At the end of the lecture, student should be able to:

• Define parasympathetic part of ANS.
• Recognise the components of parasympathetic part of N.S. (craniosacral outflow: parasympathetic cranial nerve nuclei and sacral spinal segments)
• Enlist the parasympathetic ganglia.
• Describe the pathways of pre and post ganglionic parasympathetic fibres.
• List the functions.
• Compare sympathetic and parasympathetic systems.

AUTONOMIC NERVOUS SYSTEM

• The portion of the nervous system that controls most visceral functions of the body is called the autonomic nervous system (ANS).
• Helps to control arterial pressure, gastrointestinal motility, gastrointestinal secretion, urinary bladder emptying, sweating, body temperature, and many other activities.
• Some of the above are controlled almost entirely and some only partially by the autonomic nervous system.

Divisions of the autonomic nervous system (visceral motor part of it)
Divisions of the Autonomic Nervous System

- Sympathetic and parasympathetic divisions
  - Innervate mostly the same structures
  - Cause opposite effects

DIVISIONS OF THE AUTONOMIC NERVOUS SYSTEM

- Sympathetic – “fight, flight, or fright”
  - Activated during exercise, excitement, and emergencies
- Parasympathetic – “rest and digest”
  - Concerned with conserving energy

ANATOMICAL DIFFERENCES IN SYMPATHETIC AND PARASYMPATHETIC DIVISIONS

- Arise from different regions of the CNS
  - Sympathetic – also called the thoracolumbar division
  - Parasympathetic – also called the craniosacral division
THE PARASYMPATHETIC DIVISION

- Cranial outflow (CRANIAL NERVES III, VII, IX AND X).
  - Comes from the brain
  - Innervates organs of the head, neck, thorax, and abdomen

- Sacral outflow (S1, S2, S3, S4)
  - Supplies remaining abdominal and pelvic organs
CRANIAL OUTFLOW

- Preganglionic fibers run via:
  - Oculomotor nerve (III)
  - Facial nerve (VII)
  - Glossopharyngeal nerve (IX)
  - **Vagus nerve (X)**
    (about 75% Parasympathetic nerve fibres are in vagus nerves).

- Cell bodies located in cranial nerve nuclei in the brain stem

THE PARASYMPATHETIC NERVOUS SYSTEM
**PARASYMPATHETIC NERVOUS SYSTEM; OUTFLOW VIA THE VAGUS NERVE (X)**

- Fibers innervate visceral organs of the thorax and most of the abdomen
- Stimulates - digestion, reduction in heart rate and blood pressure
- Preganglionic cell bodies
  - Located in dorsal motor nucleus in the medulla
- Ganglionic neurons
  - Confined within the walls of organs being innervated

**PARASYMPATHETIC NERVOUS SYSTEM: SACRAL OUTFLOW**

- Emerges from S₂-S₄
- Innervates organs of the pelvis and lower abdomen
- Preganglionic cell bodies
  - Located in visceral motor region of spinal gray matter
- Form splanchnic nerves

**Cranial outflow**

- III - pupils constriction
- VII - tears, nasal mucus, saliva
- IX – parotid salivary gland
- X (Vagus n) – visceral organs of thorax & abdomen:
  - Stimulates digestive glands
  - Increases motility of smooth muscle of digestive tract
  - Decreases heart rate
- Causes bronchial constriction
- **Sacral outflow (S2-4): form pelvic splanchnic nerves**
  - Supply 2nd half of large intestine
  - Supply all the pelvic (genitourinary) organs

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**Receptors**

- The parasympathetic nervous system uses chiefly **acetylcholine (ACh)** as its neurotransmitter.
- The ACh acts on two types of receptors, the **muscarinic and nicotinic cholinergic receptors**.
- Most transmissions occur in two stages:
  - When stimulated, the **preganglionic** nerve releases ACh at the ganglion, which acts on nicotinic receptors of **postganglionic** neurons.
  - The postganglionic nerve then releases ACh to stimulate the **muscarinic** receptors of the target organ.
ANATOMICAL PARASYMPATHETIC DIVISIONS

Types of muscarinic receptors

- The five main types of muscarinic receptors:
- The M1 muscarinic receptors are located in the neural system.
- The M2 muscarinic receptors are located in the heart.
- It acts to bring the heart back to normal after the actions of the sympathetic nervous system slowing down the heart rate.
- reducing contractile forces of the atrial cardiac muscle
• reducing conduction velocity of the sinoatrial node (SA node) and atrioventricular node (AV node).
• The M3 muscarinic receptors are located at endothelial cells of blood vessels, lungs causing bronchoconstriction.
• smooth muscles of the gastrointestinal tract (GIT), which help in increasing intestinal motility and dilating sphincters.
• The M3 receptors are also located in many glands that help to stimulate secretion in salivary glands.
• The M4 muscarinic receptors: Postganglionic cholinergic nerves, possible CNS effects
• The M5 muscarinic receptors: Possible effects on the CNS.
### The Autonomic Nervous System

<table>
<thead>
<tr>
<th>Structure</th>
<th>Sympathetic Stimulation</th>
<th>Parasympathetic Stimulation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Iris (eye muscle)</strong></td>
<td>Pupil dilation</td>
<td>Pupil constriction</td>
</tr>
<tr>
<td><strong>Salivary Glands</strong></td>
<td>Saliva production reduced</td>
<td>Saliva production increased</td>
</tr>
<tr>
<td><strong>Oral/Nasal Mucosa</strong></td>
<td>Mucus production reduced</td>
<td>Mucus production increased</td>
</tr>
<tr>
<td><strong>Heart</strong></td>
<td>Heart rate and force increased</td>
<td>Heart rate and force decreased</td>
</tr>
<tr>
<td><strong>Lung</strong></td>
<td>Bronchial muscle relaxed</td>
<td>Bronchial muscle contracted</td>
</tr>
<tr>
<td><strong>Stomach</strong></td>
<td>Peristalsis reduced</td>
<td>Gastric juice secreted; motility increased</td>
</tr>
<tr>
<td><strong>Small Intestine</strong></td>
<td>Motility reduced</td>
<td>Digestion increased</td>
</tr>
<tr>
<td><strong>Large Intestine</strong></td>
<td>Motility reduced</td>
<td>Secretions and motility increased</td>
</tr>
<tr>
<td><strong>Liver</strong></td>
<td>Increased conversion of glycogen to glucose</td>
<td></td>
</tr>
<tr>
<td><strong>Kidney</strong></td>
<td>Decreased urine secretion</td>
<td>Increased urine secretion</td>
</tr>
<tr>
<td><strong>Adrenal medulla</strong></td>
<td>Nor epinephrine and epinephrine secreted</td>
<td></td>
</tr>
<tr>
<td><strong>Bladder</strong></td>
<td>Wall relaxed; Sphincter closed</td>
<td>Wall contracted; Sphincter relaxed</td>
</tr>
</tbody>
</table>
Parasympathetic

- cell bodies of preganglionic fibres – brainstem (nuclei)
- and sacral region of spinal cord
- axons move through cranial nerves
- and through spinal nerves
- synapse with postganglionic fibres at ganglia near or in the target
Sensation

- **Afferent fibers** of the autonomic nervous system, transmit sensory information from the internal organs of the body back to the **central nervous system**.

- **General visceral afferent** sensations are mostly unconscious visceral motor reflex sensations from hollow organs and glands that are transmitted to the CNS.
REFERENCES

- Clinically oriented anatomy (Keith L. Moore).
- R.J. Last’s Textbook of Anatomy.
- Gray’s Student Edition of Anatomy.