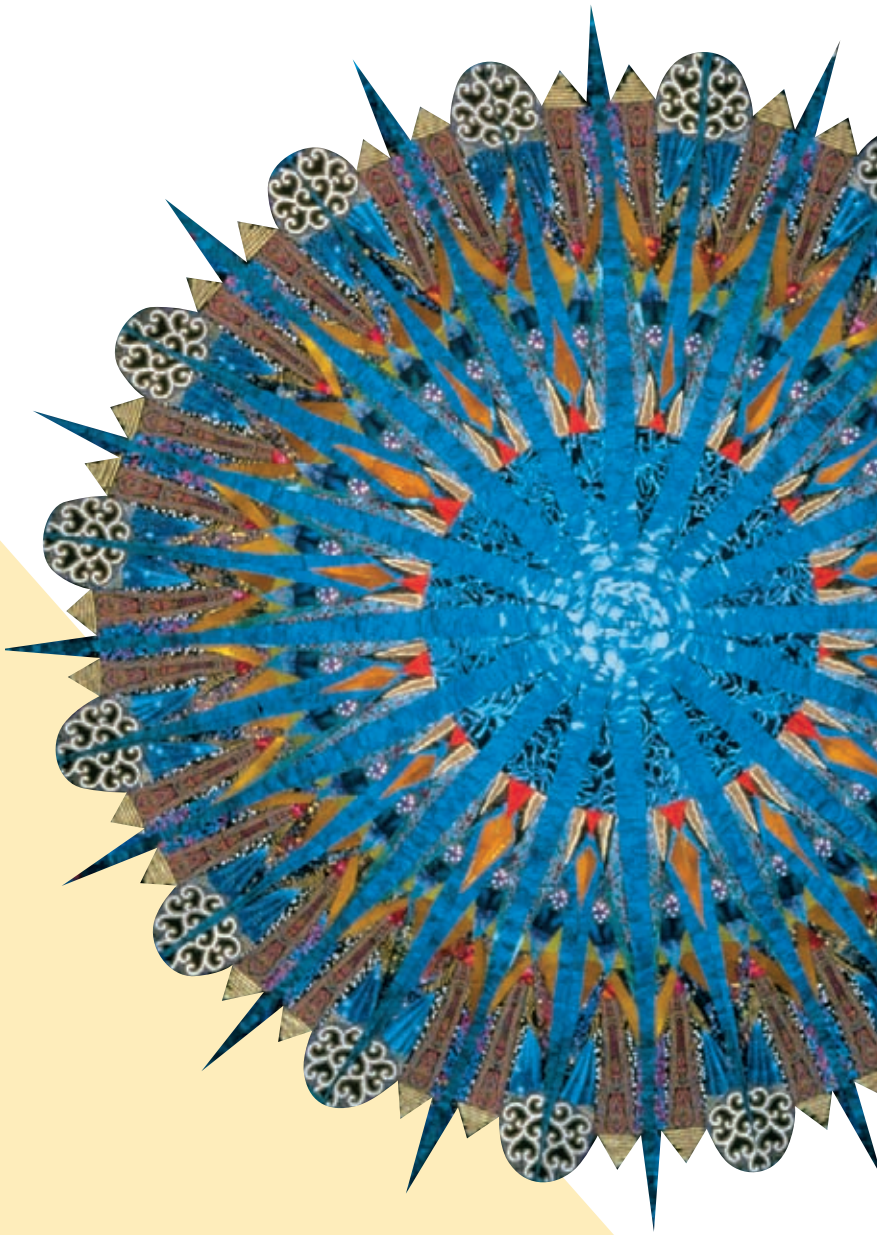
UNIT 5 Responses to Altered Endocrine Function



CHAPTER 18 Assessing Clients with Endocrine Disorders

LEARNING OUTCOMES

- Describe the anatomy and physiology of the endocrine glands.
- Explain the functions of the hormones secreted by the endocrine glands.
- Identify specific topics to consider during a health history interview of the client with health problems involving endocrine function.
- Describe techniques for assessing the thyroid gland and the effects of altered endocrine function.
- Describe normal variations in assessment findings for the older adult.
- Identify abnormal findings that may indicate malfunction of the glands of the endocrine system.

CLINICAL COMPETENCIES

- Conduct and document a health history for clients who have or are at risk for alterations in the structure or function of the endocrine glands.
- Monitor the results of diagnostic tests and report abnormal findings.
- Conduct and document a physical assessment of the structure of the thyroid gland and the effects of altered endocrine function on other body structures and functions.

EQUIPMENT NEEDED

- Reflex hammer
- Safety pin, cotton ball, containers with hot and cold water, tuning fork
- Blood pressure cuff
- Stethoscope

MEDIALINK

Resources for this chapter can be found on the Prentice Hall Nursing MediaLink DVD-ROM accompanying this textbook, and on the Companion Website at http://www.prenhall.com/lemone

KEY TERMS

acromegaly, *529*
carpal spasm, *531*
Chvostek's sign, *531*
dwarfism, *531*
exophthalmos, *529*
goiter, *530*
tetany, *531*
Trousseau's sign, *531*

The endocrine system is essential to regulate the body's internal environment. Through hormones secreted by its glands, the endocrine system regulates such varied functions as growth, reproduction, metabolism, fluid and electrolyte balance, and gender differentiation. It also helps the body adapt to constant alterations in the internal and external environment.

ANATOMY, PHYSIOLOGY, AND FUNCTIONS OF THE ENDOCRINE SYSTEM

The major endocrine organs are the pituitary gland, thyroid gland, parathyroid glands, adrenal glands, pancreas, and gonads (reproductive glands). The locations of these glands are illustrated in Figure 18–1 ■. Table 18–1 summarizes the functions of the endocrine organs and their hormones. Specific information about the ovaries and testes is found in Chapters 49 ∞ through 51 ∞.

Pituitary Gland

The pituitary gland (hypophysis) is located in the skull beneath the hypothalamus of the brain (Figure 18–2 ■). It often is called the "master gland" because its hormones regulate many body functions. The pituitary gland has two parts: the anterior pituitary (or adenohypophysis) and the posterior pituitary (or neurohypophysis). The anterior pituitary is glandular tissue, whereas the posterior pituitary is actually an extension of the hypothalamus.

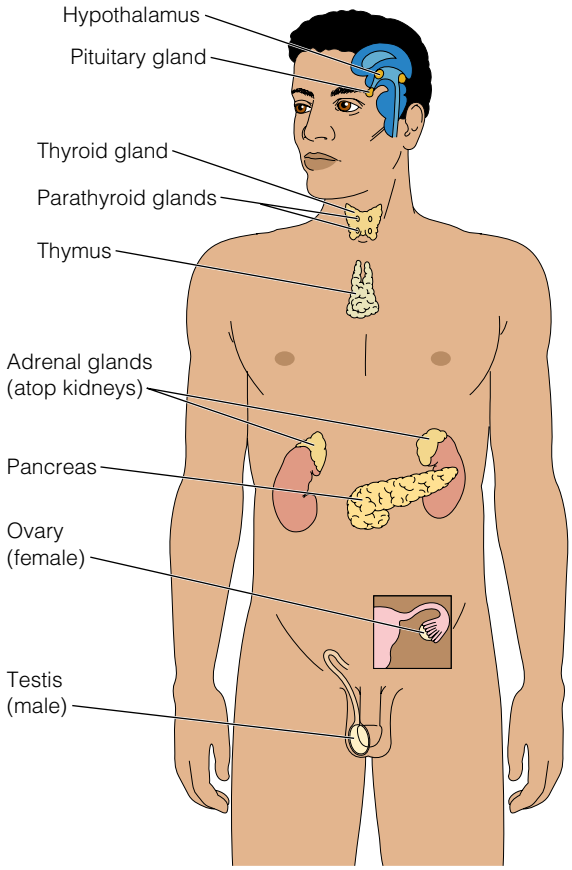


Figure 18–1 ■ Location of the major endocrine glands.

Figure 18–2 ■ Location of the pituitary gland.
Source: ISM/Phototake NYC.

Anterior Pituitary

The anterior pituitary has several types of endocrine cells and secretes at least six major hormones (Figure 18–3 ■).

- Somatotropic cells secrete growth hormone (GH) (also called somatotropin). GH stimulates growth of the body by signaling cells to increase protein production and by stimulating the epiphyseal plates of the long bones.
- Lactotropic cells secrete prolactin (PRL). Prolactin stimulates the production of breast milk.
- Thyrotropic cells secrete thyroid-stimulating hormone (TSH). TSH stimulates the synthesis and release of thyroid hormones from the thyroid gland.
- Corticotropic cells secrete adrenocorticotropic hormone (ACTH). ACTH stimulates release of hormones, especially glucocorticoids, from the adrenal cortex.
- Gonadotropic cells secrete the gonadotropin hormones, follicle-stimulating hormone (FSH), and luteinizing hormone (LH).

TABLE 18–1 Organs, Hormones, Functions, and Feedback Mechanisms of the Endocrine System

ENDOCRINE ORGAN	HORMONE SECRETED	TARGET ORGAN AND FEEDBACK MECHANISM
Thyroid gland	Thyroid hormone (TH): thyroxine (T_4) is the major hormone secreted by the thyroid gland. It is converted to triiodothyronine (T_3) at the target tissues.	Maintains metabolic rate and growth and development of all tissues. T_3 and T_4 are secreted in response to thyroid-stimulating hormone (TSH).
	Calcitonin	Maintains serum calcium levels by decreasing bone resorption and decreasing resorption of calcium in the kidneys whenever levels of plasma calcium are elevated.
Parathyroid gland	Parathyroid hormone (PTH)	Maintains serum calcium levels by stimulating bone resorption and formation and by stimulating kidney resorption of calcium in response to falling levels of plasma calcium.
Adrenal cortex	Mineralocorticoids (e.g., aldosterone)	Promote kidney tubule reabsorption of sodium and water and excretion of potassium in response to elevated levels of potassium and low levels of sodium, thereby increasing blood pressure and blood volume.
	Glucocorticoids (e.g., cortisol)	Help regulate metabolism of carbohydrates, fats, and proteins. Activate anti-inflammatory responses to stressors. Low cortisol levels stimulate hypothalamic secretion of corticotropin-releasing hormone (CRH), which stimulates the anterior pituitary gland to release ACTH, which in turn stimulates the adrenal cortex to secrete cortisol.
	Gonadocorticoids (androgens and small amounts of estrogen and progesterone)	The quantity of sex hormones produced here is small, and the mechanism is not well understood.
Adrenal medulla	Catecholamines (epinephrine and norepinephrine)	Stimulate the heart, constrict blood vessels, inhibit visceral muscles, dilate bronchioles, increase respiration and metabolism, promote hyperglycemia. Secreted in response to physical or psychologic stress.
Anterior pituitary (adenohypophysis)	Growth hormone (GH)	Promotes growth of body tissues by enhancing protein synthesis and promoting use of fat for energy and thus conserving glucose. Release is stimulated by growth hormone releasing hormone (GHRH) in response to low GH levels, hypoglycemia, increased amino acids, low fatty acids, and stress.

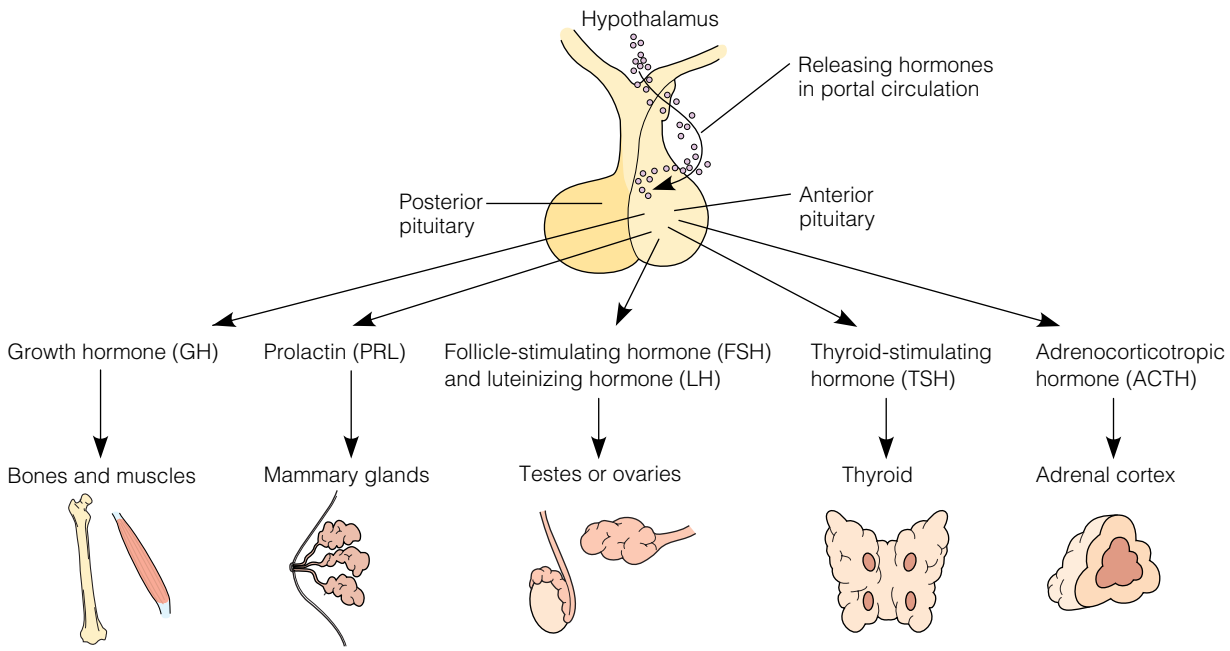


Figure 18–3 ■ Actions of the major hormones of the anterior pituitary.

These hormones stimulate the ovaries and testes (the gonads). In women, FSH stimulates the development of ovarian follicles and induces the secretion of estrogenic female sex hormones. Increasing levels of LH work together with FSH to lead to ovulation and the formation of the corpus luteum from an ovarian follicle. In men, FSH is involved in the development and maturation of sperm. LH in men is called the interstitial cell–stimulating hormone (ICSH), which stimulates the interstitial cells of the testes to produce male sex hormones.

Posterior Pituitary

The posterior pituitary is made of nervous tissue. Its primary function is to store and release antidiuretic hormone (ADH) and oxytocin, produced in the hypothalamus:

- ADH, also called vasopressin, decreases urine production by causing the renal tubules to reabsorb water from the urine and return it to the circulating blood.
- Oxytocin induces contraction of the smooth muscles in the reproductive organs. In women, oxytocin stimulates the myometrium of the uterus to contract during labor. It also induces milk ejection from the breasts.

Thyroid Gland

The thyroid gland (Figure 18–4 ■) is anterior to the upper part of the trachea and just inferior to the larynx. This butterfly-shaped gland has two lobes connected by a structure called the isthmus.

The glandular tissue consists of follicles filled with a jelly-like colloid substance called thyroglobin, a glycoprotein-iodine complex. Cells within the follicles secrete thyroid hormone (TH), a general name for two similar hormones: thyroxine (T_4) and triiodothyronine (T_3). The primary role of thyroid hormones in adults is to increase metabolism. TH secretion is initiated by the release of TSH by the pituitary gland and is dependent on an adequate supply of iodine.

The thyroid gland also secretes calcitonin, a hormone that decreases excessive levels of calcium in the blood by slowing the calcium-releasing activity of bone cells, serves as a marker for sepsis, and is believed to be a mediator of inflammatory responses. The functions of this hormone are not fully understood. When the thyroid gland is totally removed and thyroid hormone replaced, calcium homeostasis and bone density remain relatively unchanged without replacing calcitonin.

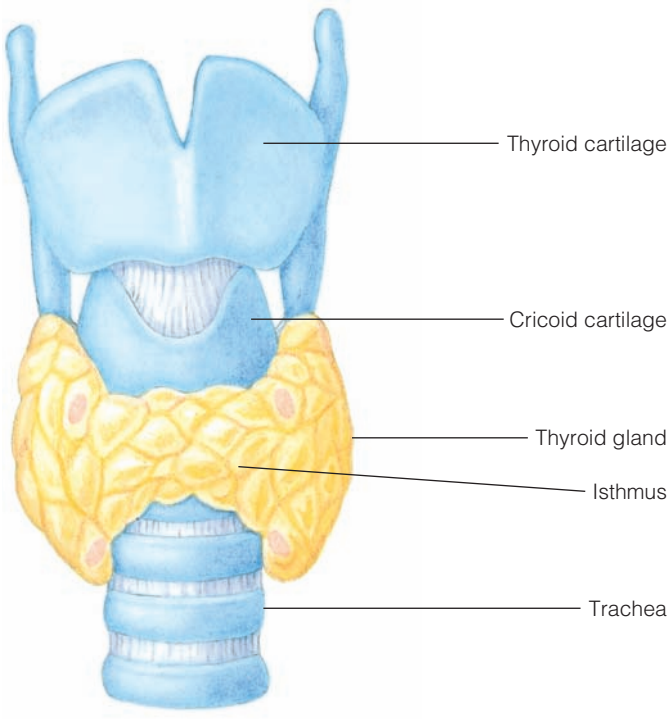


Figure 18–4 ■ The thyroid gland.
Source: Dorling Kindersley Media Library.

Parathyroid Glands

The parathyroid glands (usually four to six in number) are embedded on the posterior surface of the lobes of the thyroid gland. They secrete parathyroid hormone (PTH), or parathormone. When calcium levels in the plasma fall, PTH secretion increases. PTH also controls phosphate metabolism. It acts primarily by increasing renal excretion of phosphate in the urine, by decreasing the excretion of calcium, and by increasing bone reabsorption to cause the release of calcium from bones. Normal levels of vitamin D are necessary for PTH to exert these effects on bone and kidneys.

Adrenal Glands

The two adrenal glands are pyramid-shaped organs that sit on top of the kidneys (Figure 18–5 ■). Each gland consists of two parts, which are distinct organs: an inner medulla and an outer cortex.

The adrenal medulla produces two hormones (also called catecholamines): epinephrine (adrenaline) and norepinephrine (noradrenaline). These hormones are similar to substances released by the sympathetic nervous system and thus are not essential to life. Epinephrine increases blood glucose levels and stimulates the release of ACTH from the pituitary; ACTH in turn stimulates the adrenal cortex to release glucocorticoids. Epinephrine also increases the rate and force of cardiac contractions; constricts blood vessels in the skin, mucous membranes, and kidneys; and dilates blood vessels in the skeletal muscles, coronary arteries, and pulmonary arteries. Norepinephrine increases both heart rate and the force of cardiac contractions. It also vasoconstricts blood vessels throughout the body.

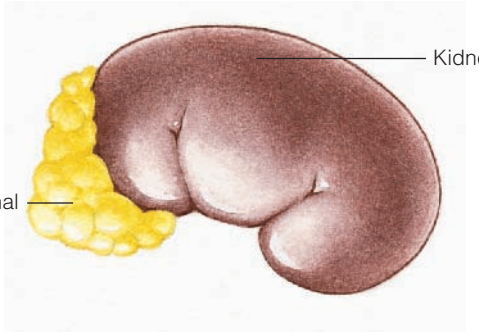


Figure 18–5 ■ Location of the adrenal glands.
Source: Dorling Kindersley Media Library.

The adrenal cortex secretes several hormones, all corticosteroids. They are classified into two groups: mineralocorticoids and glucocorticoids. These hormones are essential to life.

The release of the mineralocorticoids is controlled primarily by an enzyme called renin. When a decrease in blood pressure or sodium is detected, specialized kidney cells release renin to act on a substance called angiotensinogen, manufactured by the liver. Angiotensinogen is modified by renin and other enzymes to become angiotensin, which stimulates the release of aldosterone from the adrenal cortex. Aldosterone prompts the distal tubules of the kidneys to release increased amounts of water and sodium back into the circulating blood to increase circulating blood volume and pressure. This system (the rennin–angiotensin–aldosterone system) is illustrated in Chapter 10 ∞ with the discussion of body fluid regulation.

The glucocorticoids include cortisol and cortisone. These hormones affect carbohydrate metabolism by regulating glucose use in body tissues, mobilizing fatty acids from fatty tissue, and shifting the source of energy for muscle cells from glucose to fatty acids. Glucocorticoids are released in times of stress. An excess of glucocorticoids in the body depresses the inflammatory response and inhibits the effectiveness of the immune system.

Pancreas

The pancreas, located behind the stomach between the spleen and the duodenum, is both an endocrine gland (producing hormones) and an exocrine gland (producing digestive enzymes). The digestive enzymes produced by the pancreas are discussed in Chapter 21 ∞. The content in this chapter focuses on pancreatic hormones.

The endocrine cells of the pancreas produce hormones that regulate carbohydrate metabolism. They are clustered in bodies called pancreatic islets (or islets of Langerhans) scattered throughout the gland. Pancreatic islets have at least four different cell types:

- Alpha cells produce glucagon, which decreases glucose oxidation and promotes an increase in the blood glucose level by signaling the liver to release glucose from glycogen stores.
- Beta cells produce insulin, which facilitates the uptake and use of glucose by cells and prevents an excessive breakdown of glycogen in the liver and muscle. In this way, insulin decreases blood glucose levels. Insulin also facilitates lipid formation, inhibits the breakdown and mobilization of stored fat, and helps amino acids move into cells to promote protein synthesis. In general, the actions of glucagon and insulin oppose one another, helping to maintain a stable blood glucose level.
- Delta cells secrete somatostatin, which inhibits the secretion of glucagon and insulin by the alpha and beta cells.
- F cells secrete pancreatic polypeptide, which is believed to inhibit the exocrine activity of the pancreas.

Gonads

The gonads are the testes in men and the ovaries in women. These organs are the primary source of steroid sex hormones in the body. The hormones of the gonads are important in regulating body growth and promoting the onset of puberty.

In men, androgens (primarily testosterone) produced by the testes maintain reproductive functioning and secondary sex characteristics. Androgens also promote the production of sperm. In women, the ovaries secrete estrogens and progesterone to maintain reproductive functioning and secondary sex characteristics. Progesterone also promotes the growth of the lining of the uterus to prepare for implantation of a fertilized ovum. (The structure and functions of the gonads are discussed in Chapter 49 ∞.)

AN OVERVIEW OF HORMONES

Hormones are chemical messengers secreted by the endocrine organs and transported throughout the body, where they exert their action on specific cells called target cells. Hormones do not cause reactions directly but rather regulate tissue responses. They may produce either generalized effects or local effects.

Hormones are transported from endocrine gland cells to target cells in the body in one of four ways:

- Endocrine glands release most hormones, including TH and insulin, into the bloodstream. Some hormones require a protein carrier.
- Neurons release some hormones, such as epinephrine, into the bloodstream. This is called the neuroendocrine route.
- The hypothalamus releases its hormones directly to target cells in the posterior pituitary by nerve cell extension.
- With the paracrine method, released messengers diffuse through the interstitial fluid. This method of transport involves a number of hormonal peptides that are released throughout various organs and cells and act locally. An example is endorphins, which act to relieve pain.

Hormones that are released into the bloodstream circulate as either free, unbound molecules or as hormones attached to transport carriers. Peptide and protein hormones (such as insulin) circulate unbound, while steroid and thyroid hormones are carried by specific transport carriers synthesized by the liver. Hormone receptors are complex molecular structures, located on or inside target cells. They act by binding to specific receptor sites located on the surfaces of the target cells. These receptors recognize a specific hormone and translate the message into a cellular response. The receptor sites are structured so that they respond only to a specific hormone; for example, receptors in the thyroid gland are responsive to TSH but not to LH. Drugs that compete with a hormone for binding with transport carrier molecules increase hormone action by increasing the availability of the free, unbound hormone. Hormone levels are controlled by the pituitary gland and by feedback mechanisms. Although most feedback mechanisms are negative, a few are positive. Negative feedback is controlled much as the thermostat in a house regulates temperature. Sensors in the endocrine system detect changes in hormone levels and adjust hormone secretion to maintain normal body levels. When the sensors detect a decrease in hormone levels, they begin actions to cause an increase in hormone levels; when hormone levels rise above normal, the sensors cause a decrease in hormone production and release. For example, when the hypothalamus or anterior pituitary gland senses increased blood levels of TH,

it releases hormones, causing a reduction in the secretion of TSH, which in turn prompts a decrease in the output of TH by the thyroid gland. See Figure 18–6 ■.

In positive feedback mechanisms, increasing levels of one hormone cause another gland to release a hormone. For example, the increased production of estradiol (a female ovarian hormone) during the follicular stage of the menstrual cycle in turn stimulates increased FSH production by the anterior pituitary gland. Estradiol levels continue to increase until the ovarian follicle disappears, eliminating the source of the stimulation for FSH, which then decreases.

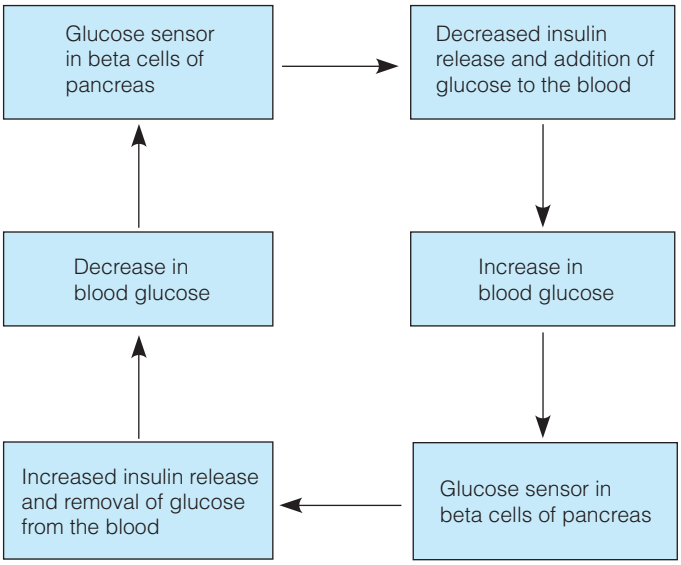


Figure 18–6 ■ Negative feedback.

Stimuli for hormone release may also be classified as hormonal, humoral, or neural (Figure 18–7 ■). In hormonal release, hypothalamic hormones stimulate the anterior pituitary to release hormones. Fluctuations in the serum level of these hormones in turn prompt other endocrine glands to release hormones. In humoral release, fluctuations in the serum levels of certain ions and nutrients stimulate specific endocrine glands to release hormones to bring these levels back to normal. In neural release, nerve fibers stimulate the release of hormones.

ASSESSING ENDOCRINE FUNCTION

The function of the endocrine glands is assessed by findings from diagnostic tests, a health assessment interview to collect subjective data, and a physical assessment to collect objective data. Hormones affect all body tissues and organs, and manifestations of dysfunction are often nonspecific, making assessment of endocrine function sometimes more difficult than assessment of other body systems.

Diagnostic Tests

The results of diagnostic tests of the endocrine system are used to support the diagnosis of a specific disease, to provide information to identify or modify the appropriate medication or therapy used to treat the disease, and to help nurses monitor the client's responses to treatment and nursing care interventions. Diagnostic tests to assess the structure and function of the glands of the endocrine system are described in the table on pages 523–526 and are summarized in the bulleted list that follows. More information is included in the discussion of specific disorders in Chapters 19 and 20 ∞ .

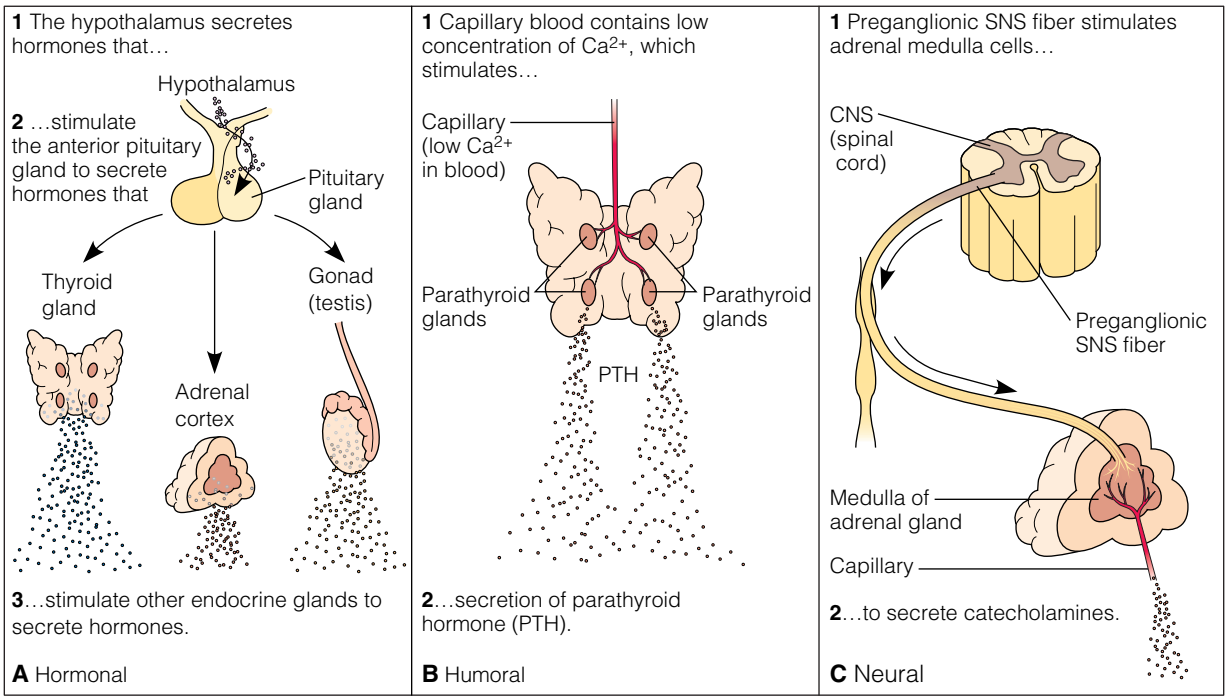


Figure 18–7 ■ Examples of three mechanisms of hormone release: *A,* hormonal; *B,* humoral; or *C,* neural.

DIAGNOSTIC TESTS of the Endocrine System

PITUITARY TESTS

NAME OF TEST Growth Hormone (GH), Human Growth Hormone (hGH)

PURPOSE AND DESCRIPTION In this serum test, GH levels (affected by food, stress, and activity) are measured to identify GH deficiency (dwarfism) or GH excess (gigantism, acromegaly).

Normal value:
Men: <5 ng/mL
Women: <10 ng/mL

RELATED NURSING CARE Inform client not to eat or drink 8–10 hours prior to having blood drawn. Have client rest for 30 to 60 minutes before blood is drawn.

NAME OF TEST Somatomedin C (Insulin-Like Growth Factor or IGF-1)

PURPOSE AND DESCRIPTION The results of this serum test are used to evaluate secretion of growth factor and to identify GH deficiency or excess (as above).

Normal value:
125–250 ng/mL

RELATED NURSING CARE None; overnight fasting is preferred but not necessary.

NAME OF TEST Water Deprivation Test

PURPOSE AND DESCRIPTION This combination blood and urine test is used to identify causes of polyuria (increased urine output), including central diabetes insipidus, neurogenic diabetes insipidus, syndrome of inappropriate antidiuretic hormone, and psychogenic polydipsia. ADH or vasopressin is given IM or subcutaneously. In clients without pathology, there is no change in urine and plasma osmolality.
Urine osmolality increases in central diabetes insipidus and decreases in nephrogenic diabetes insipidus.

RELATED NURSING CARE Inform client not to smoke, eat, or drink after midnight, and that the test will take up to 8 hours. Every hour for ordered length of test: assess weight, take postural BP (lying and standing measures separated by 2 minutes), assess urine for volume and specific gravity, and send samples of urine to the lab for osmolality. Blood samples for osmolality are taken when urine samples are collected and when client demonstrates orthostatic hypotension.

NAME OF TEST Magnetic Resonance Imaging (MRI)

PURPOSE AND DESCRIPTION This radiographic study is done to identify tumors of the hypothalamus or pituitary gland.

RELATED NURSING CARE Inform client of need to lie still during the examination. Assess for any metallic implants (such as pacemakers, body piercings, shrapnel). If present, test is not performed.

THYROID TESTS

NAME OF TEST Thyroid-Stimulating Hormone (TSH)

PURPOSE AND DESCRIPTION In this blood test, TSH and T_4 levels are measured to differentiate pituitary from thyroid causes of hypothyroidism. A decreased T_4 level and a normal or increased TSH level can indicate a thyroid disorder. A decreased T_4 level and a decreased TSH level can indicate a pituitary disorder.

Normal value:
<3 ng/mL

RELATED NURSING CARE Inform clients to avoid shellfish for several days prior to the test. Evaluate medications: TSH value may be increased by aspirin, steroids, dopamine, and heparin; and decreased by lithium and potassium iodide.

NAME OF TEST Thyroxine (T_4)

PURPOSE AND DESCRIPTION This serum test is done to determine thyroid function and aid in the diagnosis of hyperthyroidism and hypothyroidism.
Normal value:
free T_4 1.0–2.3 ng/dL

RELATED NURSING CARE Assess medications: Value may be decreased by cortisone, chlorpromazine (Thorazine), phenytoin (Dilantin), heparin, lithium, sulfonamides, reserpine (Serpasil), testosterone, propranolol (Inderal), tolbutamide (Orinase), and salicylates in high doses. Values may be increased by oral contraceptives, estrogen, clofibrate, and perphenazine (Trilafon).

NAME OF TEST Triiodothyronine (T_3)

PURPOSE AND DESCRIPTION This serum test is used to diagnose hyperthyroidism and to compare T_3 with T_4 for diagnosis of thyroid disorder.
Normal value:
80–200 ng/dL

RELATED NURSING CARE Evaluate medications: Value can be decreased by propylthiouracil, methimazole (Tapazole), lithium, phenytoin (Dilantin), propranolol (Inderal), reserpine (Serpasil), large doses of aspirin, steroids, and sulfonamides. Value can be increased by estrogen, progestins, oral contraceptives, T_3, and methadone.

NAME OF TEST Triiodothyronine Resin Uptake (T_3RU)

PURPOSE AND DESCRIPTION This test is an indirect measure of free thyroxine (T_4). The client's blood is mixed with radioactive T_3 and synthetic resin, and the radioactive T_3 will bind with available thyroid-binding globulin sites. The unbound radioactive T_3 is added to resin for T_3 uptake. In hyperthyroidism there are few binding sites left, more T_3 is taken up by the resin, and a high T_3 resin uptake results. The opposite occurs in hypothyroidism.
Normal value:
25–35% uptake

RELATED NURSING CARE No special preparation is needed.

(continued)

DIAGNOSTIC TESTS of the Endocrine System (continued)

NAME OF TEST Thyroid Antibodies (TA)

PURPOSE AND DESCRIPTION A blood test used to identify thyroid immune disease (Graves' disease, chronic thyroiditis, Hashimoto's thyroiditis).

Normal values:
Antithyroglobulin: negative to titer <1:20
Antimicrosomal: negative to titer <1:100

RELATED NURSING CARE Assess for family history of thyroid disease and ask about recent viral infection (which could trigger autoimmune disease).

NAME OF TEST Radioactive Iodine Uptake (RIA)

PURPOSE AND DESCRIPTION This test provides a direct measure of thyroid activity and is useful in evaluating the activity of solitary thyroid nodules. Based on the rationale that the thyroid gland takes up iodine in any form, radioactive iodine is given orally or intravenously, and the thyroid gland uptake is measured with a scanner at several hourly intervals and at 24 hours.

Normal value for uptake:
2–4 hours: 3–19%
24 hours: 11–30%

RELATED NURSING CARE The client should not eat or drink for 6 to 8 hours before the test, but can have food 1 hour after the oral dose is given. Tell clients not to take supplemental iodine several weeks before the test and thyroid medications should be discontinued.

NAME OF TEST Thyroid Scan

PURPOSE AND DESCRIPTION This radiologic study evaluates thyroid nodules. Radioactive isotopes are given orally and a scanner is passed over the thyroid to make a graphic record of the radiation emitted. A normal thyroid scan has a homogeneous pattern of radiation with symmetric lobes. Benign lesions appear as warm spots (take up more radiation); malignant tumors appear as cold spots (less radiation taken up).

RELATED NURSING CARE No special preparation is needed.

PARATHYROID TESTS

NAME OF TEST Parathyroid Hormone (PTH)

PURPOSE AND DESCRIPTION A blood test done to identify hypoparathyroidism or hyperparathyroidism; also used to monitor response to PTH therapy.

Normal value:
Intact PTH: 11–54 pg/mL
C-terminal PTH: 50–330 pg/mL
N-terminal PTH: 8–24 pg/mL

RELATED NURSING CARE Tell client not to eat or drink for 8 hours before the test.

NAME OF TEST Calcium (Ca)

PURPOSE AND DESCRIPTION This serum test is used to check for serum calcium excess or deficit in parathyroid and bone disorders; and to monitor calcium levels.

Normal value:
9.0–11.0 mg/dL, 4.5–5.5 mEq/L, or 2.3–2.8 mmol/L (SI units)

RELATED NURSING CARE Assess for manifestations of tetany, including positive Chvostek's and Trousseau's signs, if hypocalcemia is present.

ADRENAL TESTS

NAME OF TEST Cortisol

PURPOSE AND DESCRIPTION A serum test is done to measure amount of total cortisol in the serum and evaluate adrenal cortex function. It is decreased in Addison's disease and hypothyroidism; increased in Cushing's syndrome and hyperthyroidism.

Normal value:
8 A.M.–10 A.M.: 138–635 nmol
4 P.M.–6 P.M.: 83–359 nmol

A 24-hour urine test may be conducted to measure free (unbound) cortisol

Normal value: <100 mcg/24 hours

RELATED NURSING CARE Tell client not to eat or drink and to rest for 2 hours before the test. Evaluate medications: Cortisol is decreased by androgens, phenytoin (Dilantin), and increased by oral contraceptives, estrogen, spironolactone (Aldactone), and triparanol.

Instruct client how to save urine for 24-hour period, to eat a low-sodium diet before the test, and to avoid stressful situations and physical activity for at least 24 hours prior to the test. Assess medications; values may be increased by reserpine (Serpasil), diuretics, phenothiazines, and amphetamines.

DIAGNOSTIC TESTS of the Endocrine System (continued)

NAME OF TEST Aldosterone

PURPOSE AND DESCRIPTION This blood test is done to identify a deficit or an excess of aldosterone; and to compare blood and urine levels with other lab data to evaluate overhydration with increased sodium and adrenal malfunction.

Normal value: <16 mcg/dL (fasting)

A 24-hour urine test is considered a more reliable measure of aldosterone than a random aldosterone test.

Normal value: 6–25 mcg/24 hours

RELATED NURSING CARE Assess diet and lab results: Levels are increased by hyponatremia, hyperkalemia, and a low-salt diet. Assess medications: Values are increased by diuretics, hydralazine (Apresoline), diazoxide (Hyperstat), nitroprusside, and oral contraceptives.

Assess diet and lab results as for blood test. Assess medications: Urine aldosterone levels are increased by diuretics, lithium, and oral contraceptives.

NAME OF TEST Adrenocorticotropic Hormone (ACTH)

PURPOSE AND DESCRIPTION This serum test is done to determine if a decreased plasma level of cortisol is due to adrenal cortex hypofunction or pituitary hypofunction.

Normal value:
7 A.M.–10 A.M.: 8–80 pg/mL
4 P.M.: 5–30 pg/mL
10 P.M.–12 P.M.: <10 pg/mL

RELATED NURSING CARE Tell the client that food and fluids may be restricted, and to eat a low-carbohydrate diet for 24 hours prior to the test. Assess medications: ACTH values may be increased by metyrapone, vasopressin, and insulin; and decreased by steroids, estrogen amphetamines, and alcohol.

NAME OF TEST ACTH Stimulation

PURPOSE AND DESCRIPTION Done to check for pituitary hypofunction. The drug metyrapone (Metopirone) is given to block the production of cortisol, thus causing an increased ACTH secretion. If the ACTH level does not increase, the problem is pituitary insufficiency.

RELATED NURSING CARE Assess medications as for ACTH test.

NAME OF TEST ACTH Suppression

PURPOSE AND DESCRIPTION Done to check for the origin of the condition. The drug dexamethasone (Decadron) is given to suppress ACTH production. If an extremely high dose is needed, the cause is of pituitary origin; if the plasma cortisol continues to be high with ACTH suppression, the cause could be adrenal cortex hyperfunction (Cushing's syndrome). Normally, the plasma cortisol level should double in 1 hour.

RELATED NURSING CARE Tell client to avoid tea, caffeinated coffee, and chocolates; no other food or fluid restriction is needed. Assess medications: False positives may be caused by phenytoin, barbiturates, meprobamate, and carbamazepine. If dexamethasone causes gastric irritation, milk or antacids may be required.

NAME OF TEST 17-Ketosteroids

PURPOSE AND DESCRIPTION This 24-hour urine test is done to measure metabolites in urine and evaluate adrenal cortex function.

Normal value:
Men: 5–25 mg in 24 hours
Women: 5–15 mg in 24 hours

RELATED NURSING CARE Instruct client how to save urine (urine must contain a preservative and be refrigerated). Assess medications and refer to information about the test: Levels are affected by a variety of drugs; if possible, these should be discontinued for 48 hours before the test. Women cannot have the test while menstruating because blood can cause a false-positive finding.

NAME OF TEST Computerized Tomography (CT) of the Abdomen

PURPOSE AND DESCRIPTION This radiologic study is used to assess the adrenal gland for tumors (including size and metastasis).

RELATED NURSING CARE Determine if contrast medium will be used; if so, assess client for allergy to iodine (shellfish).

PANCREATIC ENDOCRINE TESTS

NAME OF TEST Fasting Blood Sugar (FBS)

PURPOSE AND DESCRIPTION This test of serum or plasma is used to identify or confirm a diagnosis of diabetes mellitus. It is also used to monitor treatment of diabetes mellitus. A finding of greater than 125 mg/dL might indicate diabetes.

Normal value:
Serum/plasma: 70–100 mg/dL

RELATED NURSING CARE Tell the client not to eat or drink for 12 hours before the test. Do not administer insulin until blood specimen is taken. Assess medications: FBS may be increased by cortisone, diuretics, ACTH, levodopa, epinephrine, anesthetics, and phenytoin (Dilantin).

(continued)

DIAGNOSTIC TESTS of the Endocrine System (continued)

NAME OF TEST Oral Glucose Tolerance Test (OGTT)

PURPOSE AND DESCRIPTION Performed to diagnose diabetes mellitus if prior fasting blood sugar (FBS) findings are increased or inconsistent.

NURSING IMPLICATIONS FOR ORAL GLUCOSE TOLERANCE TEST

- The tests will not be done if client's FBS is consistently high (>200 mg/dL). The client drinks a solution of 75 to 100 grams of glucose and samples of blood and urine are taken immediately and at 30, 60, and 120 minutes (or it may extend from 3 to 6 hours).
  The reference values are:

Time	Serum (mg/dL)	Blood mg/dL
Fasting	70–110	60–100
0.5 hour	<160	<150
1 hour	<170	<160
2 hours	<125	<115
3 hours	Fasting level	Fasting level

NURSING IMPLICATIONS

- Tell the client not to eat or drink (except water) for 12 hours before the test.
- Tell the client that food, fluids (except water), and smoking are not allowed during the test.
- Assess medications: Drugs that may increase OGTT levels are steroids, oral contraceptives, estrogens, thiazide diuretics, and salicylates.
- Explain to the client that he or she may feel weak and may perspire during the test and these symptoms should be reported to the nurse. Although they usually are transitory, they may be manifestations of hyperinsulinism.

NAME OF TEST Glycosylated Hemoglobin (Hb A_1C)

PURPOSE AND DESCRIPTION This serum test is used to measure the effectiveness of treatment of diabetes mellitus. The results represent an average blood glucose level during a 1- to 4-month period; an elevated level indicates uncontrolled diabetes mellitus and increased risk for complications.

Normal value: 5.5–9% of total Hgb

RELATED NURSING CARE Monitor findings: Decreased levels can be caused by anemias, long-term blood loss, and chronic renal failure. Increased levels may result from hyperglycemia, alcohol ingestion, pregnancy, hemodialysis, and prolonged cortisone intake.

NAME OF TEST Computed Tomography (CT) of the Abdomen

PURPOSE AND DESCRIPTION This radiographic test is done to identify pancreatic tumors or cysts.

RELATED NURSING CARE If contrast medium is used, assess for allergy to iodine (shellfish).

- As a result of the many hormones produced by the pituitary gland and by the number of target organs for those hormones, many direct and indirect diagnostic tests are used to determine pituitary function. The diagnostic tests described in this chapter include those of growth hormone (GH), somatomedin C, causes of polyuria, and pituitary tumors.
- Although a substantial number of diagnostic tests are used to identify and monitor thyroid function, the most accurate is TSH. Other tests of thyroid structure and function include thyroxine, triiodothyronine, thyroid antibodies, radioactive iodine uptake, and thyroid scan.
- Diagnostic tests of the parathyroid hormone, which regulates serum calcium and phosphate levels, include PTH and serum calcium.
- Diagnostic tests for the adrenal glands assess the glucocorticoids, mineralocorticoids, and androgens through both blood and 24-hour urine studies. The tests are of cortisol, aldosterone, ACTH, 17-ketosteroids, and CT of the abdomen to identify adrenal gland tumors.
- Diagnostic tests of the pancreas are performed primarily to identify, confirm, and monitor glucose levels in clients with diabetes mellitus. Those described are oral glucose tolerance test (OGTT), fasting blood sugar (FBS), glycosylated hemoglobin (Hb A_1C), and CT of the abdomen to identify pancreatic tumors or cysts.

Regardless of the type of diagnostic test, the nurse is responsible for explaining the procedure and any special preparation needed, for assessing for medication use that may affect the outcome of the tests, for supporting the client during the examination as necessary, for documenting the procedures as appropriate, and for monitoring the results of the tests.

Genetic Considerations

When conducting a health assessment interview and physical assessment, it is important for the nurse to consider genetic influences on health of the adult. During the health assessment interview, ask about endocrine disorders in immediate family members, including the family member's age of onset and gender. Ask the client about a family history of such diseases as diabetes mellitus, diabetes insipidus, thyroid disorders, growth problems, hypertension, and obesity. Ask women about problems with pregnancy, menstruation, and/or menopause.

During the physical assessment, assess for any manifestations that might indicate a genetic disorder (see box below). If data are found to indicate genetic risk factors or alterations, ask about genetic testing and refer for appropriate genetic counseling and evaluation. Chapter 8 ∞ provides further information about genetics in medical-surgical nursing.

Health Assessment Interview

A health assessment interview to determine problems with the endocrine system may be part of a health screening or total health assessment, or it may focus on a chief complaint (such as increased urination or changes in energy levels). If the client has a problem with endocrine function, the nurse analyzes its onset, characteristics and course, severity, precipitating and relieving factors, and any associated symptoms, noting the timing and circumstances. For example, the nurse may ask the client:

- Describe the swelling you noticed in the front of your neck. When did it begin? Have you noticed any changes in your energy level?
- When did you first notice that your hands and feet were getting larger?
- Have you noticed that your appetite has increased even though you have lost weight?

The health history includes information about the client's medical history, family history, and social and personal history. Ask the client about any changes in normal growth and development as well as in height and weight. Changes in the size of extremities can often be detected by asking whether the client has had to have rings enlarged or to buy increasingly larger gloves and shoes. Enlargement of the neck may be identified by asking whether the client has difficulty finding shirts or blouses with a collar that fits. Also explore changes such as difficulty swallowing; increased or decreased thirst, appetite, and/or urination; visual changes; sleep disturbances; altered patterns of hair distribution (such as increased facial hair in women); changes in menstruation; changes in memory or ability to concentrate; and changes in hair and skin texture. Ask the client about any blow to the head, as well as previous hospitalizations, chemotherapy, radiation (especially to the neck), and the use of medications (especially hormones or steroids).

The nurse also asks about the client's occupational and social history. Include questions about the client's satisfaction with occupation, personal relationships, and lifestyle. Other areas of assessment include the client's usual means of coping; use of alcohol, smoking, or drugs; diet (including weight gain or loss); exercise patterns; and sleep patterns. Although the client may not recognize changes in behavior, family members may be able to provide important information.

Interview questions categorized by functional health patterns are listed on page 528.

GENETIC CONSIDERATIONS
Endocrine System

- Type 1 and type 2 diabetes mellitus are classified as multifactorial inheritance disorders because both genetic and environmental factors are necessary for onset of the disorder.
- Pendred syndrome is an inherited disorder in which people have hereditary deafness and a thyroid goiter.
- Hashimoto's disease (chronic thyroiditis) is believed to have a genetic component.
- Multiple endocrine neoplasia is a group of rare diseases caused by genetic defects leading to hyperplasia and hyperfunction of two or more components of the endocrine system (especially the parathyroid, pancreas, and pituitary glands).

Physical Assessment

Physical assessment of the endocrine system may be performed as part of a total health assessment, or it may be a focused assessment of clients with known or suspected problems with endocrine function. Sample documentation of an assessment of the thyroid gland is included in the box below.

SAMPLE DOCUMENTATION
Assessment of the Thyroid Gland

A 37-year-old female presents at community clinic for complaints of "always feeling so hot," "always hungry but losing weight," and "can't sleep at night—too jittery." Weight 110 lb (loss of 12 pounds in last 3 months). BP 90/78 (averages 84/72), P 96. Skin very warm and moist. Anterior neck has diffuse enlargement. Thyroid gland enlarged bilaterally on palpation. Referral made to endocrine clinic for further evaluation.

The only endocrine organ that can be palpated is the thyroid gland; however, other assessments that provide information about endocrine problems include inspection of the skin, hair, nails, facial appearance, reflexes, and musculoskeletal system. Measuring and monitoring trends in height and weight and vital signs also provide clues to altered endocrine system function.

The client may sit during the examination. A reflex hammer is used to test deep tendon reflexes. Prior to the examination, the nurse collects the necessary equipment and explains the techniques to the client to decrease anxiety. Additional techniques for assessing hypocalcemic tetany, a complication of endocrine disorders or surgery, are included in the examination sequence. Normal age-related changes in assessment findings are described in Table 18–2.

MEDIALINK Case Study: Endocrine Assessment

FUNCTIONAL HEALTH PATTERN INTERVIEW **Endocrine System**

Functional Health Pattern	Interview Questions and Leading Statements
Health Perception-Health Management	■ Describe your overall state of health, rating it on a scale of 1 to 10 with 10 being the best health you have had. ■ Describe any problems you have had with an endocrine gland (pituitary, thyroid, parathyroid, adrenal, pancreas, ovaries, testes). ■ If you had a problem with any of these glands, how was it treated (medications, surgery, diet, hormone replacement)? ■ Do you smoke, drink alcohol, and/or use recreational drugs? If so, how much and what kind? ■ Have you ever been tested for high or low blood sugar?
Nutritional-Metabolic	■ Describe what you eat and how much (and type of) fluid you drink in a 24-hour period. ■ Do you take any nutritional supplements, herbs, or vitamins? ■ Have you noticed any change in your hunger or thirst? ■ Has your weight changed? If so, how many pounds and over what time period? ■ Have you noticed any change in your energy level? If so, explain. ■ Have you noticed any change in your ability to tolerate heat or cold? ■ Have you noticed any difficulty swallowing? Explain. ■ Have you noticed any change in the texture of your skin? If so, what were they?
Elimination	■ Have you noticed any change in the color, odor, amount, or frequency of urination? If so, describe it. ■ Have you ever had kidney stones? If so, how were they treated? ■ Has there been a change in your bowel elimination (such as diarrhea or constipation)? If so, explain the change.
Activity-Exercise	■ Describe your physical activities in a usual day. ■ Has your energy level increased or decreased? Explain. ■ Do some activities make you very tired? Explain how you feel.
Sleep-Rest	■ How many hours of sleep do you get each night? ■ Do you feel nervous and unable to rest? ■ Do you sweat at night?
Cognitive-Perceptual	■ Have you noticed any problem with your memory? ■ Do you feel restless, anxious, or confused? ■ Have you noticed any change in your voice? ■ Have you noticed any change in the color or condition of your skin and hair (color, dryness, oiliness, bruises)? ■ Have you had any headaches, memory loss, changes in sensation, depression? Describe them, if so. ■ Have you noticed any change in your vision? Describe them, if so. ■ Have you had any heart palpitations? ■ Have you had any abdominal pain? What is it like and where is it located? ■ Have you had any pain or stiffness in your muscles and joints?
Self Perception-Self-Concept	■ How does this condition make you feel about yourself? ■ How do you feel about taking medications?
Role-Relationships	■ How does this condition make you feel about yourself? How does this condition affect your relationships with others? ■ How does this condition make you feel about yourself? Does anyone in your family have an endocrine disorder? If so, when did it begin and how does it affect them? What family member is affected and at what age did it begin?
Sexuality-Reproductive	■ How does this condition make you feel about yourself? Has having this condition affected your usual sexual activities? ■ *For women:* Have you noticed any change in your menstrual periods? ■ *For women:* Have you had any problems becoming pregnant? ■ *For women:* If you have children, what were their weights at birth? ■ *For men:* Have you noticed any change in your ability to have an erection?
Coping-Stress-Tolerance	■ Does stress seem to make your condition worse? Explain. ■ Has this condition created stress for you? ■ Describe what you do when you feel stressed.
Value-Belief	■ Tell me how specific relationships or activities help you cope with this condition. ■ Describe specific cultural beliefs or practices that affect how you care for and feel about this condition. ■ Are there any specific treatments that you would not use to treat this condition?

TABLE 18–2 **Age-Related Endocrine Changes**

AGE-RELATED CHANGE	SIGNIFICANCE
Pituitary: ↓ production of ACTH , TSH, FSH	■ Decreased secretion of glucocorticoids, 17-ketosteroids, progesterone, androgen, and estrogen (and thus lower levels on diagnostic tests)
Thyroid: ↑ in fibrosis and nodularity, ↓ in gland activity	■ Lower basal metabolic rate ■ Increased incidence of hypothyroidism ■ Palpable nodules on palpation
Adrenal medulla: ↑ secretion and level of norepinephrine, ↓ beta-adrenergic response to norepinephrine	■ Decreased response to beta-adrenergic and receptor blockers (medications) ■ May contribute to increased incidence of hypertension
Pancreas: calcification of blood vessels and distention and dilation of pancreatic ducts	■ Decreased production of lipase with reduced fat absorption and digestion, leading to intolerance of fatty foods and indigestion ■ Decreased absorption of fat-soluble vitamins
Pancreas: delayed and decreased insulin release; believed accompanied by decreased sensitivity to circulating insulin	■ Decreased ability to metabolize glucose with higher and more prolonged blood glucose levels may contribute to increased incidence of type 2 diabetes mellitus with aging (however, higher than normal blood glucose levels are not unusual in nondiabetic older adults)

ENDOCRINE ASSESSMENTS

Technique/Normal Findings	Abnormal Findings
Skin Assessments with Abnormal Findings	
Inspect skin color *Skin color should be even, and appropriate to age and race of the client.*	■ Hyperpigmentation may be seen in clients with Addison's disease or Cushing's syndrome. ■ Hypopigmentation may be seen in diabetes mellitus, hyperthyroidism, or hypothyroidism. ■ A yellowish cast to the skin might indicate hypothyroidism. ■ Purple striae over the abdomen and bruising may be present in the client with Cushing's syndrome.
Palpate the skin, assessing texture, moisture, and the presence of lesions. *Skin should be appropriate to the client's race, smooth, warm, dry, and intact without abnormal lesions.*	■ Rough, dry skin is often seen in clients with hypothyroidism, whereas smooth and flushed skin can be a sign of hyperthyroidism. ■ Lesions (such as ulcerations) on the lower extremities might indicate diabetes mellitus.
Nails and Hair Assessment with Abnormal Findings	
Assess texture, distribution, and condition of nails and hair. *Hair should be of normal texture, appropriately distributed for gender; nails surfaces should have even color with smooth surfaces.*	■ Increased pigmentation of the nails is often seen in clients with Addison's disease. ■ Dry, thick, brittle nails and hair may be apparent in hypothyroidism; thin, brittle nails and thin, soft hair may be apparent in hyperthyroidism. ■ Hirsutism (excessive facial, chest, or abdominal hair) may be seen in Cushing's syndrome.
Facial Assessments with Abnormal Findings	
Inspect the symmetry and form of the face. *Face should be bilaterally symmetrical.*	■ Variations of form and structure may indicate growth abnormalities such as **acromegaly** (continued growth of bone from growth hormone hypersecretion).
Inspect position of eyes. *Eyes should be equal in position on both sides of the face. Eyelids should close over eyes.*	■ **Exophthalmos** (protruding eyes) may be seen in hyperthyroidism.

Technique/Normal Findings	Abnormal Findings

Thyroid Gland Assessment with Abnormal Findings

Palpate the thyroid gland for size and consistency.
Stand behind the client, and place your fingers on either side of the trachea below the thyroid cartilage (Figure 18–8 ■). Ask the client to tilt the head to the right. Now ask the client to swallow. As the client swallows, displace the left lobe while palpating the right lobe. Repeat to palpate the left lobe. *Thyroid gland is not usually palpable. If it is, lobes should feel smooth, rubbery, and free of nodules.*

- The thyroid may be enlarged in clients with Graves' disease or a **goiter** (enlarged thyroid gland).
- Multiple nodules may be seen in metabolic disorders, whereas the presence of only one nodule may indicate a cyst or a benign or malignant tumor.
- One enlarged nodule suggests malignancy.

Figure 18–8 ■ Palpating the thyroid gland from behind the client.

Motor Function Assessment with Abnormal Findings

Assess the deep tendon reflexes. Deep tendon reflexes are assessed with the reflex hammer, and include the biceps reflex, brachioradialis reflex, triceps reflex, patellar reflex, and Achilles reflex. *Normal values range from 1+ (present, but decreased) to 2+ (normal) to 3+ (increased). See Chapter 43 ∞ for guidelines and illustrations of deep tendon reflex assessment.*

- Increased reflexes may be seen in hyperthyroidism; decreased reflexes may be seen in hypothyroidism.

Sensory Function Assessment with Abnormal Findings

Test the client's sensitivity to pain, temperature, vibration, light touch, and stereognosis (the ability to identify an object merely by touch). Compare symmetric areas on both sides of the body, and compare the distal to the proximal regions of the extremities. Ask the client to close his or her eyes.
Sensory function should be bilaterally intact.

- **To test pain, use the blunt and sharp ends of a new safety pin. Discard the pin after use.**
- **To test temperature, use cups or other containers of cold and hot water.**
- **To test vibration, use a tuning fork over one of the client's finger or toe joints.**
- **To test light touch, use a cotton wisp.**
- **To test stereognosis, place in the client's hand a simple, familiar object, such as a rubber band, cotton ball, or button. Ask the client to identify the object.**

- Peripheral neuropathy and paresthesias (altered sensations) may occur in diabetes, hypothyroidism, or acromegaly.

Technique/Normal Findings	Abnormal Findings
Musculoskeletal Assessment with Abnormal Findings	
Inspect the size and proportions of the client's body structure. *Size and proportion of body structures should be bilaterally equal.*	■ Extremely short stature may indicate **dwarfism**, which is caused by insufficient growth hormone. ■ Extremely large bones may indicate acromegaly, which is caused by excessive growth hormone.
Assessing for Hypocalcemic Tetany	
Assess for **Trousseau's sign** (a test for hypocalcemia) with resulting **tetany** (tonic muscle spasms) by inflating a blood pressure cuff above the antecubital space to a point greater than systolic blood pressure for 2–5 minutes. Trousseau's sign is discussed in relation to hypocalcemia in Chapter 10 ∞. *A normal finding would be no carpal spasm in response to compression of the arm by the blood pressure cuff.*	■ Decreased calcium levels cause the client's hand and fingers to contract (**carpal spasm**).
Assess for **Chvostek's sign** (a test for hypocalcemia) by tapping your finger in front of the client's ear at the angle of the jaw. A positive Chvostek's sign causes facial grimacing due to repeated contractions of the facial muscle. Chvostek's sign is discussed and illustrated in relation to hypocalcemia in Chapter 10 ∞. *A normal finding would be no facial grimacing in response to tapping the client's face in front of the ear.*	■ Decreased calcium levels cause the client's lateral facial muscles to contract.

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NCLEX-RN® Review
Care Plan Activity: Type 2 Diabetes
Case Studies
Assessing a Client for Hypocalcemia
Endocrine Assessment
MediaLink Application: Endocrine Hormones
Links to Resources

TEST YOURSELF NCLEX-RN® REVIEW

1 What physiologic response is expected if the pituitary produces an increased amount of ADH?
   1. increased output of urine
   2. decreased output of urine
   3. increased facial hair growth in women
   4. decreased production of testosterone

2 What assessment might be made to identify low calcium levels?
   1. Save urine to measure 7-ketosteroids.
   2. Palpate turgor of skin.
   3. Conduct a Trousseau's sign test.
   4. Observe color of skin.

3 Excessive amounts of glucocorticoids, produced by the adrenal cortex, result in what pathophysiologic health problem?
   1. inhibited immune response
   2. increased response to glucagon
   3. delayed onset of puberty
   4. decreased metabolic rate

4 When conducting a health history focused on the endocrine system, which of the following questions should be included?
   1. "When did you first notice the pain in your abdomen?"
   2. "Do your children have problems with urination?"
   3. "Have you noticed a change in your thirst?"
   4. "How did you get this scar on your leg?"

5 What assessments are made when palpating the thyroid gland?
   1. edema and movement
   2. size and consistency
   3. character and texture
   4. pain and pulse rate

6 Decreased calcium levels can be assessed with Chvostek's sign. To conduct this assessment, the nurse:
   1. inflates a blood pressure cuff above the antecubital space.
   2. taps the finger in front of the client's ear.
   3. depresses the skin over the shin.
   4. pinches a fold of skin over the sternum.

7 Which of the following tests is the most accurate indicator of thyroid function?
   1. GH
   2. FBS
   3. aldosterone
   4. TSH

8 Which is the only endocrine organ that can be palpated during physical assessment?
   1. pancreas
   2. liver
   3. thyroid
   4. pituitary

9 You are caring for a client with newly diagnosed hypothyroidism. What skin assessment might you find?
   1. increased hair growth
   2. rough, dry skin
   3. smooth, flushed skin
   4. cold and clammy skin

10 What endocrine disorder might be assessed by testing deep tendon reflexes?
   1. Cushing's syndrome
   2. acromegaly
   3. tetany
   4. hyperthyroidism

See Test Yourself answers in Appendix C.

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