14.2F: Autonomic Reflexes

Autonomic reflexes are unconscious motor reflexes relayed from the organs and glands to the CNS through visceral afferent signaling.

Learning Objectives

- Describe autonomic reflexes

Key Points

- While the unconscious reflex arcs are normally undetectable, in certain instances they may trigger pain, typically masked as referred pain.
- The sympathetic nervous system is a quick-response, mobilizing system while the parasympathetic system is a more slowly activated, dampening system—but there are exceptions, such as in sexual arousal and orgasm where both systems play a role.
- Within the brain, the ANS is located in the medulla oblongata in the lower brainstem. The medulla’s major ANS functions include respiration, cardiac regulation, vasomotor activity, and certain reflex actions (such as coughing, sneezing, vomiting, and swallowing).

Key Terms

- reflex arc: A neural pathway that controls an action reflex. There are two types of reflex arcs: the autonomic reflex arc that affects the inner organs, and the somatic reflex arc that affects muscles.
- referred pain: Pain perceived at a location other than the site of the painful stimulus.
• **somatic**: Part of, or relating to, the body of an organism.

### EXAMPLES

An example of referred pain from an autonomic reflex arc occurs when the bowel is suddenly distended. In these cases, the body will interpret the afferent pain stimulus as somatic.

### The Autonomic Nervous System

The autonomic nervous system (ANS, visceral nervous system, or involuntary nervous system) is the part of the peripheral nervous system that acts as a control system. It functions largely below the level of consciousness, and controls visceral functions.

The ANS affects heart rate, digestion, respiratory rate, salivation, perspiration, pupillary dilation, micturition (urination), and sexual arousal. Most autonomic functions are involuntary but a number of ANS actions can work alongside some degree of conscious control. Everyday examples include breathing, swallowing, and sexual arousal, and in some cases functions such as heart rate.

### Functions

Within the brain, the ANS is located in the medulla oblongata in the lower brainstem. The medulla’s major ANS functions include respiration (the respiratory control center, or RCC), cardiac regulation (the cardiac control center, or CCC), vasomotor activity (the vasomotor center or VMC), and certain reflex actions (such as coughing, sneezing, vomiting and swallowing).

These then subdivide into other areas and are also linked to ANS subsystems and nervous systems external to the brain. The hypothalamus, just above the brain stem, acts as an integrator for autonomic functions, receiving ANS regulatory input from the limbic system to do so.

### Classifications

The ANS is classically divided into two subsystems: the parasympathetic nervous system (PSNS) and sympathetic nervous system (SNS) that operate independently in some functions and interact co-operatively in others. In many cases, the two have opposite actions. When one activates a physiological response, the other inhibits it.

An older simplification of the sympathetic and parasympathetic nervous systems as excitatory and inhibitory was overturned due to the many exceptions found. A more modern characterization is that the sympathetic nervous system is a quick-response, mobilizing system and the parasympathetic is a more slowly activated, dampening system—but there are exceptions, such as in sexual arousal and orgasm where both play a role.

The enteric nervous system is also sometimes considered part of the autonomic nervous system, and sometimes considered an independent system.
The ANS is unique in that it requires a sequential two-neuron efferent pathway; the preganglionic neuron must first create a synapse to a postganglionic neuron before innervating the target organ. The preganglionic, or first neuron will begin at the outflow and will cross a synapse at the postganglionic, or second neuron’s cell body. The postganglionic neuron will then create a synapse at the target organ.

General visceral afferent sensations are mostly unconscious, visceral motor reflex sensations from hollow organs and glands that are transmitted to the CNS (see the following illustration for a depiction of a typical nerve fiber, including general visceral afferent fibers).

While the unconscious reflex arcs are normally undetectable, in certain instances they may send pain sensations to the CNS, masked as referred pain. If the peritoneal cavity becomes inflamed or if the bowel is suddenly distended, the body will interpret the afferent pain stimulus as somatic in origin. This pain is usually non-localized. The pain is usually referred to dermatomes that are at the same spinal nerve level as the visceral afferent synapse.

**Typical spinal nerve:** This schematic (but not anatomically correct) depiction of a typical spinal nerve indicates (1) somatic efferent fibers, (2) somatic afferent fibers, (3 to 5) sympathetic efferent fibers, and (6 and 7) sympathetic afferent fibers.