AUTONOMIC NERVOUS SYSTEM

DR. AZZA SAJID

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Autonomic nervous system

- Autonomic nervous system (ANS) is the part of nervous system that is responsible for homeostasis. It consists of three subsystems:
  - The sympathetic nervous system.
  - The parasympathetic nervous system.
  - The enteric (ENS) nervous system.

- The ANS regulates the activities of smooth muscles, cardiac muscles, endocrine glands and exocrine glands.
These functions are regulated by brain centers in the hypothalamus and brainstem.

Some target organs are innervated by both sympathetic and parasympathetic nervous system. Others are controlled by one.

The ENS controls the activity of gastrointestinal tract.
Autonomic Nervous system
The ANS functions involuntarily (reflexively) in an automatic manner without conscious control.

The ANS operates through visceral reflexes. (e.g., response to cold).
Peripheral motor portion of ANS are made up of two neurons:

1) Periganglionic neurons  
2) Postganglionic neurons.

- The cell bodies of periganglionic neurons are located in the **intermediolateral (IML)** column of the spinal cord and **motor nuclei** of some cranial nerves.
- Periganglionic axons are small diameter myelinated, relatively slowly conducted.
- Autonomic output diffuse by diverging periganglionic axon to average 8-9 postganglionic neurons.
- Postganglionic axons are unmyelinated and terminate on the **visceral effectors**.
- Periganglionic neurons release **acetylcholine (ACh)** at their nerve terminals.
Sympathetic nervous system

- The sympathetic nervous system is called “fight or flight system” because it is most active in times of stress, fear or excitement.

- The system originates in the spinal cord as pre-ganglionic neurons, which connect with post-ganglionic neurons going to the organ they act upon.

- This prepares for physical activity by:
  - Increasing ventilation and expanding the respiratory passages.
- Increasing the cardiac output, blood pressure (so the blood is pumped faster) and blood distribution through vasoconstriction (blood to the muscles at the expense of the gut).
- Increasing the concentration of blood glucose above normal, by releasing glucose from the liver.
- Increasing sweating (to cool the body during activity)
- Inhibiting digestion.
The parasympathetic nervous system.

- The parasympathetic nervous system is called the “rest and digest system” because it is most active in times of rest and relaxation.
- Parasympathetic pathways are composed of preganglionic and postganglionic neurons.
- The perganglionic nerve fibers originate in the cranial nerve nuclei in the brainstem and in lower spinal cord.
- This system prepares for resting activities by
  - Promoting digestion, defecation and urination.
  - Slowing respiration.
  - Slowing the heart beat.
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The enteric nervous system

- This system comprises submucosal and myenteric plexuses; entirely contained within the gut wall.
- Stimulation of the myenteric plexus increases the intestinal motility by stimulation peristalsis and inhibiting contraction of sphincter muscles throughout the intestinal tract.
The ANS influences functioning of the enteric nervous system:

- The sympathetic stimulation inhibits peristalsis and increases sphincter tone, thereby inhibiting digestion.
- The parasympathetic stimulation promotes peristalsis and relaxes the sphincters, thereby enhancing digestion.
Chemical transmission

- Transmission at the synaptic junction between preganglionic and postganglionic neurons, and between postganglionic neurons and autonomic effectors are chemically mediated.

- The principle transmitter agents involved are: acetylcholine (ACh) and norepinephrine.

- The autonomic neurons that are cholinergic (release ACh) are:
  - All periganglionic neurons
  - All parasympathetic postganglionic neurons
  - Sympathetic postganglionic neurons that innervate sweat glands.
  - Sympathetic postganglionic neurons that end on blood vessels in some skeletal muscles and produce vasodilatation when stimulated.
The remaining sympathetic postganglionic neurons are noradrenergic (release norepinephrine).

Transmission in autonomic ganglia is mediated by the action of ACh on nicotinic cholinergic receptors that are blocked by hexamethonium (Nn receptors) to distinguish them from the nicotinic cholinergic receptors (Mm) located at the neuromuscular junction and blocked by D-tubocurane.
Noradrenergic neurotransmission:

- Norepineprine spreads farther and has more prolonged action than ACh.

- Norepinephrine, epinephrine and dopamine are all found in plasma.

- The epinephrine and some of dopamine come from the adrenal medulla, but most of the norepinephrine diffuses into the blood stream from sympathetic nerve endings.
**Autonomic dysfunction**

- Drugs, neurodegenerative diseases, trauma, inflammatory processes and neoplasia are factors that can lead to dysfunction of the ANS.

- The types of dysfunction may range from **complete autonomic failure** to **autonomic hyperactivity**.

- Among disorders associated with autonomic failure are orthostatic hypotension, neurogenic syncope, impotence, neurogenic bladder, gastrointestinal dysmotility and Horner's syndrome.

- Autonomic hyperactivity can be basic for neurogenic hypertension, cardiac arrhythmias, neurogenic pulmonary edema, and myocardial injury.
THANKS