Chapter Contents
Hormones
The Endocrine Glands
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Objectives
After study of this chapter you should be able to:
1. Define hormones.
2. Compare steroid and amino acid hormones.
3. Label a diagram of the endocrine system.
4. Name the hormones produced by the endocrine glands, and briefly describe the function of each.
5. Identify and use roots pertaining to the endocrine system.
6. Describe the main disorders of the endocrine system.
7. Interpret abbreviations used in endocrinology.
8. Analyze several case studies concerning disorders of the endocrine system.
The endocrine system consists of a widely distributed group of glands that secrete regulatory substances called hormones. Because these substances are released directly into the blood, the endocrine glands are known as the ductless glands. Despite the fact that hormones in the blood reach all parts of the body, only certain tissues respond. The tissue that is influenced by a specific hormone is called the target tissue. The cells that make up this tissue have specific receptors on their membranes to which the hormone attaches, enabling it to act on the cells.

**Hormones**

Hormones are produced in extremely small amounts and are highly potent. By means of their actions on various target tissues, they affect growth, metabolism, reproductive activity, and behavior.

Chemically, hormones fall into two categories: steroid hormones, made from lipids, and hormones made of amino acids, which include proteins and proteinlike compounds. Steroids are produced by the sex glands (gonads) and the outer region (cortex) of the adrenal glands. All of the remaining endocrine glands produce amino acid hormones.

The production of hormones is controlled mainly by negative feedback. That is, the hormone itself, or some product of hormone activity, acts as a control over further manufacture of the hormone—a self-regulating system. Hormone production also may be controlled by nervous stimulation or by other hormones.

**The Endocrine Glands**

Refer to Figure 16-1 to locate the endocrine glands described below. Display 16-1 lists the main endocrine glands and summarizes the main hormones secreted by each and their functions.

**Pituitary**

The pituitary gland (hypophysis) is a small gland beneath the brain. It is divided into an anterior lobe (adenohypophysis) and a posterior lobe (neurohypophysis). Both lobes are connected to and controlled by the hypothalamus, a part of the brain. The anterior pituitary releases six hormones. One of these is growth hormone (somatotropin), which stimulates the growth of bones and acts on other tissues as well. The remainder of the pituitary hormones regulate other glands, including the thyroid, adrenals, gonads, and mammary glands (see Display 16-1). These hormones are released in response to substances (releasing hormones) that are sent to the anterior pituitary from the hypothalamus. They can be identified by the ending -tropin, as in gonadotropin. The adjective ending is -tropic.

The posterior pituitary releases two hormones that are actually produced in the hypothalamus. These hormones, antidiuretic hormone and oxytocin, are stored in the posterior pituitary until nervous signals arrive from the hypothalamus to trigger their release. Antidiuretic hormone (ADH) acts on the kidneys to conserve water and also promotes constriction of blood vessels. Both of these actions serve to increase blood pressure. Oxytocin stimulates uterine contractions and promotes milk “letdown” in the breasts during lactation.

**Thyroid and Parathyroids**

The thyroid gland consists of two lobes on either side of the larynx and upper trachea (Fig. 16-2). It secretes a mixture of hormones, mainly thyroxine (T₄) and triiodothyronine (T₃). Because thyroid hormones
contain iodine, their levels can be measured and the activity of the thyroid gland can be studied by following the uptake of iodine. Most thyroid hormone in the blood is bound to protein, mainly thyroid binding globulin (TBG).

On the posterior surface of the thyroid are four to six tiny **parathyroid glands** that affect calcium metabolism (Fig. 16-3). Parathyroid hormone increases the blood level of calcium. It works with the thyroid hormone thyrocalcitonin, which lowers blood calcium, to regulate calcium balance.

**Adrenals**

The **adrenal glands**, located atop each kidney, are divided into two distinct regions: an outer cortex and an inner medulla (Fig. 16-4). The hormones produced by this gland are involved in the body's response to stress. The cortex produces steroid hormones, cortisol, aldosterone, and small amounts of sex hormones. Cortisol (hydrocortisone) mobilizes reserves of fats and carbohydrates to increase the levels of these nutrients in the blood. It also acts to reduce inflammation and is used clinically for this purpose. Aldosterone acts on the kidneys to conserve sodium and water while eliminating potassium. The adrenal cortex also produces small amounts of sex hormones, mainly testosterone, but their importance is not well understood.

The medulla of the adrenal gland produces two similar hormones, epinephrine (adrenaline) and norepinephrine (noradrenaline). These are released in response to stress and work with the nervous system to help the body meet challenges.
## DISPLAY 16-1 The Endocrine Glands and Their Hormones

<table>
<thead>
<tr>
<th>GLAND</th>
<th>HORMONE</th>
<th>PRINCIPAL FUNCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>anterior pituitary</td>
<td>GH (growth hormone), also called somatotropin</td>
<td>promotes growth of all body tissues</td>
</tr>
<tr>
<td></td>
<td>TSH (thyroid-stimulating hormone)</td>
<td>stimulates thyroid gland to produce thyroid hormones</td>
</tr>
<tr>
<td></td>
<td>ACTH (adrenocorticotropic hormone)</td>
<td>stimulates adrenal cortex to produce cortical hormones; aids in protecting body in stress situations (injury, pain)</td>
</tr>
<tr>
<td></td>
<td>FSH (follicle-stimulating hormone)</td>
<td>stimulates growth and hormone activity of ovarian follicles; stimulates growth of testes; promotes development of sperm cells</td>
</tr>
<tr>
<td></td>
<td>LH (luteinizing hormone); ICSH (interstitial cell-stimulating hormone)</td>
<td>causes development of corpus luteum at site of ruptured ovarian follicle in female; stimulates secretion of testosterone in male</td>
</tr>
<tr>
<td></td>
<td>PRL (prolactin)</td>
<td>stimulates secretion of milk by mammary glands</td>
</tr>
<tr>
<td>posterior pituitary</td>
<td>ADH (antidiuretic hormone; vasopressin)</td>
<td>promotes reabsorption of water in kidney tubules; stimulates smooth muscle tissue of blood vessels to constrict</td>
</tr>
<tr>
<td></td>
<td>oxytocin</td>
<td>causes contraction of uterus; causes ejection of milk from mammary glands</td>
</tr>
<tr>
<td>thyroid</td>
<td>thyroid hormone: thyroxine or tetraiodothyronine (T₄) and triiodothyronine (T₃)</td>
<td>increases metabolic rate and production of body heat, influencing both physical and mental activities; required for normal growth</td>
</tr>
<tr>
<td></td>
<td>calcitonin</td>
<td>decreases calcium level in blood</td>
</tr>
<tr>
<td>parathyroids</td>
<td>parathyroid hormone</td>
<td>regulates exchange of calcium between blood and bones; increases calcium level in blood</td>
</tr>
<tr>
<td>adrenal medulla</td>
<td>epinephrine (adrenaline) and norepinephrine (noradrenaline)</td>
<td>active in response to stress; increases respiration, blood pressure, and heart rate</td>
</tr>
<tr>
<td>adrenal cortex</td>
<td>cortisol (hydrocortisone)</td>
<td>aids in metabolism of carbohydrates, proteins, and fats; active during stress</td>
</tr>
<tr>
<td></td>
<td>aldosterone</td>
<td>aids in regulating electrolytes and water balance</td>
</tr>
<tr>
<td>sex hormones</td>
<td></td>
<td>may influence secondary sexual characteristics</td>
</tr>
<tr>
<td>pancreatic islets</td>
<td>insulin</td>
<td>aids transport of glucose into cells; required for cellular metabolism of foods, especially glucose; decreases blood sugar levels</td>
</tr>
<tr>
<td></td>
<td>glucagon</td>
<td>stimulates liver to release glucose, thereby increasing blood sugar levels</td>
</tr>
<tr>
<td>testes</td>
<td>testosterone</td>
<td>stimulates growth and development of sexual organs plus development of secondary sexual characteristics; stimulates maturation of sperm cells</td>
</tr>
<tr>
<td>ovaries</td>
<td>estrogens</td>
<td>stimulate growth of primary sexual organs and development of secondary sexual characteristics</td>
</tr>
<tr>
<td></td>
<td>progesterone</td>
<td>stimulates development of secretory parts of mammary glands; prepares uterine lining for implantation of fertilized ovum; aids in maintaining pregnancy</td>
</tr>
<tr>
<td>thymus</td>
<td>thymosin</td>
<td>important in development of T cells needed for immunity and in early development of lymphoid tissue</td>
</tr>
</tbody>
</table>
In ancient times, people accepted the theory that a person’s state of health depended on the balance of four body fluids. These fluids, called “humors,” were yellow bile, black bile, phlegm, and blood. A predominance of any one of these humors would determine a person’s mood or temperament. Yellow bile caused anger; black bile caused depression; phlegm (mucus) made a person sluggish; blood resulted in cheerfulness and optimism.

Although we no longer believe in humoralism, we still have adjectives in our vocabulary that reflect these early beliefs. Choleric describes a person under the influence of yellow bile; melancholic describes the effects of black bile (melano- means black or dark); a phlegmatic person is slow to respond; a sanguine individual “goes with the flow.”

The humors persist today in the adjective “humoral,” which describes substances carried in the blood or other body fluids. The term is applied to hormones and other circulating materials that influence body responses. Humoral immunity is immunity based on antibodies carried in the bloodstream.

**BOX 16-1 Are You In a Good Humor?**

In ancient times, people accepted the theory that a person’s state of health depended on the balance of four body fluids. These fluids, called “humors,” were yellow bile, black bile, phlegm, and blood. A predominance of any one of these humors would determine a person’s mood or temperament. Yellow bile caused anger; black bile caused depression; phlegm (mucus) made a person sluggish; blood resulted in cheerfulness and optimism.

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The humors persist today in the adjective “humoral,” which describes substances carried in the blood or other body fluids. The term is applied to hormones and other circulating materials that influence body responses. Humoral immunity is immunity based on antibodies carried in the bloodstream.

**FIGURE 16-2.** Thyroid gland (anterior view) in relation to the larynx and trachea. (Reprinted with permission from Cohen BJ, Wood DL. Memmler’s The Human Body in Health and Disease. 9th Ed. Philadelphia: Lippincott Williams & Wilkins, 2000.)

**FIGURE 16-3.** Posterior view of the thyroid gland showing the parathyroid glands embedded in its surface. (Reprinted with permission from Cohen BJ, Wood DL. Memmler’s The Human Body in Health and Disease. 9th Ed. Philadelphia: Lippincott Williams & Wilkins, 2000.)
Pancreas

The endocrine portions of the pancreas are the pancreatic islets, small clusters of cells within the pancreatic tissue. The term islet, meaning “small island,” is used because these cells look like little islands in the midst of the many pancreatic cells that secrete digestive juices (Fig. 16-5). The islet cells produce two hormones, insulin and glucagon, that regulate sugar metabolism. Insulin increases cellular use of glucose, thus decreasing sugar levels in the blood. Glucagon has the opposite effect of increasing blood sugar levels.

Other Endocrine Tissues

The thymus, described in Chapter 9, is considered an endocrine gland because it secretes a hormone, thymosin, which stimulates the T lymphocytes of the immune system. The gonads (Chapters 14 and 15) are also included because, in addition to producing the sex cells, they secrete hormones. Other organs, including the
stomach, kidney, heart, and small intestine, also produce hormones. However, they have other major functions and are discussed with the systems to which they belong.

Finally, prostaglandins are a group of hormones produced by many cells. They have a variety of effects, including stimulation of uterine contractions, promotion of the inflammatory response, and vasomotor activities. They are called prostaglandins because they were first discovered in the prostate gland.

**FIGURE 16-5.** Microscopic view of pancreatic cells. Light staining islet cells are seen among the cell clusters that produce digestive juices. (Reprinted with permission from Cohen BJ, Wood DL. Memmler’s The Human Body in Health and Disease. 9th Ed. Philadelphia: Lippincott Williams & Wilkins, 2000.)

**Key Terms**

**NORMAL STRUCTURE AND FUNCTION**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>adrenal gland</td>
<td>A gland on the upper surface of the kidney. The outer region (cortex) secretes steroid hormones; the inner region (medulla) secretes epinephrine (adrenaline) and norepinephrine (noradrenaline) (root adren/o)</td>
</tr>
<tr>
<td>endocrine</td>
<td>Pertaining to a ductless gland that secretes directly into the blood</td>
</tr>
<tr>
<td>hormone</td>
<td>A secretion of an endocrine gland. A substance that travels in the blood and has a regulatory effect on tissues, organs, or glands.</td>
</tr>
<tr>
<td>hypophysis</td>
<td>The pituitary gland (root hypophys); named from hypo meaning “below” and physis meaning “growing” because the gland grows below the hypothalamus</td>
</tr>
<tr>
<td>hypothalamus</td>
<td>A portion of the brain that controls the pituitary gland and is active in maintaining homeostasis</td>
</tr>
<tr>
<td>pancreatic islets</td>
<td>Clusters of endocrine cells in the pancreas that secrete hormones that regulate sugar metabolism; also called islets of Langerhans or islet cells (root insul/o, meaning “island”)</td>
</tr>
<tr>
<td>parathyroid glands</td>
<td>Small glands on the back of the thyroid that act to increase blood calcium levels; there are usually four to six parathyroid glands (root parathy/o, parathyroid/o); the name literally means “near the thyroid”</td>
</tr>
</tbody>
</table>
Normal Structure and Function, continued

**pituitary gland**
pi-TU-i-tar-ē

A small endocrine gland at the base of the brain. The anterior lobe secretes growth hormone and hormones that stimulate other glands; the posterior lobe releases ADH and oxytocin manufactured in the hypothalamus.

**prostaglandins**
pros-ta-GLAN-dinz

A group of hormones produced throughout the body that have a variety of effects, including stimulation of uterine contractions and regulation of blood pressure, blood clotting, and inflammation.

**receptor**

A site on the cell membrane to which a substance, such as a hormone, attaches.

**steroid hormone**
STER-oyd

A hormone made from lipids and including the sex hormones and the hormones of the adrenal cortex.

**target tissue**

The specific tissue on which a hormone acts; may also be referred to as the target organ.

**thyroid gland**
THĪ-royd

An endocrine gland on either side of the larynx and upper trachea. It secretes hormones that affect metabolism and growth and a hormone that regulates calcium balance (root thyr/o, thyroid/o).

### Roots Pertaining to the Endocrine System

<table>
<thead>
<tr>
<th>ROOT</th>
<th>MEANING</th>
<th>EXAMPLE</th>
<th>DEFINITION OF EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>endocrin/o</td>
<td>endocrine glands or system</td>
<td>endocrinopathy</td>
<td>any disease of the endocrine glands</td>
</tr>
<tr>
<td>pituitar</td>
<td>pituitary gland, hypophysis</td>
<td>pituitarism</td>
<td>condition caused by any disorder of pituitary function</td>
</tr>
<tr>
<td>hypophys</td>
<td>pituitary gland, hypophysis</td>
<td>hypophyseal*</td>
<td>pertaining to the pituitary gland</td>
</tr>
<tr>
<td>thyro, thyroid/o</td>
<td>thyroid gland</td>
<td>thyrotropic</td>
<td>acting on the thyroid gland</td>
</tr>
<tr>
<td>parathyro, parathyroid/o</td>
<td>parathyroid gland</td>
<td>parathyroidectomy</td>
<td>excision of a parathyroid gland</td>
</tr>
<tr>
<td>adren/o, adrenal/o</td>
<td>adrenal gland, epinephrine</td>
<td>adrenergic</td>
<td>activated (erg-) by or related to epinephrine (adrenaline)</td>
</tr>
<tr>
<td>adrenocortic/o</td>
<td>adrenal cortex</td>
<td>adrenocortical</td>
<td>pertaining to the adrenal cortex</td>
</tr>
<tr>
<td>insul/o</td>
<td>pancreatic islets</td>
<td>insuloma</td>
<td>tumor of islet cells</td>
</tr>
</tbody>
</table>

*Note spelling.*
Define each of the following words:

1. endocrinology (en-dō-krin-OL-ō-jē) ________________________
2. hypophysectomy (hi-pof-i-SEK-tō-mē) ________________________
3. thyrolytic (thi-ro-LIT-ik) ________________________
4. hyperadrenalism (hi-per-a-drē-nal-izm) ________________________
5. insulitis (in-sū-LĪ-tis) ________________________

Words for conditions resulting from endocrine dysfunctions are formed by adding the suffix -ism to the name of the gland or its root and adding the prefix hyper- or hypo- for overactivity or underactivity of the gland. Use the full name of the gland to form words with each of the following definitions:

6. condition of overactivity of the thyroid gland ________________________
7. condition of underactivity of the parathyroid gland ________________________
8. condition of underactivity of the adrenal gland ________________________

Use the word root for the gland to form a word for each of the following definitions:

9. condition of underactivity of the adrenal cortex ________________________
10. condition of overactivity of the pituitary gland (use pituitar) ________________________

Word building. Write a word for each of the following definitions:

11. physician who specializes in study of the endocrine system ________________________
12. incision into the thyroid gland ________________________
13. any disease of the adrenal gland ________________________
14. inflammation of the adrenal gland ________________________
15. pertaining to (-ar) the pancreatic islets ________________________

Clinical Aspects of the Endocrine System

Endocrine diseases usually result from the overproduction (hypersecretion) or underproduction (hypo-secretion) of hormones. They also may result from secretion at the wrong time or from failure of the target tissue to respond. The causes of abnormal secretion may originate in the gland itself or may result from failure of the hypothalamus or the pituitary to release the proper amount of hormone stimulators. Some of the common endocrine disorders are described below. Conditions resulting from hypersecretion or hyposecretion of hormones are summarized in Display 16-2.

Pituitary

A pituitary adenoma (tumor) usually increases secretion of growth hormone or ACTH. Less commonly, a tumor affects the secretion of prolactin. An excess of growth hormone in children causes gigantism.
adults it causes **acromegaly**, characterized by enlargement of the hands, feet, jaw, and facial features. Treatment is by surgery to remove the tumor (adenomectomy) or by drugs to reduce the level of growth hormone in the blood. Excess ACTH overstimulates the adrenal cortex, resulting in **Cushing disease**.

Increased prolactin causes milk secretion, or galactorrhea, in both males and females. Radiographic studies in cases of pituitary adenoma usually show enlargement of the bony structure in the skull (sella turcica) that contains the pituitary.

Hypofunction of the pituitary, such as is caused by tumor or interruption of blood supply to the gland, may involve a single hormone but usually affects all functions and is referred to as **panhypopituitarism**. The widespread effects of this condition include dwarfism (from lack of growth hormone), lack of sexual development and sexual function, fatigue, and weakness.

A specific lack of ADH from the posterior pituitary results in **diabetes insipidus**, in which the kidneys have a decreased ability to conserve water. Symptoms are polyuria (elimination of large amounts of urine) and polydipsia (excessive thirst). Diabetes insipidus should not be confused with diabetes mellitus, a disorder of glucose metabolism described below. The two diseases share the symptoms of polyuria and polydipsia but have entirely different causes. Diabetes mellitus is the more common disorder, and when the term diabetes is used alone, it generally refers to diabetes mellitus. The word diabetes is from the Greek meaning “siphon,” referring to the large urinary output in both forms of diabetes.

**Thyroid**

Because thyroid hormone affects the growth and function of many tissues, a deficiency of this hormone in infancy causes physical and mental retardation as well as other symptoms that together constitute **congenital hypothyroidism**, formerly called cretinism. In the adult, thyroid deficiency causes **myxedema**, in which there is weight gain, lethargy, rough, dry skin, and facial swelling. Both of these conditions are easily treated with thyroid hormone. Most U.S. states now require testing of newborns for hypothyroidism. If not diagnosed at birth, hypothyroidism will lead to mental retardation within 6 months.

The most common form of hyperthyroidism is **Graves disease**, also called diffuse toxic goiter. This is an autoimmune disorder in which antibodies stimulate an increased production of thyroid hormone. There is weight loss, irritability, hand tremor, and rapid heart rate (tachycardia). A most distinctive sign is a bulging of the eyeballs, termed **exophthalmos**, caused by swelling of the tissues behind the eyes (Fig. 16-6). Treatment for Graves disease may include antithyroid drugs, surgical removal of all or part of the thyroid, or radiation delivered in the form of radioactive iodine.

A common sign in thyroid disease is an enlarged thyroid, or **goiter**. However, a goiter is not necessarily accompanied by malfunction of the thyroid. A simple or nontoxic goiter is caused by a deficiency of iodine...
in the diet. With the addition of iodine to salt and other commercial foods, this form of goiter has become a thing of the past.

Thyroid function is commonly tested by measuring radioactive iodine uptake (RAIU) by the gland. Blood levels of total and free thyroxine (T₄) and triiodothyronine (T₃) are also measured, as are the levels of thyroxine-binding globulin (TBG) and thyroid-stimulating hormone (TSH) from the pituitary. Thyroid scans after the administration of radioactive iodine are also used to study the activity of this gland.

**Parathyroids**

Overactivity of the parathyroid glands, usually from a tumor, causes a high level of calcium in the blood. Because this calcium is obtained from the bones, there is also degeneration of the skeleton and bone pain. A common side effect is the development of kidney stones from the high levels of circulating calcium.

Damage to the parathyroids or their surgical removal, as during thyroid surgery, results in a decrease in blood calcium levels. This causes numbness and tingling in the arms and legs and around the mouth (perioral), as well as **tetany** (muscle spasms). Treatment consists of supplying calcium.

**Adrenals**

Hypofunction of the adrenal cortex, or **Addison disease**, is usually caused by autoimmune destruction of the gland. It may also result from a deficiency of ACTH from the pituitary. The lack of aldosterone results in water loss, low blood pressure, and electrolyte imbalance. There is also weakness, nausea, and increase of brown pigmentation. This last symptom is caused by release of a hormone from the pituitary that stimulates the pigment cells (melanocytes) in the skin. Once diagnosed, Addison disease is treated with replacement cortical hormones.

An excess of adrenal cortical hormones results in **Cushing syndrome**. Patients have a moon-shaped face, obesity localized in the torso, weakness, excess hair growth (hirsutism), and fluid retention (Fig. 16-7). The
most common cause of Cushing syndrome is the therapeutic administration of steroid hormones. It also may be caused by a tumor. If the disorder is caused by a pituitary tumor that increases production of ACTH, it is referred to as Cushing disease.

The Pancreas and Diabetes

The most common endocrine disorder, and a serious public health problem, is diabetes mellitus, a failure of the body cells to use glucose effectively. The excess glucose accumulates in the blood, causing hyperglycemia. Increased urination (polyuria) marks the effort to eliminate the excess glucose in the urine, a condition termed glycosuria. The result is dehydration and excessive thirst (polydipsia). There is also weakness, weight loss, and extreme hunger (polyphagia). Unable to use carbohydrates, the body burns more fat. This leads to accumulation of ketone bodies in the blood and a shift toward acidosis, a condition termed ketoacidosis. If untreated, diabetes will lead to starvation of the central nervous system and coma. Diabetic patients are prone to cardiovascular, neurologic, and vision problems, infections, and, sometimes, renal failure.

There are two types of diabetes mellitus. Heredity seems to be a factor in the appearance of both. Type 1, also called juvenile-onset or insulin-dependent diabetes mellitus (IDDM), usually appears in children and teenagers. It is caused by a failure of the pancreatic islets to produce insulin, resulting, perhaps, from autoimmune destruction of the cells. Because insulin levels are very low or absent, patients need careful monitoring and administration of this hormone. Blood sugar level may be tested multiple times during the day, and insulin may be given in divided doses by injection or by means of an insulin pump that delivers the hormone around the clock (continuous subcutaneous insulin infusion; CSII). Diet must be carefully regulated to keep glucose levels steady. Insulin is obtained from animals and is now also made by genetic engineering.

Type 2 diabetes mellitus, also called adult-onset or non–insulin-dependent diabetes mellitus (NIDDM), accounts for about 90% of diabetes cases. Type 2 diabetes is initiated by cellular resistance to insulin. Feedback stimulation of the pancreatic islets leads to overproduction of insulin and then to reduced insulin production by the overworked cells. Metabolic syndrome (also called syndrome X or insulin resistance syndrome) is the term now used to describe a state of hyperglycemia caused by insulin resistance in association with some metabolic disorders, including high levels of plasma triglycerides (fats), low levels of high-density lipoproteins (HDLs), hypertension, and coronary heart disease.
Most cases of type 2 diabetes are linked to obesity, especially upper body obesity. Although seen mostly in older people (hence the name adult-onset diabetes), the incidence of type 2 diabetes is increasing among younger generations, presumably because of increased obesity, poor diet, and sedentary habits. Exercise and weight loss for the overweight are the first approaches to treating type 2 diabetes, and these measures often lead to management of the disorder. Drugs for increasing insulin production or improving cellular responses to insulin may also be prescribed, with insulin treatment given if necessary.

Gestational diabetes mellitus (GDM) refers to glucose intolerance during pregnancy. This imbalance usually appears in women with a family history of diabetes. Women must be monitored during pregnancy for signs of diabetes mellitus, especially those with predisposing factors, because this condition can cause complications for both the mother and the fetus. Again, ensuring a proper diet is a first step to management, with insulin treatment recommended if needed.

Diabetes is diagnosed by measuring levels of glucose in blood plasma with or without fasting and by monitoring glucose levels in the blood after oral administration of glucose (oral glucose tolerance test; OGTT). Categories of impaired fasting blood glucose (IFG) and impaired glucose tolerance (IGT) are stages between a normal response to glucose and diabetes.

Excess insulin may result from a pancreatic tumor, but more often it occurs after administration of too much hormone to a diabetic patient. The resultant hypoglycemia leads to insulin shock, which is treated by administration of glucose.

### Key Clinical Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>acromegaly</td>
<td>Overgrowth of bone and soft tissue, especially in the hands, feet, and face, caused by an excess of growth hormone in an adult. The name comes from <em>acro</em> meaning “extremity” and <em>megal/o</em> meaning “enlargement.”</td>
</tr>
<tr>
<td>Addison disease</td>
<td>A disease resulting from deficiency of adrenocortical hormones. It is marked by darkening of the skin, weakness, and alterations in salt and water balance.</td>
</tr>
<tr>
<td>adenoma</td>
<td>A neoplasm of a gland</td>
</tr>
<tr>
<td>congenital hypothyroidism</td>
<td>A condition caused by congenital lack of thyroid secretion and marked by arrested physical and mental development; formerly called cretinism (<em>KRÊ-tin-izm</em>)</td>
</tr>
<tr>
<td>Cushing disease</td>
<td>Overactivity of the adrenal cortex resulting from excess production of ACTH by the pituitary</td>
</tr>
<tr>
<td>Cushing syndrome</td>
<td>A condition resulting from an excess of hormones from the adrenal cortex. It is associated with obesity, weakness, hyperglycemia, hypertension, and hirsutism (excess hair growth).</td>
</tr>
<tr>
<td>diabetes insipidus</td>
<td>A disorder caused by insufficient release of ADH from the posterior pituitary. It results in excessive thirst and production of large amounts of very dilute urine. The word <em>insipidus</em> means “tasteless,” referring to the dilution of the urine.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>diabetes mellitus</td>
<td>A disorder of glucose metabolism caused by deficiency of insulin production or failure of the tissues to respond to insulin. Type 1 is juvenile-onset or insulin-dependent diabetes mellitus (IDDM); type 2 is adult-onset or non–insulin-dependent diabetes mellitus (NIDDM). The word mellitus comes from the Latin root for honey, referring to the sugar content of the urine.</td>
</tr>
<tr>
<td>exophthalmos</td>
<td>Protrusion of the eyeballs as seen in Graves disease</td>
</tr>
<tr>
<td>gigantism</td>
<td>Overgrowth caused by an excess of growth hormone from the pituitary during childhood; also called giantism</td>
</tr>
<tr>
<td>glycosuria</td>
<td>Excess sugar in the urine</td>
</tr>
<tr>
<td>goiter</td>
<td>Enlargement of the thyroid gland. May be toxic or nontoxic. Simple (nontoxic) goiter is caused by iodine deficiency.</td>
</tr>
<tr>
<td>Graves disease</td>
<td>An autoimmune disease resulting in hyperthyroidism. A prominent symptom is exophthalmos (protrusion of the eyeballs). Also called exophthalmic goiter.</td>
</tr>
<tr>
<td>hyperglycemia</td>
<td>Excess glucose in the blood</td>
</tr>
<tr>
<td>hypoglycemia</td>
<td>Abnormally low level of glucose in the blood</td>
</tr>
<tr>
<td>insulin shock</td>
<td>A condition resulting from an overdose of insulin, causing hypoglycemia</td>
</tr>
<tr>
<td>ketoacidosis</td>
<td>Acidosis (increased acidity of body fluids) caused by an excess of ketone bodies, as in diabetes mellitus; diabetic acidosis</td>
</tr>
<tr>
<td>metabolic syndrome</td>
<td>A state of hyperglycemia caused by cellular resistance to insulin, as seen in type 2 diabetes, in association with other metabolic disorders; syndrome X or insulin resistance syndrome</td>
</tr>
<tr>
<td>myxedema</td>
<td>A condition caused by hypothyroidism in an adult. There is dry, waxy swelling most notable in the face.</td>
</tr>
<tr>
<td>panhypopituitarism</td>
<td>Underactivity of the entire pituitary gland</td>
</tr>
<tr>
<td>tetany</td>
<td>Irritability and spasms of muscles; may be caused by low blood calcium and other factors</td>
</tr>
</tbody>
</table>
### Supplementary Terms

#### NORMAL STRUCTURE AND FUNCTION

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pineal gland</td>
<td>A small gland in the brain (see Fig. 16-1). Its function in humans is not clear, but it seems to regulate behavior and sexual development in response to environmental light.</td>
</tr>
<tr>
<td>sella turcica</td>
<td>A saddle-shaped depression in the sphenoid bone that contains the pituitary gland (literally means “Turkish saddle”)</td>
</tr>
<tr>
<td>sphenoid bone</td>
<td>A bone at the base of the skull that houses the pituitary gland</td>
</tr>
</tbody>
</table>

#### SYMPTOMS AND CONDITIONS

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>adrenogenital syndrome</td>
<td>Condition caused by overproduction of androgens from the adrenal cortex resulting in masculinization; may be congenital or acquired, usually as a result of an adrenal tumor</td>
</tr>
<tr>
<td>Conn syndrome</td>
<td>Hyperaldosteronism caused by an adrenal tumor</td>
</tr>
<tr>
<td>craniopharyngioma</td>
<td>A tumor of the pituitary gland</td>
</tr>
<tr>
<td>Hashimoto disease</td>
<td>A chronic thyroiditis of autoimmune origin</td>
</tr>
<tr>
<td>ketosis</td>
<td>Accumulation of ketone bodies, such as acetone, in the body. Usually results from deficiency or faulty metabolism of carbohydrates, as in cases of diabetes mellitus and starvation.</td>
</tr>
<tr>
<td>multiple endocrine neoplasia (MEN)</td>
<td>A hereditary disorder that causes tumors in several endocrine glands; classified according to the combination of glands involved</td>
</tr>
<tr>
<td>pheochromocytoma</td>
<td>A usually benign tumor of the adrenal medulla or other structures containing chromaffin cells (cells that stain with chromium salts). The tumor causes increased production of epinephrine and norepinephrine.</td>
</tr>
<tr>
<td>pituitary apoplexy</td>
<td>Sudden massive hemorrhage and degeneration of the pituitary gland associated with a pituitary tumor. Common symptoms include severe headache, visual problems, and loss of consciousness.</td>
</tr>
<tr>
<td>Simmonds disease</td>
<td>Hypofunction of the anterior pituitary (panhypopituitarism), usually because of an infarction; pituitary cachexia</td>
</tr>
<tr>
<td>thyroid storm</td>
<td>A sudden onset of the symptoms of thyrotoxicosis occurring in patients with hyperthyroidism who are untreated or poorly treated. May be brought on by illness or trauma. Also called thyroid crisis.</td>
</tr>
<tr>
<td>thyrotoxicosis</td>
<td>Condition resulting from overactivity of the thyroid gland. Symptoms include anxiety, irritability, weight loss, and sweating. The main example of thyrotoxicosis is Graves disease.</td>
</tr>
<tr>
<td>von Recklinghausen disease</td>
<td>Degeneration of bone caused by excess production of hormone from the parathyroid glands. Also called Recklinghausen disease of bone.</td>
</tr>
</tbody>
</table>
## DIAGNOSIS AND TREATMENT

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>fasting plasma glucose (FPG)</strong></td>
<td>Measurement of glucose in the blood after a fast of at least 8 hours. A reading equal to or greater than 126 mg/dL indicates diabetes. Also called fasting blood glucose (FBG) or fasting blood sugar (FBS).</td>
</tr>
<tr>
<td><strong>free thyroxine index (FTI, T₇)</strong></td>
<td>Calculation based on the amount of T₄ present and T₃ uptake that is used to diagnose thyroid dysfunction.</td>
</tr>
<tr>
<td><strong>glycosylated hemoglobin (HbA₁c) test</strong></td>
<td>A test that measures the binding of glucose to hemoglobin during the lifespan of a red blood cell. It reflects the average blood glucose level over 2 to 3 months and is useful in evaluating long-term therapy for diabetes mellitus. Also called glycohemoglobin test.</td>
</tr>
<tr>
<td><strong>oral glucose tolerance test (OGTT)</strong></td>
<td>Measurement of glucose levels in blood plasma after administration of a challenge dose of glucose to a fasting patient. Used to measure patient’s ability to metabolize glucose. A value equal to or greater than 200 mg/dL in the 2-hour sample indicates diabetes.</td>
</tr>
<tr>
<td><strong>radioactive iodine uptake test (RAIU)</strong></td>
<td>A test that measures thyroid uptake of radioactive iodine as an evaluation of thyroid function.</td>
</tr>
<tr>
<td><strong>radioimmunoassay (RIA)</strong></td>
<td>A method of measuring very small amounts of a substance, especially hormones, in blood plasma using radioactively labeled hormones and specific antibodies.</td>
</tr>
<tr>
<td><strong>thyroid scan</strong></td>
<td>Visualization of the thyroid gland after administration of radioactive iodine.</td>
</tr>
<tr>
<td><strong>thyroxine-binding globulin (TBG) test</strong></td>
<td>Test that measures the main protein that binds T₄ in the blood.</td>
</tr>
<tr>
<td><strong>transsphenoidal adenomectomy</strong></td>
<td>Removal of a pituitary tumor through the sphenoid sinus (space in the sphenoid bone).</td>
</tr>
</tbody>
</table>

Also used to diagnose endocrine disorders are imaging techniques, other measurements of hormones or their metabolites in plasma and urine, and studies involving hormone stimulation or suppression.
# ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTH</td>
<td>Adrenocorticotropic hormone</td>
</tr>
<tr>
<td>ADH</td>
<td>Antidiuretic hormone</td>
</tr>
<tr>
<td>BS</td>
<td>Blood sugar</td>
</tr>
<tr>
<td>CSII</td>
<td>Continuous subcutaneous insulin infusion</td>
</tr>
<tr>
<td>DM</td>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td>FBG</td>
<td>Fasting blood glucose</td>
</tr>
<tr>
<td>FBS</td>
<td>Fasting blood sugar</td>
</tr>
<tr>
<td>FPG</td>
<td>Fasting plasma glucose</td>
</tr>
<tr>
<td>FTI</td>
<td>Free thyroxine index</td>
</tr>
<tr>
<td>GDM</td>
<td>Gestational diabetes mellitus</td>
</tr>
<tr>
<td>GH</td>
<td>Growth hormone</td>
</tr>
<tr>
<td>HbA_{1c}</td>
<td>Hemoglobin A_{1c}; glycohemoglobin; glycosylated hemoglobin</td>
</tr>
<tr>
<td>131I</td>
<td>Iodine 131 (radioactive iodine)</td>
</tr>
<tr>
<td>IDDM</td>
<td>Insulin-dependent diabetes mellitus</td>
</tr>
<tr>
<td>IFG</td>
<td>Impaired fasting blood glucose</td>
</tr>
<tr>
<td>IGT</td>
<td>Impaired glucose tolerance</td>
</tr>
<tr>
<td>MEN</td>
<td>Multiple endocrine neoplasia</td>
</tr>
<tr>
<td>NIDDM</td>
<td>Non–insulin-dependent diabetes mellitus</td>
</tr>
<tr>
<td>NPH</td>
<td>Neutral protamine Hagedorn (insulin)</td>
</tr>
<tr>
<td>OGTT</td>
<td>Oral glucose tolerance test</td>
</tr>
<tr>
<td>RAIU</td>
<td>Radioactive iodine uptake</td>
</tr>
<tr>
<td>RIA</td>
<td>Radioimmunoassay</td>
</tr>
<tr>
<td>SIADH</td>
<td>Syndrome of inappropriate antidiuretic hormone (secretion)</td>
</tr>
<tr>
<td>T3</td>
<td>Triiodothyronine</td>
</tr>
<tr>
<td>T4</td>
<td>Thyroxine; tetraiodothyronine</td>
</tr>
<tr>
<td>T7</td>
<td>Free thyroxine index</td>
</tr>
<tr>
<td>TBG</td>
<td>Thyroxine-binding globulin</td>
</tr>
<tr>
<td>TSH</td>
<td>Thyroid-stimulating hormone</td>
</tr>
</tbody>
</table>
Glands of the Endocrine System
Write the name of each numbered part on the corresponding line of the answer sheet.

Adrenals
Ovaries
Pancreatic islets
Parathyroids
Pineal
Pituitary (hypophysis)
Testes
Thymus
Thyroid

1. ____________________________ 6. ____________________________
2. ____________________________ 7. ____________________________
3. ____________________________ 8. ____________________________
4. ____________________________ 9. ____________________________
5. ____________________________
Chapter Review 16-1

Match the following terms and write the appropriate letter to the left of each number:

<table>
<thead>
<tr>
<th>Number</th>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>hypothalamus</td>
<td>a. outer region of an organ</td>
</tr>
<tr>
<td>2</td>
<td>cortex</td>
<td>b. substance regulated by the parathyroids</td>
</tr>
<tr>
<td>3</td>
<td>islets</td>
<td>c. part of the brain that controls the pituitary</td>
</tr>
<tr>
<td>4</td>
<td>hypophysis</td>
<td>d. pancreatic endocrine cells</td>
</tr>
<tr>
<td>5</td>
<td>calcium</td>
<td>e. pituitary</td>
</tr>
<tr>
<td>6</td>
<td>iodine</td>
<td>a. pancreatic hormone that regulates sugar metabolism</td>
</tr>
<tr>
<td>7</td>
<td>oxytocin</td>
<td>b. hormone produced by the adrenal medulla</td>
</tr>
<tr>
<td>8</td>
<td>hydrocortisone</td>
<td>c. hormone that produces uterine contractions</td>
</tr>
<tr>
<td>9</td>
<td>glucagon</td>
<td>d. ingredient in thyroid hormone</td>
</tr>
<tr>
<td>10</td>
<td>epinephrine</td>
<td>e. hormone produced by the adrenal cortex</td>
</tr>
<tr>
<td>11</td>
<td>OGTT</td>
<td>a. form of diabetes mellitus</td>
</tr>
<tr>
<td>12</td>
<td>NPH</td>
<td>b. test of sugar metabolism</td>
</tr>
<tr>
<td>13</td>
<td>ACTH</td>
<td>c. hormone that increases water reabsorption in the kidneys</td>
</tr>
<tr>
<td>14</td>
<td>ADH</td>
<td>d. a form of insulin</td>
</tr>
<tr>
<td>15</td>
<td>NIDDM</td>
<td>e. hormone that stimulates the adrenal cortex</td>
</tr>
<tr>
<td>16</td>
<td>Graves disease</td>
<td>a. enlargement of the thyroid</td>
</tr>
<tr>
<td>17</td>
<td>myxedema</td>
<td>b. disorder caused by underactivity of the adrenal cortex</td>
</tr>
<tr>
<td>18</td>
<td>Cushing syndrome</td>
<td>c. condition caused by hyperthyroidism</td>
</tr>
<tr>
<td>19</td>
<td>goiter</td>
<td>d. disorder caused by overactivity of the adrenal cortex</td>
</tr>
<tr>
<td>20</td>
<td>Addison disease</td>
<td>e. disorder caused by lack of thyroid hormone in adults</td>
</tr>
</tbody>
</table>

**SUPPLEMENTARY TERMS**

<table>
<thead>
<tr>
<th>Number</th>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>glycosylated hemoglobin</td>
<td>a. tumor of the pituitary gland</td>
</tr>
<tr>
<td>22</td>
<td>Hashimoto disease</td>
<td>b. small gland in the brain that is regulated by light</td>
</tr>
<tr>
<td>23</td>
<td>pheochromocytoma</td>
<td>c. chronic thyroiditis</td>
</tr>
<tr>
<td>24</td>
<td>pineal</td>
<td>d. substance used in testing for diabetes</td>
</tr>
<tr>
<td>25</td>
<td>craniopharyngioma</td>
<td>e. tumor of the adrenal medulla</td>
</tr>
</tbody>
</table>
Fill in the blanks:
26. The gland under the brain that controls other glands is the _______________________________.
27. The gland in the neck that affects metabolic rate is the _______________________________.
28. The endocrine glands located above the kidneys are the _______________________________.
29. The hormone insulin is so named because it is produced by the _______________________________.
30. The most common endocrine disorder is _______________________________.
31. Excess sugar in the blood is called _______________________________.

Define each of the following words:
32. hypophysitis (hi-po-fi Sī-tis) _______________________________.
33. hypopituitarism (hi-po-pī-Tū-i-ta-rizm) _______________________________.
34. adrenalectomy (ad-rē-nal-EK-tō-mē) _______________________________.
35. hyperthyroidism (hi-per-THō-royd-ism) _______________________________.
36. endocrinologist (en-dō-kri-NOL-ō-jist) _______________________________.
37. adrenocortical (ad-rē-nō-KOR-ti-kal) _______________________________.

Word building. Write a word for each of the following definitions:
38. pertaining to the hypophysis _______________________________.
39. inflammation of the pancreatic islets _______________________________.
40. enlargement of the adrenal gland _______________________________.

Use the full name of the gland as the root to write a word for each of the following definitions:
41. removal of one half (hemi-) of the thyroid gland _______________________________.
42. inflammation of the thyroid gland _______________________________.
43. surgical removal of parathyroid gland _______________________________.
44. condition caused by underactivity of the adrenal gland _______________________________.

Use the root thyr/o to write a word for each of the following definitions:
45. acting on the thyroid gland _______________________________.
46. destructive of (-lytic) thyroid tissue _______________________________.
47. any disease of the thyroid gland _______________________________.

Word analysis. Define each of the following words, and give the meaning of the word parts in each. Use a dictionary if necessary.
48. euthyroidism _______________________________.
   a. eu- __________________
   b. thyroid __________________
   c. -ism __________________
49. adrenocorticotropic _________________________________
   a. adren/o __________________
   b. cortic/o __________________
   c. -tropic _________________

50. panhypopituitarism _________________________________
   a. pan- _________________
   b. hypo- _________________
   c. pituitar _______________
   d. -ism _________________

51. thyrotoxicosis _________________________________
   a. thyr/o _________________
   b. toxic/o _________________
   c. -sis _________________

**Case Studies**

**Case Study 16-1: Acute Pancreatitis**

Two weeks after his emergency cardiac bypass surgery, R.B. was admitted to the hospital with acute pancreatitis, probably triggered by the trauma of the heart surgery. As a nurse, R.B. knew that the mild form of the disease was self-limiting, whereas severe pancreatitis has a mortality rate near 50%. He was terrified, having survived heart surgery, to now have to worry about multisystem organ failure. He had once cared for a patient who died of necrotizing hemorrhagic pancreatitis.

On admission, R.B. had severe stabbing midepigastric pain that radiated to his back, nausea, vomiting, abdominal distention and rigidity, and jaundice. He also manifested a low-grade fever, hypotension, tachycardia, and decreased breath sounds over all lung fields. His cardiac enzymes were normal, but he showed an increase in serum leukocytes, amylase, and lipase. CT scan of the abdomen showed pancreatic inflammation with edema. His chest radiograph showed bilateral pleural effusion and atelectasis.

R.B.’s treatments included NPO, an NG tube, medications to decrease his pain and gastric secretions, and supplemental oxygen. He was monitored for all physiologic parameters, with close attention paid to his fluid and electrolyte balance and intravascular volume, and recovered and was discharged after 6 days.

**Case Study 16-2: Hyperparathyroidism**

B. E., a 58-year-old woman with a history of hypertension, had a partial nephrectomy 4 years ago for renal calculi. During a routine physical examination, her total serum calcium level was 10.8 mg/dL. Her parathyroid hormone level was WNL; she was in no apparent distress, and the remainder of her physical examination and laboratory data were noncontributory.

B.E. underwent exploratory surgery for an enlarged right superior parathyroid gland. The remaining three glands appeared normal. The enlarged gland was excised, and a biopsy was performed on the remaining glands. The pathology report showed an adenoma of the abnormal gland. On her first postoperative day, she complained of perioral numbness and tingling. She had no other symptoms, but her serum calcium was subnormal. She was given one ampule of calcium gluconate. Within 2 days, her calcium level had improved and she was discharged.
Case Study 16-3: Diabetes Treatment With an Insulin Pump

M.G., a 32-year-old marketing executive, was diagnosed with juvenile-onset (type 1) diabetes at the age of 3 years. She vividly remembers her mother taking her to the doctor because she had an illness that caused her to feel extremely tired and very thirsty and hungry. She also had a cut on her knee that would not heal and had begun to wet her bed. Her mother had had gestational diabetes during her pregnancy with M.G.; M.G. was described as a “macrosomia” because she weighed 10 lb at birth.

M.G. has managed her disease with meticulous attention to her diet, exercise, preventative health care, regular blood glucose monitoring, and twice-daily injections of regular and NPH insulin, which she rotates among her upper arms, thighs, and abdomen. She continues in a smoking cessation program supported by weekly acupuncture treatments. She maintains good control of her disease in spite of the inconvenience and time it consumes each day. She will be married next summer and would like to start a family. M.G.’s doctor suggested she try an insulin pump to give her more freedom and enhance her quality of life. After intensive training, she has received her pump. It is about the size of a beeper with a thin catheter that she introduces through a needle into her abdominal subcutaneous tissue. She can administer her insulin in a continuous subcutaneous insulin infusion (CSII) and in calculated meal bolus doses. She still has to test her blood for hyperglycemia and hypoglycemia and her urine for ketones when her blood sugar is too high. She hopes one day to have an islet transplantation.

CASE STUDY QUESTIONS

Multiple choice: Select the best answer and write the letter of your choice to the left of each number.

_____ 1. Necrotizing hemorrhagic pancreatitis can be described as:
   a. enlargement of the pancreas with anemia
   b. inflammation of the pancreas with tissue death and bleeding
   c. inflammation of the pancreas with overgrowth of tissue
   d. marsupialization of a pancreatic pseudocyst
   e. none of the above

_____ 2. R.B.’s midepigastric pain was located:
   a. inferior to the sternum
   b. periumbilical
   c. cephalad to the clavicle
   d. lateral to the anterior costal margins
   e. anterolateral

_____ 3. Intravascular volume and hemodynamic stability refer to:
   a. measured amount of urine in the drainage bag
   b. speed with which pancreatic fluid moves
   c. movement of cells through a flow cytometer
   d. body fluids and blood pressure
   e. blood count and clotting factors
4. Renal calculi are:
   a. kidney stones
   b. gallstones
   c. stomach ulcers
   d. bile obstructions
   e. muscle spasms

5. B.E.’s serum calcium was 10.8 mg/dL, which is:
   a. 5.4 micrograms of calcium in her serous fluid
   b. 10.8 grams of electrolytes in parathyroid hormone
   c. 10.8 milligrams calcium in 100 cc of blood
   d. 21.6 liters of calcium in 100 grams of serum
   e. 10.8 micrograms of calcium in 100 cc of serous parathyroid fluid

6. B.E. had perioral numbness and tingling. Perioral is:
   a. peripheral to any orifice
   b. lateral to the eye
   c. within the buccal mucosa
   d. around the mouth
   e. circumferential to the perineum

7. M.G.’s diabetes is also described as:
   a. adult-onset diabetes
   b. type 2 diabetes mellitus
   c. diabetes insipidus
   d. insulin-dependent diabetes mellitus
   e. NIDDM

8. Gestational diabetes occurs:
   a. in a woman during pregnancy
   b. to any large fetus
   c. during menopause
   d. at the time of puberty
   e. at the time of delivery of a large baby with high blood sugar

9. The term macrosomia describes:
   a. excessive weight gain during pregnancy
   b. a large body
   c. an excessive amount of sleep
   d. inability to sleep during pregnancy
   e. too much sugar in the amniotic fluid

10. M.G. injected the insulin into the subcutaneous tissue, which is:
    a. only present in the abdomen, thighs, and upper arms
    b. a topical application
    c. below the skin
    d. in a large artery
    e. above the pubic bone
11. An islet transplantation refers to:
   a. transfer of parathyroid cells to the liver
   b. excision of bovine pancreatic cells
   c. surgical insertion of an insulin pump into the abdomen
   d. a total pancreas and kidney transplantation
   e. transfer of insulin-secreting cells into a pancreas

Write a term from the case studies with each of the following meanings:

12. yellowish color of the skin _________________________________
13. enzyme that digests fats _________________________________
14. surgical excision of a kidney _________________________________
15. tumor of a gland _________________________________
16. single-use glass injectable medication container _________________________________
17. high serum glucose _________________________________

Abbreviations. Define each of the following abbreviations:

18. NPO _________________________________
19. NG _________________________________
20. BUN _________________________________
21. WNL _________________________________
22. NPH _________________________________
23. CSII _________________________________
Chapter 16 Crossword
Endocrine System

ACROSS
2. An islet is a small _______.
5. Measurement used to diagnose diabetes: abbreviation
7. Temperature: root
8. Sudden degeneration of the pituitary is pituitary __________.
10. Diabetes affects the metabolism of __________.
11. A form of hyperthyroidism is named for him.
13. Pituitary hormone that acts on the thyroid: abbreviation
15. Test for measuring hormones in the blood: abbreviation
16. Alternate name for the pituitary
17. Any disease of the adrenal gland

DOWN
1. Pituitary hormone that controls water loss: abbreviation
3. Alternate name for growth hormone
4. Disorder caused by excess growth hormone in adults
5. A form of thyroid hormones in the blood
6. Excess sugar in the urine
7. The cells or tissues a hormone acts on
9. True, normal: prefix
12. Against: prefix
14. Over, abnormally high: prefix
Answers to Chapter Exercises

EXERCISE 16-1

1. study of the endocrine glands or system
2. surgical removal of the pituitary gland (hypophysis)
3. destructive to the thyroid gland
4. condition of overactivity of the adrenal gland
5. inflammation of the pancreatic islets
6. hyperthyroidism (hī̂-pē̂r-THÎ-royd-izm)
7. hypoparathyroidism (hī̂-pō-par-a-THÎ-royd-izm)
8. hypoadrenalism (hī̂-pō-ad-RE-nal-izm)
9. hypoadrenocorticism (hī̂-pō-ad-rē̂-nō-KOR-ti-sizm)
10. hyperpituitarism (hī̂-per-pi-TÛ-i-ta-rizm)
11. endocrinologist (en-dō̂-kri-NOL-ō̂-jist)
12. thyrotomy (thî-ROT-ō̂-mē); also thyroidotomy (thī̂-royd-OT-ō̂-mē)
13. adrenopathy (ad-rē̂-nal-OP-a-the); also adrenopathy (ad-ren-OP-a-thē)
14. adrenalitis (ad-rē̂-nal-I-tis); also adrenitis (ad-re-NI-tis)
15. insular (IN-sū-lar)

LABELING EXERCISE 16-1 GLANDS OF THE ENDOCRINE SYSTEM

1. pineal
2. pituitary (hypophysis)
3. thyroid
4. parathyroids
5. thymus
6. adrenals
7. pancreatic islets
8. ovaries
9. testes

Answers to Chapter Review 16-1

1. c
2. a
3. d
4. e
5. b
6. d
7. c
8. e
9. a
10. b
11. b
12. d
13. e
14. c
15. a
16. c
17. e
18. d
19. a
20. b
21. d
22. d
23. e
24. b
25. a
26. pituitary (hypophysis)
27. thyroid
28. adrenals
29. pancreatic islets
30. diabetes mellitus
31. hyperglycemia
32. inflammation of the pituitary gland (hypophysis)
33. condition caused by underactivity of the pituitary gland
34. surgical removal of the adrenal gland
35. condition caused by overactivity of the thyroid gland
36. physician who specializes in study and treatment of endocrine disorders
37. pertaining to the adrenal cortex
38. hypophyseal
39. insulitis
40. adrenomegaly
41. hemithyroidectomy
42. thyroiditis
43. parathyroidectomy
44. hypoadrenalism
45. thyrotropic
46. thyrolytic
47. thyopathy
48. normal function of the thyroid gland
   a. true, good, normal
   b. thyroid gland
   c. condition of
49. acting on the adrenal cortex
   a. adrenal gland
   b. cortex
   c. acting on
50. condition of complete underactivity of the pituitary gland
   a. all
   b. under, abnormally low
   c. pituitary gland
   d. condition of
51. a toxic condition caused by hyperactivity of the thyroid gland
   a. thyroid
   b. poisonous
   c. condition of

Answers to Case Study Questions
1. b
2. a
3. d
4. a
5. c
6. d
7. d
8. a
9. b
10. c
11. e
12. jaundice
13. lipase
14. nephrectomy
15. adenoma
16. ampule
17. hyperglycemia
18. nothing by mouth/non per os
19. nasogastric
20. blood urea nitrogen
21. within normal limits
22. neutral protamine Hagedorn
23. continuous subcutaneous insulin infusion

ANSWERS TO CROSSWORD PUZZLE

Endocrine System