CHAPTER XXI

Nervous Control of the Viscera—
Efferent System

The hypothalamus may be regarded as the origin of the neuro-endocrine outflow. The neural part of the outflow is also known as the autonomic nervous system. It extends downward into the brain stem and spinal cord and its peripheral fibers carry motor impulses to the viscera, blood vessels, and secretory glands. As in the somatic nervous system, the transmission of impulses is mediated by chemical substances liberated at the nerve terminals. However, many of the synaptic connections of the autonomic nerves are made outside the spinal cord in ganglion cells and numerous nerve plexuses that accompany the blood vessels to the organs they supply. The endocrine part of the outflow produces its effects through hormones secreted into the blood stream. These substances are transported by the circulation to their target organs which in turn regulate the internal secretions by reacting back on the hypothalamus. A reciprocal relationship therefore exists between the central nervous system and the endocrine glands. If the activity of the hypothalamus is abnormally increased or decreased, corresponding derangements occur in endocrine function, producing symptoms of excessive secretion or insufficiency.

AUTONOMIC OUTFLOW

The autonomic nerves are classified into two major subdivisions called the sympathetic and the parasympathetic. Some physiological systems are controlled predominantly by one or the other, but in many instances the organs are innervated by both. In such cases, the two divisions act reciprocally, excitation of one causing inhibition of the other. Reciprocal action is obviously important to the function of the hollow organs. For example, emptying of the urinary bladder is accomplished by contraction of the muscular wall and relaxation of the sphincter. The detrusor muscle is
supplied by parasympathetic fibers from the sacral segments of the cord, while the internal sphincter is supplied by sympathetic fibers from the lumbar segments of the cord.

**Sympathetic division**

**Functional anatomy**

The sympathetic nerves arise from columns of cells in the gray matter of the lateral horn of the spinal cord. The columns extend from the first thoracic segment (T1) to the second lumbar segment (L2). The axons pass out of the cord through the ventral roots as preganglionic fibers or white rami in company with the spinal motor nerves supplying the skeletal muscles. After emerging from the cord, they leave the spinal nerves and proceed to the ganglia of the sympathetic chain, where they make synaptic contacts. The white rami are all myelinated and belong to the B group of fibers. From the sympathetic chain, postganglionic fibers take devious routes to their destinations in one of the organs. Many of them, however, pass back as the grey rami to join a spinal nerve through which they are distributed to the blood vessels and skin. The grey rami are mostly unmyelinated and belong to the C group of fibers.

The sympathetic chain extends down the whole length of the vertebral column; it is divided on each side into four parts:

1. The cervical part consists of three ganglia—superior, middle, and inferior—from which postganglionic fibers are distributed along the arteries to structures in the head, neck, and thorax. The superior cervical ganglion gives rise to the internal carotid plexus which sends branches to the dilator muscle of the pupil. The inferior cervical or stellate ganglion is often fused with the first thoracic ganglion and contributes to the deep part of the cardiac plexus.

2. The thoracic part comprises a series of ganglia from each thoracic spinal segment. Branches from the upper five ganglia are distributed to the aortic, cardiac, and pulmonary plexuses. Branches from the lower seven ganglia form the greater and lesser splanchnic nerves. The lowest splanchnic nerve arises from the last thoracic ganglion and ends in the renal plexus.

3. The lumbar part is situated in front of the vertebral column. It is composed of a dense network of fibers, some of which enter the celiac ganglion, while others form numerous secondary plexuses. Most of the branches run with the arteries to supply the abdominal viscera; others descend into the pelvis to join the hypogastric plexus.