a protruding abdomen, dwarf-like height, expressionless face with a wide-open mouth and thick, protruding tongue, and dry skin. Early discovery and treatment may correct most of the physical deficiencies but often does not help with the mental retardation. Myxedema is a severe type of hypothyroidism in older children and adults, usually female, with a range of symptoms depending on the age of the patient at onset of the disease. Symptoms may include puffiness in the extremities, slow muscular response, excessively dry skin, bloated face with thickened tongue, excessive fatigue, weight gain, loss of hair, slow or slurred speech, and menorrhagia in female patients. In severe cases, myxedema can progress into coma although this is a rare life-threatening form.

Thyroid cancer occurs in the thyroid gland and often does not cause symptoms until the disease is very advanced and often irreparable damage has occurred to the gland. Some patients may complain of hoarseness or difficulty swallowing. Patients with family history of thyroid cancer are ten times more likely to also develop thyroid cancer which indicates the disease may have a strong genetic link. Women are also three times more likely to develop thyroid cancer than men. The prognosis of patients with thyroid cancer greatly depends on the patient’s age at diagnosis, the advancement of the cancer at diagnosis, and the size of the primary tumor. It is a condition caused by the overactivity of one or more of the four parathyroid glands and is usually
caused by a tumor or excessive growth of one of the parathyroid glands (adenoma). Although some patients may have few symptoms, it may often result in such clinical symptoms as mental disturbances, fatigue, weakness, bone loss, and even in severe cases, kidney failure. **Hypoparathyroidism** (underactivity of the parathyroid glands) results from reduced levels of parathyroid hormone (PTH) and causes low blood calcium levels known as hypocalcemia. When levels of PTH are low, resulting in hypocalcemia, initial symptoms will include tingling of the nose, ears, fingertips or toes, followed by spasms, cramping, or twitching of the feet and hands. Severe, continual muscle contractions may then develop called tetany. The patient may experience emotional and mental status changes such as aggression, confusion, irritability, and memory loss. Left untreated, hypocalcemia will eventually progress into heart arrhythmias, spasms in the trachea leading to respiratory paralysis, respiratory arrest, and death. Calcium replacement therapy with vitamin D is effective in reducing hypocalcemia and this treatment is usually life-long unless the condition is discovered early enough in the patient’s life to be completely treated.

**Parathyroid Disorders**

The parathyroid glands help control blood calcium levels, which contribute to bone growth and muscular health. **Hyperparathyroidism** is a condition caused by the overactivity of one or more of the four parathyroid glands and is usually caused by a tumor or excessive growth of one of the parathyroid glands (adenoma). Although some patients may have few symptoms, it often results in such clinical symptoms as mental disturbances, fatigue, weakness, bone loss, and even in severe cases, kidney failure.

**Hypoparathyroidism** (underactivity of the parathyroid glands) results from reduced levels of parathyroid hormone (PTH) and causes low blood calcium levels known as hypocalcemia. When levels of PTH are low, resulting in hypocalcemia, initial symptoms will include tingling of the nose, ears, fingertips or toes, followed by spasms, cramping, or twitching of the feet and hands. Severe, continual muscle contractions called tetany may then develop. The patient may experience emotional and mental status changes such as aggression, confusion, irritability, and memory loss. Left untreated, hypocalcemia will eventually progress into heart arrhythmias, spasms in the trachea leading to respiratory paralysis, respiratory arrest, and death. Calcium replacement therapy with vitamin D is effective in reducing hypocalcemia and this treatment is usually life-long unless the condition is discovered early enough in the patient’s life to be completely treated.

**Adrenal Disorders**

Like other endocrine glands, the adrenal glands may also become overactive (hyperadrenalism) or underactive (hypoadrenalism). Hyperadrenalism can be caused by an adrenal tumor, excessive secretion of corticotrophin (ACTH) from the pituitary gland, or the abnormal production of corticotrophin in another organ (occurs in the lung cancer). **Cushing’s Syndrome** is a condition where there are excessive amounts of circulating cortisol levels in the blood. The patient presents with muscular weakness, fatigue, and physical changes in body appearance. Psychiatric problems are common in this disease and patients often develop diabetes mellitus. Prolonged use or large doses of glucocorticoids (steroids) to treat other conditions may result in Cushing’s
syndrome. Treatment of Cushing’s depends on the cause of the hyperadrenali-
sm and may include surgery to remove a tumor or radiation to reduce a tumor
in the pituitary or adrenal gland. Adrenogenital syndrome results in symptoms
of excessive androgens both in men and women, which, in turn, can result
in hirsutism, abnormal hair growth. Virilism is also a condition caused by
excessive androgen secretion. Virilism results in mature masculine features in
children. Administration of steroids can keep the overactivity in balance.

Hypoadrenalism, or adrenal insufficiency, is also known as Addison’s
disease and is a partial or complete failure of adrenocortical function. It is
characterized by weakness and fatigue, gastrointestinal disturbances, anorexia
and weight loss, and a very distinct bronze skin color. Reduced levels of
aldosterone result in the body’s inability to retain salt and water resulting
in dehydration, hyperkalemia (excessive potassium blood levels), and other
electrolyte imbalances. Hyperkalemia is a life-threatening condition requir-
ing immediate emergency care. Treatment includes the replacement of natu-
rnal hormones and correction of salt and potassium levels. Perhaps the most
famous Addison’s patient was US President John F. Kennedy.

Pancreas Disorders

Sometimes, the pancreas may become inflamed, as in pancreatitis effecting
the production and secretion of the hormone insulin. Hyperinsulinsism is the
 oversecretion of insulin and may cause hypoglycemia, a dangerous lowering
of blood sugar levels that deprives the body of needed glucose. Hypoglycemia
can be successfully controlled with dietary changes and patient awareness of
physical symptoms signaling the decline in blood glucose levels. Hyposcre-
tion of insulin can cause diabetes mellitus, a widespread disease that affects
about 4 percent of the U.S. population.

Diabetes or Failure of the Beta Cells

Diabetes occurs either as Type I diabetes (insulin-dependent diabetes mel-
itus or IDDM), Type II diabetes (noninsulin-dependent diabetes mellitus
or NIDDM), or Type III diabetes (gestational diabetes or GDM). Type I
diabetes (formerly known as juvenile onset diabetes) usually occurs before
the age of 30 and is the result of underproduction or complete absence of insu-
lin production (hypoinsulinism) by the beta cells. A reduction in insulin
depresses cells of the glucose fuel they need and they begin to metabolize
proteins and fats as replacements. This activity causes metabolic waste
products known as ketones to build up in the blood and spill over into the
urine (ketonuria) and this leads to a very serious condition called acidosis.
When excessive glucose accumulates in the blood and overflows into the
urine a condition called glucosuria (glycosuria) develops. The goal of dia-
abetes treatment is to keep blood glucose levels as near to normal as possible.
Type I diabetic may be treated with controlled doses of insulin along with
consistent, moderate exercise and weight management. Type II diabetics
(formerly known as adult onset diabetes) usually do not require insulin injec-
tions but may need oral hypoglycemic medications and follow strict dietary
guidelines, and exercise routines. Type II diabetes is the more common of
the two diabetic forms and has a gradual onset in adults between the ages
of 30 and 55. In Type II, pancreatic function of insulin production and
secretion still remains but is insufficient for normal glucose metabolism.
It is very common for overweight and obsess people whose responsiveness
to insulin is abnormally low to develop Type II diabetes. This response is
called insulin resistance.

Both Type I and Type II diabetes can lead to insulin reaction and/or dia-
abetic coma. Insulin reaction or insulin shock, is a condition where excessive
levels of insulin causes a rapid onset of symptoms such as tremors, tachycar-
dia, hunger, dizziness, irritability, confusion, seizures, and loss of conscious-
ness. Diabetic coma results from abnormally low levels of insulin, such as
occurs when an insulin dose is skipped or excessive amounts of carbohy-
drates have been consumed by the patient. Diabetic coma has a slow onset
and presents with such symptoms as excessive thirst, increased urination,
nausea and vomiting, abdominal pain, flushed and dry skin, “fruity” breath
odor, heavy respirations, dilated and fixed pupils, hyperglycemia, loss of con-
sciousness, and coma. Left untreated, the patient could die.

Type III, or gestational, diabetes (GDM) is a condition where a female’s
body loses the ability to process carbohydrates and sugars during pregnancy.
Affecting approximately four percent of pregnant women today, its onset
usually occurs between weeks 24 to 28 of the pregnancy and may have most
of the typical symptoms of the other forms of diabetes. During the preg-
nancy, the treatment of GDM is similar to the treatment of any diabetes,
watching the mother and the fetus very closely due to the increased risk for
complications. This condition usually disappears right after delivery of the
baby with 30–40 percent of women with GDM developing Type II diabetes
within 5 to 10 years after GDM.

Complications of diabetes cover a wide range of ailments from circula-
tory problems to infections to organ failure. Diabetic nephropathy is a kid-
ney disease resulting from diabetes mellitus. Also called glomerulosclerosis,
this condition can be expected to eventually develop in all Type I diabetic
patients. Insufficient control of blood glucose levels and blood pressure by the
diabetic patient will accelerate the destruction of the renal function. Diabetic
neuropathy is loss of sensation in the extremities. This condition is com-
pounded by hyperglycemia which delays healing and substantially reduces the
diabetic’s resistance to infection. Diabetics require close observation for the
development of foot wounds and infections that may occur from circulatory
difficulties common in diabetes, especially in the lower extremities. Diabetic
retinopathy is a disease of the retinal blood vessels causing gradual visual loss
leading to blindness. Diabetic retinopathy is a major cause of blindness and
results from hemorrhages, abnormal dilation of retinal veins, the formation of
abnormal new vessels, and damaging microaneurysms in the eyes. The body
uses stored proteins and fats to replace glucose for energy, thereby causing
acidosis, ketoacidosis, and ketosis, all of which are marked by the abnormal
presence of ketone bodies in the blood and urine.

Before the discovery of insulin as a compound that affects blood sugar
levels, people with diabetes usually died of some of the many complications
of the disease. Although diabetes is still not curable, technology has given
new solutions to diabetes care. Quick-acting and long-acting insulins provide
more options for managing insulin-dependent diabetes. A wider range of oral
drugs are available to treat Type II diabetes. New monitors make it easier and
more comfortable for people to test and track their blood glucose. External
insulin pumps can replace the discomfort of daily injections. Laser surgery
can treat diabetic eye disease and prevent blindness. Successful kidney and
pancreas transplantation procedures bring hope to people with organ fail-
ure. In addition, much has been learned about how to manage diabetes and
prevent complications through weight reduction, blood glucose control, and exercise and there are more successful methods of managing diabetes during pregnancy today. Researchers have also identified lifestyle changes that can help prevent diabetes.

Cancers of the Endocrine System

Cancers occur commonly in the endocrine system. Many, such as thyroid cancer, can be treated with removal of the affected gland and supplementation with a synthetic version of the necessary hormones that are then missing from the body. In other endocrine cancers, such as pancreatic cancer, the prognosis is poor even after aggressive treatment. Cancer of the pancreas is the fourth-leading cause of cancer-related death in the United States. Surgical removal of the affected area of the pancreas is currently the only potential cure, however only 15–20 percent of diagnosed patients are candidates for surgery.

 MORE ABOUT . . .
 Misleading Common Terms

In certain parts of the country, both types of diabetes are simply called sugar, as in the phrase, “he has sugar.” Sometimes common terms for diseases seem to misrepresent what the disease is. Diabetes is in fact an underproduction of or resistance to insulin, although in the past, many people thought it was caused by sugar alone.

VOCABULARY REVIEW

In the previous section you learned terms related to pathology. Before going on to the exercises, review the terms below and refer to the previous section if you have any questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. The etymologies (word histories) are for your information only. You do not need to memorize them.

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>acromegaly [āk-rō-MĒG-ā-le]</td>
<td>Abnormally enlarged features resulting from a pituitary tumor and hypersecretion of growth hormone.</td>
</tr>
<tr>
<td>Addison’s [ÄD-ī-sōn] disease</td>
<td>Underactivity of the adrenal glands.</td>
</tr>
<tr>
<td>Cushing’s [KUSH-ings] syndrome</td>
<td>Group of symptoms caused by overactivity of the adrenal glands.</td>
</tr>
<tr>
<td>diabetes [dī-ā-BĒ-tēz]</td>
<td>See Type I diabetes, Type II diabetes, Type III diabetes.</td>
</tr>
<tr>
<td>Term</td>
<td>Meaning</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>diabetic neuropathy [nū-RŌP-ā-thē]</td>
<td>Loss of sensation in the extremities due to diabetes.</td>
</tr>
<tr>
<td>dwarfism [DWŌRF-īzm]</td>
<td>Abnormally stunted growth caused by hyposecretion of growth hormone, congenital lack of a thyroid gland, or a genetic defect.</td>
</tr>
<tr>
<td>gigantism [JĪ-gānt-īzms]</td>
<td>Abnormally fast and large growth caused by hypersecretion of growth hormone.</td>
</tr>
<tr>
<td>goiter [GÖY-tēr]</td>
<td>Abnormal enlargement of the thyroid gland.</td>
</tr>
<tr>
<td>Graves’ [grāvz] disease</td>
<td>Overactivity of the thyroid gland.</td>
</tr>
<tr>
<td>gigantism [Jī-gān-tīzms]</td>
<td>Overactivity of the parathyroid glands.</td>
</tr>
<tr>
<td>hirsutism [HĒR-sū-tīzms]</td>
<td>Abnormal hair growth due to an excess of androgens.</td>
</tr>
<tr>
<td>hypersecretion [HĪ-pēr-sē-KRĒ-shūn]</td>
<td>Abnormally high secretion, as from a gland.</td>
</tr>
<tr>
<td>hyposecretion [HĪ-pō-sē-KRĒ-shūn]</td>
<td>Abnormally low secretion, as from a gland.</td>
</tr>
<tr>
<td>Term</td>
<td>Meaning</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>insulin-dependent diabetes mellitus (IDDM)</td>
<td>See Type I diabetes.</td>
</tr>
<tr>
<td>ketoacidosis [ké-tō-ə-si-DŌ-sis]</td>
<td>Condition of high acid levels caused by the abnormal accumulation of ketones in the body.</td>
</tr>
<tr>
<td>ketosis [kē-TŌ-sis]</td>
<td>Condition caused by the abnormal release of ketones in the body.</td>
</tr>
<tr>
<td>noninsulin-dependent diabetes mellitus (NIDDM)</td>
<td>See Type II diabetes.</td>
</tr>
<tr>
<td>pancreatitis [PĀN-krē-ā-TĪ-tis]</td>
<td>Inflammation of the pancreas.</td>
</tr>
<tr>
<td>polyuria [pōl-ē-YŪ-rē-ā]</td>
<td>Excessive excretion of urine, resulting in frequent urination.</td>
</tr>
<tr>
<td>syndrome of inappropriate ADH (SIADH)</td>
<td>Excessive secretion of antidiuretic hormone.</td>
</tr>
<tr>
<td>tetany [TĒT-ā-nē]</td>
<td>Neurological syndrome, usually due to decreased serum levels of calcium in the blood.</td>
</tr>
<tr>
<td>thyrotoxicosis [THĪ-ō-tōk-sī-KŌ-sis]</td>
<td>State of dangerously high levels of thyroid hormone.</td>
</tr>
<tr>
<td>Type I diabetes</td>
<td>Endocrine disorder with abnormally low or completely absent levels of insulin; also known as insulin-dependent diabetes mellitus (IDDM).</td>
</tr>
<tr>
<td>Type II diabetes</td>
<td>Disease caused by failure of the body to recognize insulin that is present or by an abnormally low level of insulin; also known as noninsulin-dependent diabetes mellitus (NIDDM); usually adult onset.</td>
</tr>
<tr>
<td>virilism [vĪR-ī-līzm]</td>
<td>Condition with excessive androgen production, often resulting in the appearance of mature male characteristics in young.</td>
</tr>
</tbody>
</table>

**CASE STUDY**

**Getting a Diagnosis**

Gail decides to wait until after the holidays to make her appointment with the endocrinologist. She thinks that she will watch what she eats and then go to the doctor when she is less busy. For a few days, she moderates her eating and feels a little better. However, on the big holiday weekend, Gail goes to several parties, drinks, and overeats. When she wakes up in the morning, she feels dizzy, is in a cold sweat, and feels very hungry. Right away, she realizes that something is terribly wrong. Since it is a holiday weekend, she has a friend take her to the emergency room. Once there, her symptoms worsen. The emergency room doctor tests her blood sugar and finds it is very low. After she has eaten something, he tests it again. Because Gail is overweight, the doctor suspects that her body is not sensitive to insulin. Gail is sent to Dr. Malpas, an endocrinologist, the very next day.

**Critical Thinking**

40. What type of diabetes does Gail appear to have?
41. What might some recommendations be for Gail’s diet?
Write A for adrenal, PA for pancreas, PI for pituitary, and T for thyroid to indicate the gland from which each of the following diseases arises.

42. acromegaly: _____________
43. diabetes mellitus: _____________
44. exophthalmos: _____________
45. gigantism: _____________
46. goiter: _____________
47. myxedema: _____________
48. Cushing’s syndrome: _____________
49. Graves’ disease: _____________
50. Addison’s disease: _____________
51. dwarfism: _____________
52. cretinism: _____________

Surgical Terms

Certain endocrine glands that become diseased can be surgically removed and then synthetic versions of the hormones they formerly produced are given to the patients to help their bodies continue performing the necessary endocrine functions.

An adenectomy is the removal of any gland. An adrenalectomy is the removal of an adrenal gland. Adrenalectomy may be performed in two methods—an open procedure or a laparoscopic procedure. Open operations may be performed through the back (sometimes requiring partial removal of a rib), the flank, or the abdomen. Laparoscopic procedures use small telescopes and long instruments to remove the adrenal gland through a series of small incisions. Typically, patients having laparoscopic procedures have less pain and a rapid recovery.

Removal of the pituitary gland (also called hypophysis) is a hypophysectomy. It is most commonly performed to treat tumors and sometimes is used to treat Cushing’s syndrome due to pituitary adenoma.

The pancreas is removed in a pancreatectomy. Operations on the pancreas typically require an abdominal incision with some dissection of the stomach and intestines to expose the pancreas located deep within the abdomen. Many tumors may be dissected out of the substance of the pancreas, but in some cases may require partial removal of the pancreas. Removal of the parathyroid gland is performed in a parathyroidectomy. An incision is made along the collar line. The surgeon will move the thyroid gland to one side, then the other, to allow inspection of the parathyroid glands, which are located behind or to the side of the thyroid, deep within the neck. The surgeon will remove one or more of the parathyroids, depending on the specific disorder. The muscles are then repaired and the skin incision is closed with sutures that will either absorb or be removed soon after the operation. Recently, there has been discussion of the acceptability of a minimally invasive, or “keyhole,” surgery for this problem. This is sometimes feasible and is being investigated here in the United States very carefully. Although it is being performed in some areas of the world, there are concerns about the possibility of more complications and a lower success rate with this type of procedure. Therefore, it is not yet widely accepted as a standard operation. A thymectomy is an operation to remove the thymus gland, leading to remission. However, this remission may not be permanent. A thymectomy is mainly carried out in an adult. This is because the thymus loses most of its functional capacity after adolescence, but
does retain a small portion of its function during adulthood. This is shown in the decreasing size of the thymus with increasing age after adolescence. A thyroidectomy is the removal of the entire thyroid gland. Surgery to remove only a portion of the thyroid is termed a partial, sub-total, or hemi-thyroidectomy. The metabolic functions of the thyroid are easily replaced with a well-tolerated oral medicine if surgery makes this necessary.

Some of these operations mentioned above may only require the removal of only the diseased part of a gland, leaving the remaining portion to continue its endocrine function. Other procedures that surgically remove the entire gland may require life-long hormone replacement or supplement therapy to replace the hormones once produced and secreted by the removed gland.

**VOCABULARY REVIEW**

In the previous section you learned terms related to surgery. Before going on to the exercises, review the terms below and refer to the previous section if you have any questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. The etymologies (word histories) are for your information only. You do not need to memorize them.

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>adrenalectomy</td>
<td>[ā-drē-nāl-ĒK-tō-mē] adrenal + -ectomy</td>
</tr>
<tr>
<td>hypophysectomy</td>
<td>[hī-pōf-ī-SĒK-tō-mē] hypophys(is) + -ectomy</td>
</tr>
<tr>
<td>pancreatectomy</td>
<td>[PĀN-krē-ā-TĒK-tō-mē] pancreat-, pancreas + -ectomy</td>
</tr>
<tr>
<td>parathyroidectomy</td>
<td>[PĀ-rā-thī-rōy-DĒK-tō-mē] parathyroid + -ectomy</td>
</tr>
<tr>
<td>thymectomy</td>
<td>[thī-MĒK-tō-mē] thym(us) + -ectomy</td>
</tr>
<tr>
<td>thyroidectomy</td>
<td>[thī-rōy-DĒK-tō-mē] thyroid + -ectomy</td>
</tr>
</tbody>
</table>

**CASE STUDY**

**Controlling the Disease**

After the emergency room incident, Gail goes to her appointment with the endocrinologist, where she is given medication to make her body more sensitive to insulin, and told to diet sensibly and exercise. When she returns three months later, Dr. Malpas is pleased to see that Gail is controlling her diabetes, losing weight slowly, and exercising regularly. Her outlook is favorable. Dr. Malpas has another patient, Will Burns, who has had an overactive thyroid since he was a child.

Lately, Will’s hyperthyroidism has increased. Dr. Malpas biopsies Will’s thyroid and tells Will it would be best to remove the thyroid.

**Critical Thinking**

53. What did Dr. Malpas probably find that necessitated thyroid removal?

54. What medications could Will be given after the operation?
Build Your Medical Vocabulary

Supply the missing part of the term:

55. removal of a gland: ________ectomy
56. removal of the pituitary gland: ________ectomy
57. removal of an adrenal gland: ________ectomy
58. removal of the thymus gland: ________ectomy
59. removal of part of the pancreas: ________ectomy
60. removal of the thyroid gland: ________ectomy
61. removal of one or more of the parathyroid glands: ________ectomy

After completing the terms in items 55 through 61, use them to define the following treatments:

62. Treatment for Graves' disease: ________ectomy
63. Treatment for severe virilism: ________ectomy
64. Treatment for a cancerous gland: ________ectomy
65. Treatment for hyperparathyroidism: ________ectomy
66. Treatment for acromegaly: ________ectomy

Pharmacological Terms

Hormonal deficiencies are sometimes treated by hormone replacement therapy (HRT). Common types of hormone therapy include synthetic thyroid, estrogen, and testosterone. Other medications include those that regulate levels of substances in the body, such as glucose levels in diabetics. An antihypoglycemic raises blood sugar. An antihyperglycemic or hypoglycemic lowers blood sugar. Instead of or in addition to using drugs to regulate blood sugar, many diabetics are now treated with medications that increase sensitivity to their own insulin. Human growth hormone (somatotropin) occurs naturally in the body. In some cases of dwarfism, a synthetic version of HGH is given to promote growth. Steroids are used in controlling various symptoms and treating many diseases within and outside the endocrine system. Steroids can also be abused for muscle growth as discussed in Chapter 5. Table 15-2 lists common pharmacological agents used in treating the endocrine system.

There are several new endocrine therapy drugs available for the replacement or supplemental treatment of hormone absence or deficiency. Tamoxifen is an orally estrogen which is used in the treatment of breast cancer and is currently the world's largest selling drug for that purpose. Anastrozole (trade name: Arimidex) is a drug indicated in the treatment of breast cancer in post-menopausal women. It is used both following surgery and in metastatic breast cancer. It has the effect of decreasing the amount of estrogens that the body makes. While officially indicated for women, this...
drug has proven effective in also reducing estrogens (in particular and more importantly, estradiol) in men. Excess estradiol in men can cause benign prostatic hyperplasia, gynecomastia, and symptoms of hypogonadism. Some athletes and body builders will also use anastrozole as a part of their steroid cycle to reduce and prevent symptoms of excess estrogens; in particular, gynecomastia and water retention. This drug is frequently used in the treatment of growth disorder affected children to stop or slow the onset of puberty. At the onset of puberty the bone growth plates begin to close. This can occur in children as young as 5 years old so for children severely behind in growth, the opportunity for increased growth is diminished. Arimidex is shown to slow or stop this process.

Carbimazole is used to treat hyperthyroidism by reducing the production of the thyroid hormones T3 and T4 thyroxine). Treatment is usually given for 12–18 months followed by a gradual withdrawal. Letrozole is approved by the United States Food and Drug Administration (FDA) for the treatment of local or metastatic breast cancer that is hormone receptor positive or has an unknown receptor status in postmenopausal women. Side effects include signs and symptoms of hypoestrogenism. Levothyroxine, a thyroid hormone, is used to treat hypothyroidism. When taken correctly, levothyroxine reverses the symptoms experienced with hypothyroidism. It is also used to treat congenital hypothyroidism (cretinism) and goiter (enlarged thyroid gland).

In 2002, studies on the effects of Hormone Replacement Therapy (HRT) for the treatment of menopause in women proclaimed HRT as a danger to women. The U.S. federal government halted the hormone trial of the Women’s Health Initiative (WHI) early, a study Levothyroxine, a thyroid hormone, is used to treat hypothyroidism. When taken correctly, levothyroxine reverses the symptoms experienced with hypothyroidism. It is also used to treat congenital hypothyroidism (cretinism) and goiter (enlarged thyroid gland). But fast-forward to 2008 and the picture of hormone replacement therapy changed yet again. Because the 2002 WHI

### Table 15-2: Agents Used in Treating the Endocrine System

<table>
<thead>
<tr>
<th>Drug Class</th>
<th>Purpose</th>
<th>Generic</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>antihyperglycemic</td>
<td>to lower blood sugar or increase sensitivity to insulin</td>
<td>insulin</td>
<td>Humulin, Novolin Diabeta, Micronase Avandia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>glyburide</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>rosiglitazone</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>pioglitazone</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>chlorpropamide</td>
<td></td>
</tr>
<tr>
<td>antihypoglycemic</td>
<td>to prevent or relieve severe hypoglycemia or insulin reaction</td>
<td>glucagon</td>
<td>Glucagon Diagnostic Kit</td>
</tr>
<tr>
<td>human growth hormone</td>
<td>to increase height in cases of abnormal lack of growth</td>
<td>somatotropin</td>
<td>Humatrope, Nutropin</td>
</tr>
<tr>
<td>steroid</td>
<td>to increase growth; to relieve symptoms of various diseases</td>
<td>methylprednisolone</td>
<td>Medrol, Cortan, Deltasone Decadron, Cortastat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>prednisone</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>desamethasone</td>
<td></td>
</tr>
</tbody>
</table>
study included women from ages 50 to 79, the initial results were a combined tabulation of all age groups together. But when data was re-analyzed to focus on the youngest members alone, an entirely different risk-to-benefit ratio of HRT began to emerge. While the impact of HRT on the heart may seem less ominous today than in 2002, links to breast cancer are less clear—and some say less encouraging. Many experts say that in the years following the WHI announcement, women stopped taking hormones en masse and the incidence of breast cancer subsequently declined. While studies are still ongoing, and reanalysis of the original data continues to shape medical opinions, experts say there are a few lessons learned thus far that are not likely to change. Among them: That hormone replacement therapy is not a panacea for disease prevention, even in situations where it was found to be helpful, such as reduction in hip fractures. Moreover, if hormone replacement therapy must be used to control menopause symptoms, the lowest possible dose for the shortest possible duration is recommended. Today the emphasis rests on the importance of treating every woman individually, with decisions about hormone use made strictly on a case-by-case basis.

**Vocabulary Review**

In the previous section you learned terms related to pharmacology. Before going on to the exercises, review the terms below and refer to the previous section if you have any questions. Pronunciations are provided for certain terms. Sometimes information about where the word came from is included after the term. The etymologies (word histories) are for your information only. You do not need to memorize them.

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>antihyperglycemic</td>
<td>Agent that lowers blood glucose.</td>
</tr>
<tr>
<td>anti-, against + hyperglycem(ia) + -ic, pertaining to</td>
<td></td>
</tr>
<tr>
<td>antihypoglycemic</td>
<td>Agent that raises blood glucose.</td>
</tr>
<tr>
<td>anti- + hypoglycem(ia) + -ic</td>
<td></td>
</tr>
<tr>
<td>hormone replacement therapy (HRT)</td>
<td>Ingestion of hormones to replace missing (or increase low levels of needed) hormones.</td>
</tr>
<tr>
<td>human growth hormone</td>
<td>Naturally occurring substance in the body that promotes growth; synthesized substance that serves the same function.</td>
</tr>
<tr>
<td>hypoglycemic</td>
<td>Agent that lowers blood glucose.</td>
</tr>
<tr>
<td>hypoglycem(ia) + -ic</td>
<td></td>
</tr>
<tr>
<td>radioactive iodine therapy</td>
<td>Use of radioactive iodine to eliminate thyroid tumors.</td>
</tr>
<tr>
<td>steroid</td>
<td>A hormone or chemical substance released by several endocrine glands or manufactured in various medications.</td>
</tr>
<tr>
<td>STER-oyd, STER-oyd</td>
<td></td>
</tr>
</tbody>
</table>
CASE STUDY

Learning the Outcome
At the same time that Gail’s diabetes is diagnosed, she is beginning to feel symptoms of menopause. Women in their late forties and throughout their fifties represent a large concentration of newly diagnosed diabetics. Will has had his thyroid removed. Both Gail and Will probably get hormone replacement therapy.

Critical Thinking

67. What hormones could be prescribed for Gail?
68. What hormones could be prescribed for Will?

PHARMACOLOGICAL TERMS EXERCISES

Build Your Medical Vocabulary

In the space provided, write the name of the gland from which a hormone is needed to relieve symptoms of the disease.

69. Addison’s disease: ________________

70. hyperglycemia: ________________

71. diabetes insipidus: ________________

72. myxedema: ________________

73. panhypopituitarism: ________________

CHALLENGE SECTION

The laboratory report shown here is for a woman on hormone replacement therapy who also takes thyroid medications.

Pathologist’s Laboratory
West Lake Road
West Lake, CT 00008
555-678-8900

<table>
<thead>
<tr>
<th>Patient Name:</th>
<th>Sally Benedict</th>
<th>Age/Sex:</th>
<th>50/F</th>
<th>Patient Number:</th>
<th>41983</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requesting Physician:</td>
<td>Jane Merdin, MD</td>
<td>D.O.B.:</td>
<td>10/28/50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source:</td>
<td>09/30/XXXX</td>
<td>Collected:</td>
<td>03-27-XXXX 0826</td>
<td>Reported:</td>
<td>03-28-XXXX 1649</td>
</tr>
<tr>
<td>Comments:</td>
<td>Fasting 12 hrs.</td>
<td>Thyroid &amp; Hormone Meds.</td>
<td>Operator:</td>
<td>_____________</td>
<td>Reviewed by:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test</th>
<th>Results</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPK</td>
<td>66</td>
<td>24-170 IU/L</td>
</tr>
<tr>
<td>LDH</td>
<td>122</td>
<td>122-220 IU/L</td>
</tr>
<tr>
<td>SGOT (AST)</td>
<td>21</td>
<td>0-31 IU/L</td>
</tr>
<tr>
<td>SGPT (ALT)</td>
<td>28</td>
<td>0-31 IU/L</td>
</tr>
<tr>
<td>ALK PHOSPHATASE</td>
<td>54</td>
<td>39-117 IU/L</td>
</tr>
<tr>
<td>GGTP</td>
<td>21</td>
<td>7-33 IU/L</td>
</tr>
<tr>
<td>TOTAL BILIRUBIN</td>
<td>0.3</td>
<td>0.0-1.0 MG/DL</td>
</tr>
<tr>
<td>URIC ACID</td>
<td>3.5</td>
<td>2.4-5.7 MG/DL</td>
</tr>
<tr>
<td>TRIGLYCERIDE</td>
<td>105</td>
<td>0-200 MG/DL</td>
</tr>
<tr>
<td>CHOLESTEROL</td>
<td>229</td>
<td>0-240 MG/DL</td>
</tr>
</tbody>
</table>
### Critical Thinking

From the results of the lab report, do you think the patient’s thyroid medication is putting her thyroid in the normal range? Explain your answer.

### Terminology in Action

Below is a lab report for a 55-year-old patient.

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Flag</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Complete Blood Count</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WBC</td>
<td>5.2</td>
<td></td>
<td>3.9-11.1</td>
</tr>
<tr>
<td>RBC</td>
<td>4.11</td>
<td></td>
<td>3.80-5.20</td>
</tr>
<tr>
<td>HCT</td>
<td>39.7</td>
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<td>34.0-47.0</td>
</tr>
<tr>
<td>MCV</td>
<td>96.5</td>
<td></td>
<td>80.0-98.0</td>
</tr>
<tr>
<td>MCH</td>
<td>32.9</td>
<td></td>
<td>27.1-34.0</td>
</tr>
<tr>
<td>MCHC</td>
<td>34.0</td>
<td></td>
<td>32.0-36.0</td>
</tr>
<tr>
<td>MPV</td>
<td>8.6</td>
<td></td>
<td>7.5-11.5</td>
</tr>
<tr>
<td>NEUTROPHILS %</td>
<td>45.6</td>
<td></td>
<td>38.0-80.0</td>
</tr>
<tr>
<td>NEUTROPHILS ABS.</td>
<td>3.4</td>
<td></td>
<td>1.70-8.50</td>
</tr>
<tr>
<td>LYMPHOCYTES %</td>
<td>36.1</td>
<td></td>
<td>15.0-49.0</td>
</tr>
<tr>
<td>LYMPHOCYTES ABS.</td>
<td>1.44</td>
<td></td>
<td>1.00-3.50</td>
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<tr>
<td>EOSINOPHILS %</td>
<td>4.5</td>
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<td>0.0-8.0</td>
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<tr>
<td>EOSINOPHILS ABS.</td>
<td>0.18</td>
<td></td>
<td>0.03-0.55</td>
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<tr>
<td>BASOPHILS %</td>
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<td>0.0-2.0</td>
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<tr>
<td>BASOPHILS ABS.</td>
<td>0.03</td>
<td></td>
<td>0.000-0.185</td>
</tr>
<tr>
<td>PLATELET COUNT</td>
<td>325</td>
<td></td>
<td>150-400</td>
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</tbody>
</table>

**Automated Chemistries**

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Flag</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLUCOSE</td>
<td>405</td>
<td>*</td>
<td>65-109</td>
</tr>
</tbody>
</table>

(continued)
Which items indicate abnormalities in the endocrine system?

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Flag</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>UREA NITROGEN/CREATININE</td>
<td>28</td>
<td></td>
<td>10-29</td>
</tr>
<tr>
<td>SODIUM</td>
<td>152</td>
<td>*</td>
<td>135-145</td>
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<tr>
<td>POTASSIUM</td>
<td>4.4</td>
<td></td>
<td>3.5-5.3</td>
</tr>
<tr>
<td>CHLORIDE</td>
<td>106</td>
<td></td>
<td>96-109</td>
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<tr>
<td>CO₂</td>
<td>28</td>
<td></td>
<td>20-31</td>
</tr>
<tr>
<td>ANION GAP</td>
<td>6</td>
<td></td>
<td>3-19</td>
</tr>
<tr>
<td>CALCIUM</td>
<td>9.8</td>
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<td>8.6-10.4</td>
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<td>PHOSPHORUS</td>
<td>3.6</td>
<td></td>
<td>2.2-4.6</td>
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<tr>
<td>AST (SGOT)</td>
<td>28</td>
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<td>0-30</td>
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<tr>
<td>ALT (SGPT)</td>
<td>19</td>
<td></td>
<td>0-34</td>
</tr>
<tr>
<td>BILIRUBIN, TOTAL</td>
<td>0.5</td>
<td></td>
<td>0.2-1.2</td>
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<tr>
<td>PROTEIN, TOTAL</td>
<td>7.8</td>
<td></td>
<td>6.2-8.2</td>
</tr>
<tr>
<td>ALBUMIN</td>
<td>4.3</td>
<td></td>
<td>3.5-5.0</td>
</tr>
<tr>
<td>GLOBULIN</td>
<td>3.5</td>
<td></td>
<td>2.1-3.8</td>
</tr>
<tr>
<td>URIC ACID</td>
<td>2.4</td>
<td></td>
<td>2.0-7.5</td>
</tr>
<tr>
<td>CHOLESTEROL</td>
<td>195</td>
<td></td>
<td>120-199</td>
</tr>
<tr>
<td>TRIGLYCERIDES</td>
<td>68</td>
<td></td>
<td>40-199</td>
</tr>
<tr>
<td>IRON</td>
<td>85</td>
<td></td>
<td>30-150</td>
</tr>
<tr>
<td>HDL CHOLESTEROL</td>
<td>73</td>
<td></td>
<td>35-59</td>
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<tr>
<td>CHOLESTEROL/HDL RATIO</td>
<td>3.2</td>
<td></td>
<td>3.2-5.7</td>
</tr>
<tr>
<td>LDL, CALCULATED</td>
<td>126</td>
<td></td>
<td>70-129</td>
</tr>
<tr>
<td>T3, UPTAKE</td>
<td>42</td>
<td>*</td>
<td>24-37</td>
</tr>
<tr>
<td>T4, TOTAL</td>
<td>13.6</td>
<td>*</td>
<td>4.5-12.8</td>
</tr>
</tbody>
</table>

**Using the Internet**

Go to the site of The Endocrine Society (http://www.endo-society.org), click the news and fact section, then click the fact sheet, and click on an article about an endocrinological disease. Write a brief summary of the information you collect.
CHAPTER REVIEW

The material that follows is to help you review this chapter.

Match the Meaning

Match the following combining forms with the correct meanings. Some answers may be used more than once or not at all.

74. ___ dips(o)  
    75. ___ aden(o)  
    76. ___ thyr(o), thyroid(o)  
    77. ___ glyc(o)  
    78. ___ pancreat(o)  
    79. ___ acr(o)  
    80. ___ kal(i)  
    81. ___ calci(o)  
    82. ___ gluc(o)  
    83. ___ gonad(o)  
    84. ___ vag(o)  
    85. ___ cortic(o)  
    86. ___ endocrin(o)  
    87. ___ parathyroid(o)  
    88. ___ macr(o)  
    89. ___ oophor(o)  
    90. ___ orch(o), orchi(o), orchid(o)  
    91. ___ pachy(o)  
    92. ___ somat(o)  
    93. ___ thym(o)  

    a. large, long  
    b. gonads, sex glands  
    c. ovary  
    d. thymus gland  
    e. calcium  
    f. gland  
    g. extreme, extremity  
    h. thyroid gland  
    i. potassium  
    j. sugar, glyogen  
    k. body  
    l. vagus nerve  
    m. testis, testicle  
    n. uric acid  
    o. pancreas  
    p. glucose  
    q. cortex, outer layer of organs  
    r. endocrine gland  
    s. parathyroid gland  
    t. thirst

Mix and Match

Match the following abbreviations with their correct meaning.

94. ___ ACTH  
    95. ___ HCG  
    96. ___ DM  
    97. ___ GH  
    98. ___ ADH  
    99. ___ GTT  
    100. ___ CRH  
    101. ___ FSH  

    a. somatotrophic hormone  
    b. glucose tolerance test  
    c. potassium  
    d. hormone Replacement Therapy  
    e. human chorionic gonadotropin  
    f. fasting blood sugar  
    g. insulin-dependant diabetes mellitus  
    h. thyroxine
102. ____ T3    i. triiodothyronine
103. ____ IDDM    j. rheumatoid arthritis
104. ____ HRT    k. parathyroid hormone, parathormone
105. ____ AODM    l. melanocyte-stimulating hormone
106. ____ T4    m. radioactive iodine uptake
107. ____ NIDDM    n. growth hormone
108. ____ PTH    o. corticotropin-releasing hormone
109. ____ STH    p. luteinizing hormone
110. ____ DI    q. antidiuretic hormone
111. ____ ERT    r. diabetes insipidus
112. ____ FBS    s. adult-onset diabetes mellitus
113. ____ K    t. adrenocorticotropic hormone
114. ____ RA    u. diabetes mellitus
115. ____ RAIU    v. non–insulin-dependant diabetes mellitus
116. ____ MSH    w. follicle-stimulating hormone
117. ____ LH    x. estrogen replacement therapy

Match the Suffix

Match the following suffixes commonly used with endocrine system terms with their correct meaning.

118. ____-logy     a. study of
119. ____-megaly     b. inflammation
120. ____-emia     c. tumor, mass
121. ____-ism     d. disease
122. ____-oma     e. in the blood
123. ____-ectomy     f. condition
124. ____-itis     g. incision
125. ____-osis     h. enlargement
126. ____-otomy     i. state
127. ____-pathy     j. excision

Match the Prefix

Match the following prefixes commonly used with endocrine system terms with their correct meaning.

128. ____ hypo-     a. excessive
129. ____ para-     b. deficient
130. ____ syn-     c. against, opposing
131. ____ poly-     d. all, entire
132. ____ pan-     e. good, well, normal
133. ____ hyper-     f. together, with, joined
134. ____ eu-       g. alongside of, near
135. ____ anti-  h. many, more than one

Word Building
Using word parts you have learned in this chapter, build the correct medical terms for the following definitions.
136. study of the endocrine system _____________
137. not enough sugar in the blood _____________
138. excessive potassium in the blood _____________
139. disease of the adrenal glands _____________
140. state of inadequate pituitary gland activity throughout _____________
141. inflammation of the adrenal glands _____________
142. excision of the thyroid gland _____________
143. resembling the cortex _____________
144. physician who studies endocrine disease _____________
145. enlargement of the extremities _____________
146. deficient calcium in the blood _____________
147. excessive development of the adrenal cortex _____________
148. in inflammation of a gland _____________
149. disease of the endocrine system _____________

Definitions
Define and pronounce the following terms. The words in the curly blue brackets refer to the Spanish glossary available online at www.mhhe.com/medterm3e.

Word
150. acidosis [ás-Í-DÔ-sis] (acidosis)
151. acromegaly [ák-rô-MÈG-á-le] (acromegalia)
152. Adam’s apple
153. Addison’s [AID-é-sôn] disease
154. aden(o)
155. adenectomy [a-dè-NÈK-tô-mè] (adenectomía)
156. adrenocortical [AID-ê-nô-hô-KÔR-ô] (adrenocortical)
157. adrenal, adrenal(o)
158. adrenal cortex [a-DRÉ-nôl KÔR-têks]
159. adrenalectomy [a-drâ-nêl-ÉK-tô-mê] (adrenalectomía)
160. adrenal [adrenal] gland
161. adrenaline [a-DRÉ-nô-lîn] (adrenalina)
162. adrenal medulla [mê-DÔL-là]
163. adrenocorticotropic [a-DRÉ-nô-KÔR-tô-kô-TRÔ-pîk] hormone (ACTH)
164. aldosterone [a-lô-DÔS-têr-ôn] (aldosterona)
165. alpha [ÁL-fô] cells
166. androgen [ÂN-drô-jên] (andrógeno)
167. antidiuretic [ÂN-tê-di-yû-RE-Tîk] hormone (ADH)
168. antihyperglycemic [ÂN-tê-HÎ-pêr-glî-Sê-mîk]
169. antihypoglycemic [ÂN-tê-HÎ-pô-glî-Sê-mîk]
170. beta [BÊ-tê] cells
171. blood sugar, blood glucose
172. calcitonin [käl-sê-TÔ-nîn] (calcitonia)
173. catecholamines [kât-ê-KÔL-â-mên] (catecolaminas)
174. corticosteroids
[KÖR-tī-kō-STÉR-ōydz]  {corticosteroids}
175. cortisol [KÖR-tī-sōl]  {cortisol}
176. Cushing’s [KUS̩-ings] syndrome
177. diabetes [dī-ā-BĒ-tēz]  {diabetes}
178. diabetes insipidus
[in-SIP-i-dūs]
179. diabetes mellitus
[MÉL-ī-tūs, mé-LĪ-tūs]
180. diabetic nephropathy
[dī-ā-BĒT-īk nē-FROP-ā-thē]
181. diabetic neuropathy
[nū-RŌP-ā-thē]
182. diabetic retinopathy
[rēt-ī-NŌP-ā-thē]
183. ductless gland
184. dwarfism [DWŌRF-īzm]  {enanismo}
185. electrolyte [e-LĒK-trō-līt]  {electrólito}
186. endocrine [ĒN-dō-krr̩n] gland
{glândula endocrina}
187. epinephrine [ĒP-ī-NĒF-īn]  {epinefrina}
188. exocrine [ĒK-sō-krr̩n] gland
{glândula exocrina}
189. exophthalmos [ēk-sōf-THAL-mōs]  {exoftalmia}
190. fasting blood sugar
191. follicle-stimulating hormone (FSH)
192. gigantism [JĪ-gān-rr̩z̩m]  {gigantismo}
193. gland [glândula]
194. gluc(o)
195. glucagon [GLŪ-kā-gōn]  {glucagon}
196. glucocorticoids
[glū-kō-KÖR-tī-kōydz]
197. glucose tolerance test (GTT)
198. glucosuria [glū-kō-SŪ-rē-ā]
199. glyc(o)
200. glycogen [GLĪ-kō-jēn]
{glucógeno} glycated
[GLĪ-kā-tēd] hemoglobin
201. glycosuria [glī-kō-SŪ-rē-ā]
202. goiter [GŌ-Y-tēr]  {bocio}
203. gonad(o)
204. Graves’ [grāvz̩] disease
205. growth hormone (GH)
206. hirsutism [HĒR-sū-tēzm]  {hirsutismo}
207. hormone [HŌR-mōn]  {hormona}
208. hormone replacement therapy (HRT)
209. human growth hormone
210. hyperadrenalism
[HI-pēr-ā-DRĒN-ā-līzm]
211. hyperparathyroidism
[HI-pēr-pā-rr̩-THĒ-rr̩yōd-īzm]
{hiperparatiroidismo}
212. hypersecretion
[HI-pēr-sē-KRĒ-shūn]
213. hyperthyroidism
[HI-pēr-THē-rr̩yōd-īzm]
{hipertiroidismo}
214. hypoadrenalism
[HI-pō-ā-DRĒN-ā-līzm]
{hipoadrenalismo}
215. hypoglycemia [HI-pō-glī-SE-mē-āl]  {hipoglicemia}
216. hypoglycemic
[HI-pō-glī-SE-mīk]
{hipoglúcémico}
217. hypoparathyroidism
[HI-pō-pā-rr̩-THĒ-rr̩yōd-īzm]
{hipoparatiroidismo}
218. hypophysectomy
[HI-pōf-ī-SĒK-tō-mē]
219. hypophysis [HI-PŌF-ī-sīs]  {hipófisis}
220. hyposecretion
[HI-pō-sē-KRĒ-shūn]
221. hypothalamus
[HI-pō-THAL-ā-mūs]
{hipotálamo}
222. hypothyroidism
[HI-pō-THĒ-rr̩yōd-īzm]
{hipotiroidismo}
223. inhibiting factor
224. insulin [IN-sū-līn]  {insulina}
225. insulin-dependent diabetes mellitus (IDDM)
226. islets of Langerhans
[LĀN-gēr-hānz]
227. isthmus [ĪS-mūs]  {istmo}
228. ketoacidosis
[KĒ-tō-ā-sī-DŌ-sīs]
{ceatoacidosis}
229. ketosis [kē-TŌ-sīs]  {cetosis}
230. luteinizing [LŪ-te-īn-Zīng]
{cetoacidosis}
231. melanoctye-stimulating
[mē-LĀN-ō-sīt, MĒL-ā-nō-sīt]
{melanocitosis}
232. melatonin [mēl-ā-TŌN-īn]
233. metabolism [mē-TĀB-ō-līzm]
234. mineralocorticoid
[MĪN-ēr-ā-kō-KÖR-ī-kōyd]
235. myxedema [mīk-sē-DĒ-mā]
{mixedema}
236. neurohypophysis
[NŪR-ō-hī-PŌF-ī-sīs]
237. noninsulin-dependent
diabetes mellitus (NIDDM)
238. norepinephrine
[NŌR-ēp-ī-NĒF-īn]
{norepinefrina}
Chapter 15 The Endocrine System

Abbreviations

Write the full meaning of each abbreviation.

<table>
<thead>
<tr>
<th>ABBREVIATION</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTH</td>
<td>adrenocorticotropic hormone</td>
</tr>
<tr>
<td>ADH</td>
<td>antidiuretic hormone</td>
</tr>
<tr>
<td>CRH</td>
<td>corticotropin releasing hormone</td>
</tr>
<tr>
<td>DM</td>
<td>diabetes mellitus</td>
</tr>
<tr>
<td>FSH</td>
<td>follicle stimulating hormone</td>
</tr>
<tr>
<td>GH</td>
<td>growth hormone</td>
</tr>
<tr>
<td>GTT</td>
<td>glucose tolerance test</td>
</tr>
<tr>
<td>HCG</td>
<td>human chorionic gonadotropin</td>
</tr>
<tr>
<td>IDDM</td>
<td>insulin dependent diabetes mellitus</td>
</tr>
<tr>
<td>LH</td>
<td>luteinizing hormone</td>
</tr>
<tr>
<td>MSH</td>
<td>melanocyte stimulating hormone</td>
</tr>
<tr>
<td>NIDDM</td>
<td>non-insulin dependent diabetes mellitus</td>
</tr>
<tr>
<td>PRL</td>
<td>prolactin</td>
</tr>
<tr>
<td>PTH</td>
<td>parathyroid hormone</td>
</tr>
<tr>
<td>STH</td>
<td>somatotropin</td>
</tr>
<tr>
<td>TSH</td>
<td>thyroid stimulating hormone</td>
</tr>
<tr>
<td>T4</td>
<td>thyroxine (T4)</td>
</tr>
<tr>
<td>T3</td>
<td>triiodothyronine (T3)</td>
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<tr>
<td>SIADH</td>
<td>syndrome of inappropriate antidiuretic hormone</td>
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<tr>
<td>T1</td>
<td>triiodothyronine (T1)</td>
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<tr>
<td>T2</td>
<td>thyroxine (T2)</td>
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<td>T1</td>
<td>tipo de diabetes I</td>
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<tr>
<td>T2</td>
<td>tipo de diabetes II</td>
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<tr>
<td>v-a-s-o-PRÉS-in</td>
<td>vasopressin</td>
</tr>
<tr>
<td>v-I-l-i-m</td>
<td>virilismo</td>
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</table>

Abbreviations

Write the full meaning of each abbreviation.

<table>
<thead>
<tr>
<th>ABREVIATION</th>
<th>Meaning</th>
</tr>
</thead>
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<td>luteinizing hormone</td>
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<tr>
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<td>non-insulin dependent diabetes mellitus</td>
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<td>prolactin</td>
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<td>parathyroid hormone</td>
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<tr>
<td>T3</td>
<td>triiodothyronine (T3)</td>
</tr>
<tr>
<td>SIADH</td>
<td>syndrome of inappropriate antidiuretic hormone</td>
</tr>
<tr>
<td>T1</td>
<td>triiodothyronine (T1)</td>
</tr>
<tr>
<td>T2</td>
<td>thyroxine (T2)</td>
</tr>
<tr>
<td>v-a-s-o-PRÉS-in</td>
<td>vasopressin</td>
</tr>
<tr>
<td>v-I-l-i-m</td>
<td>virilismo</td>
</tr>
</tbody>
</table>
### Answers to Chapter Exercises

1. to eliminate various diseases and to test for others  
2. possibly yes, if her symptoms are serious enough  
3. melatonin  
4. epinephrine  
5. ADH  
6. oxytocin  
7. insulin  
8. prolactin  
9. aldosterone  
10. thyroxine  
11. testosterone  
12. thymosin  
13. C  
14. adrenal  
15. hypophysis  
16. suprarenal  
17. C  
18. pituitary  
19. luteinizing  
20. C  
21. yes, sodium  
22. endocrine  
23. adenitis  
24. pancreatopathy  
25. glycogenesis  
26. thyromegaly  
27. euthyroid  
28. removal of an adrenal gland  
29. removal of part of the pancreas  
30. glandular tumor  
31. aid in sex cell development  
32. abnormally large thyroid  
33. diabetes  
34. postprandial blood sugar  
35. D  
36. T  
37. T  
38. D  
39. D  
40. Type II diabetes  
41. Gail has to pay attention to food quantities, as well as to the kinds of foods she should avoid.  
42. PI  
43. PA  
44. T  
45. PI  
46. T  
47. T  
48. A  
49. T  
50. A  
51. PI  
52. T  
53. cancer  
54. thyroid hormones  
55. adenectomy  
56. hypophysectomy  
57. adrenalectomy  
58. thymectomy  
59. pancreatectomy  
60. thyroidectomy  
61. parathyroidectomy  
62. thyroidectomy  
63. adrenalectomy  
64. adenectomy  
65. parathyroidectomy  
66. hypophysectomy  
67. estrogen, progesterone  
68. thyroxine, triiodothyronine  
69. adrenal  
70. pancreas  
71. pituitary  
72. thyroid  
73. pituitary  
74. t  
75. f  
76. h  
77. j  
78. o  
79. g  
80. i  
81. e  
82. p  
83. b  
84. l  
85. q  
86. r  
87. s  
88. a  
89. c  
90. m  
91. n  
92. k  
93. d  
94. t  
95. e  
96. u  
97. n  
98. q  
99. b  
100. o  
101. w  
102. l  
103. g  
104. d  
105. s  
106. h  
107. v  
108. k  
109. a  
110. r  
111. x  
112. f  
113. c  
114. l  
115. m  
116. l  
117. p  
118. a  
119. h  
120. e  
121. l  
122. c  
123. j  
124. b  
125. f  
126. g  
127. d  
128. b  
129. g  
130. f  
131. h  
132. d  
133. a  
134. e  
135. c  
136. endocrinology  
137. hypoglycemia  
138. hyperkalemia  
139. adrenopathy  
140. panhypopituitarism  
141. adrenalitis  
142. thyroidectomy  
143. corticoid  
144. endocrinologist  
145. acromegaly  
146. hypocalcemia  
147. adrenocorticohyperplasia  
148. adenitis  
149. endocrinopathy  
150–299. Answers are available in the vocabulary reviews in this chapter.