AUTONOMIC NERVOUS SYSTEM AND ENDOCRINE GLANDS – Textbook and Lecture Slides

The **somatic nervous system (SNS)** conducts nerve impulses from the CNS to skeletal muscle causing them to contract. This is the voluntary nervous system because the contractions of the skeletal muscles are under conscious control (eg. Exert voluntary control over your leg muscles for the car accelerator).

There are two motor neurons in the motor pathway the upper motor neuron (85%) and the lower motor neuron (15%) that supplies skeletal muscle. There is a neuron of cell body that sits in the cerebral cortex of left and right hemispheres and when it is activated it initiates control for skeletal muscles by communicating to the brainstem and exiting via cranial nerves to supply those muscles or continue into the spinal cord and come out at its respective level.

The **autonomic nervous system (ANS)** innervates internal organs and regulated smooth muscle, cardiac muscle and glands without our control. It is known as the involuntary nervous system (eg. We cannot voluntarily make our hearts stop beating). This helps maintain the body in homeostatis (balance) via the cranial nerves.

White matter is made up of myelinated axons that travel through the cerebral peduncles of the midbrain to the medulla oblongata (cross over 85%) then go into the spinal cord and leave on the segment they need to exit. The ventral horn of the gray matter carries all the motor supply and the axon of lower motor neuron exits through rootlets which go to the spinal nerve through the ventral (anterior and lateral limbs) and is larger so has a dorsal root ganglia or dorsal rami (posterior muscles and skin of back and neck) and is smaller.

The ANS is subdivided into the parasympathetic and sympathetic division. The **parasympathetic division** functions to maintain homeostasis when we are at rest. This division is primarily concerned with conserving energy and replenishing nutrient stores. Because it is most active when the body is at rest or digesting a meal, this division is the ‘rest and digest’ division.

The **sympathetic division** functions to maintain homeostasis during exercise of times of stress or emergency, which includes the release of nutrients from stores (eg. Glucose from the liver. Because of its function in regulating the more active states this division it the ‘fight or flight’ division. During these fight or flight events the sympathetic division exhibits a mass activation response, whereby all components receiving sympathetic innervation get stimulated.

The **autonomic nervous system** innervates internal organs and regulated smooth muscle, cardiac muscle and glands without our control. It is known as the involuntary nervous system (eg. We cannot voluntarily make our hearts stop beating). This helps maintain the body in homeostatis (balance) via the cranial nerves.

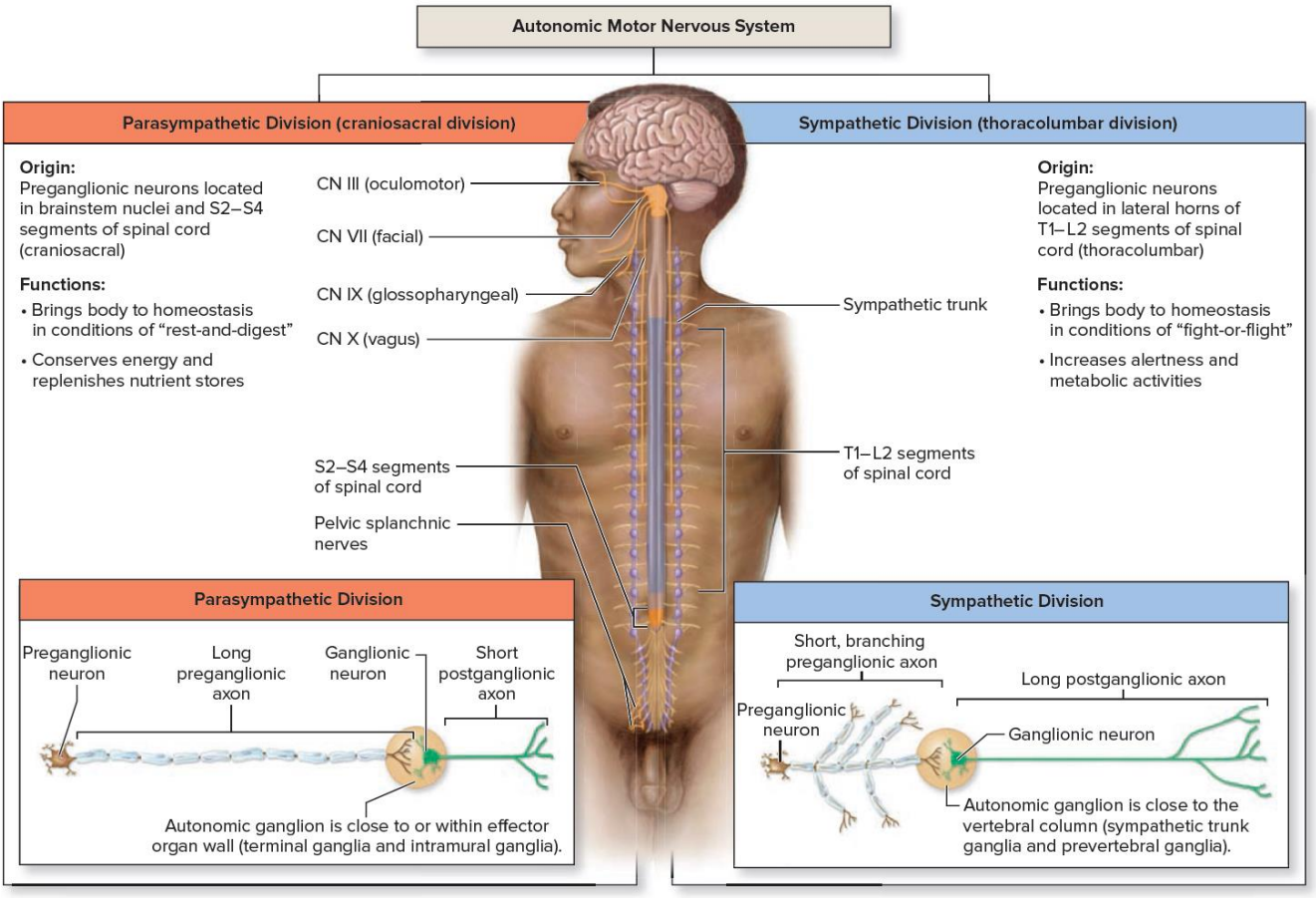
White matter is made up of myelinated axons that travel through the cerebral peduncles of the midbrain to the medulla oblongata (cross over 85%) then go into the spinal cord and leave on the segment they need to exit. The ventral horn of the gray matter carries all the motor supply and the axon of lower motor neuron exits through rootlets which go to the spinal nerve through the ventral (anterior and lateral limbs) and is larger so has a dorsal root ganglia or dorsal rami (posterior muscles and skin of back and neck) and is smaller.

Both divisions typically use a preganglionic neuron and a ganglionic neuron to innervate cardiac muscle, smooth muscle or glands. They both also have autonomic ganglia that house the ganglionic neuron cell bodies.

Parasympathetic division: preganglionic cell bodies are located in either the brainstem or the lateral gray matter of the S2-S4 spinal cord segments (craniosacral division), their preganglionic axons are longer and tend to have few (less than 4) branches and the postganglionic axons are shorter, and the autonomic ganglia are either close to or within the effector.

Sympathetic division: preganglionic neuron cell bodies are located in the lateral horns of the T1-L2 spinal cord segments (thoracolumbar division), preganglionic axons are shorter and have many branches (more than 20) and the

postganglionic axons are longer and the autonomic ganglia are relatively close to the spinal cord and are on either side of the spinal cord or anterior to the spinal cord.



PARASYMPATHETIC DIVISION

The ganglionic neurons in the parasympathetic division are found in either **terminal ganglia,** which are located close to the effector, or **intramural ganglia,** which are located within the wall of the target organ.

The **cranial nerves** associated with this division are the oculomotor (CN III), facial (CN VII), glossopharyngeal (CN IX), and vagus (CN X). The first three of these nerves convey parasympathetic innervation to the head, whereas the vagus nerve is the source of parasympathetic stimulation for the thoracic and most abdominal organs.

Oculomotor nerve (CN III): is formed by axons extending from some cell bodies housed in the nuclei in the midbrain. The preganglionic axons extend from CN III to the **ciliary ganglion** within the orbit. Postganglionic axons project from this ganglion to the ciliary muscle and sphincter pupillae muscle of the iris of the eye. Parasympathetic innervation to the ciliary muscle results in lens accommodation, which makes the lens more rounded to see close up objects. The postganglionic axons that travel to the pupillary constrictor muscle result in pupil constriction when the eye is exposed to bright light.

Facial nerve (VII): contains parasympathetic preganglionic axons that exit the pons and control the production and secretion of tears, nasal secretion and saliva. Two branches of parasympathetic preganglionic axons, the greater petrosal nerve and the chorda tympani nerve, exit the facial nerve and terminate at one of two ganglia. The greater petrosal nerve terminates at the **pterygopalatine ganglion** near the junction of the maxilla and palatine bones. Postganglionic axons project to the lacrimal gland and small glands of the nasal cavity, oral cavity and palate to increase secretion by these glands. The chorda tympani nerve terminates on ganglionic neurons in the **submandibular ganglion** near the angle of the mandible. Postganglionic axons