chapter **17**

Physiology of the Autonomic Nervous System

Objectives

AFTER STUDYING THIS CHAPTER, THE STUDENT WILL BE ABLE TO:

1. Identify physiologic effects of the sympathetic nervous system.
2. Differentiate subtypes and functions of sympathetic nervous system receptors.
3. Identify physiologic effects of the parasympathetic nervous system.
4. Differentiate subtypes and functions of parasympathetic nervous system receptors.
5. Describe signal transduction and the intracellular events that occur when receptors of the autonomic nervous system are stimulated.
6. State names and general characteristics of drugs affecting the autonomic nervous system.

AUTONOMIC NERVOUS SYSTEM

The nervous system is composed of two main divisions, the central nervous system (CNS) and the peripheral nervous system (Fig. 17–1). The central nervous system includes the brain and spinal cord. The peripheral nervous system includes all the neurons and ganglia found outside the CNS. The peripheral nervous system is subdivided into the afferent neurons and efferent neurons. Afferent neurons carry sensory input from the periphery to the CNS and modify motor output through the action of reflex arcs. The efferent neurons carry motor signals from the CNS to the peripheral areas of the body. The efferent portion of the peripheral nervous system is further subdivided into the somatic and autonomic nervous system (ANS). The somatic nervous system innervates skeletal muscles and controls voluntary movement. The ANS, without conscious thought or effort, controls involuntary activities in the visceral organs of the body such as the heart, smooth muscle, and secretory glands. These functions can be broadly described as activities designed to maintain a constant internal environment (homeostasis), to respond to stress or emergencies, and to repair body tissues. The ANS is regulated by centers in the CNS, including the hypothalamus, brain stem, and spinal cord. The autonomic nervous system is subdivided into the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS).

Nerve impulses are generated and transmitted to body tissues in the sympathetic and parasympathetic nervous systems as they are in the CNS (see Chap. 5). Autonomic nerve impulses are carried through preganglionic fibers, ganglia, and postganglionic fibers. Preganglionic impulses travel from the CNS along the preganglionic nerves to ganglia. Ganglia are composed of the terminal end of the preganglionic nerve and clusters of postganglionic cell bodies. A neurotransmitter is released from the terminal end of the preganglionic nerve allowing the nervous impulse to bridge the synapse between the preganglionic and postganglionic nerve. The postganglionic impulses travel from ganglia to effector tissues of the heart, blood vessels, glands, other visceral organs, and smooth muscle (Fig. 17–2).

The main neurotransmitters of the ANS are acetylcholine and norepinephrine (see Chap. 5). Acetylcholine is synthesized from acetylcoenzyme A and choline and released at preganglionic fibers of both the SNS and PNS and at postganglionic fibers of the PNS. Acetylcholine is also released from postganglionic sympathetic neurons that innervate the sweat glands and from motor neurons of the somatic nervous system that innervate the skeletal muscles. The nerve fibers that secrete acetylcholine are called cholinergic fibers. Norepinephrine is synthesized from the amino acid tyrosine by a series of enzymatic conversions that also produce dopamine and epinephrine (ie, tyrosine → dopamine → norepinephrine → epinephrine). Norepinephrine is the end product, except in the adrenal medulla, where most of the norepinephrine is converted to epinephrine. Norepinephrine is released at most postganglionic fibers of the