Overview of the Nervous System and Its Divisions

Lecture by:

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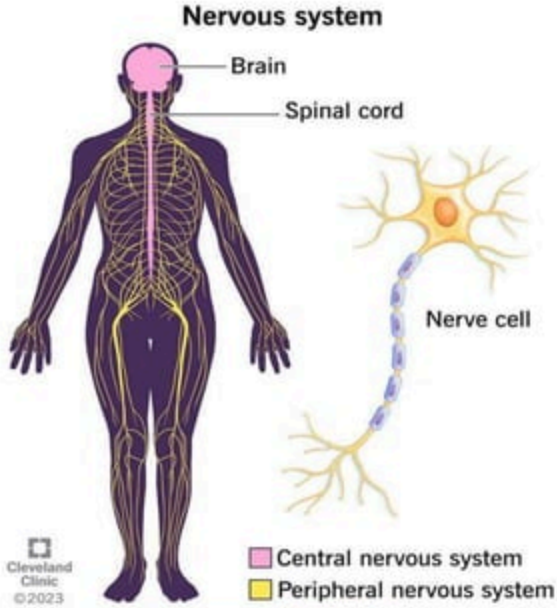
Introduction to the Nervous System:

- **Definition and function:**

The nervous system comprises the brain, spinal cord, and nerves, coordinating the body's actions by transmitting signals between different parts.

- **Function :**

It works closely with the endocrine system to regulate bodily functions.


Nervous system
Brain
Spinal cord
Nerve cell
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Central nervous system
Peripheral nervous system

- **Division:**

The nervous system is divided into the Central Nervous System (CNS) and the Peripheral Nervous System (PNS). The CNS includes the brain and spinal cord, while the PNS consists of nerves outside the CNS.

- **Further division:**

The PNS can be subdivided into the Somatic Nervous System, responsible for voluntary movements, and the Autonomic Nervous System (ANS), controlling involuntary actions.

Central Nervous System (CNS):

- **Components:**

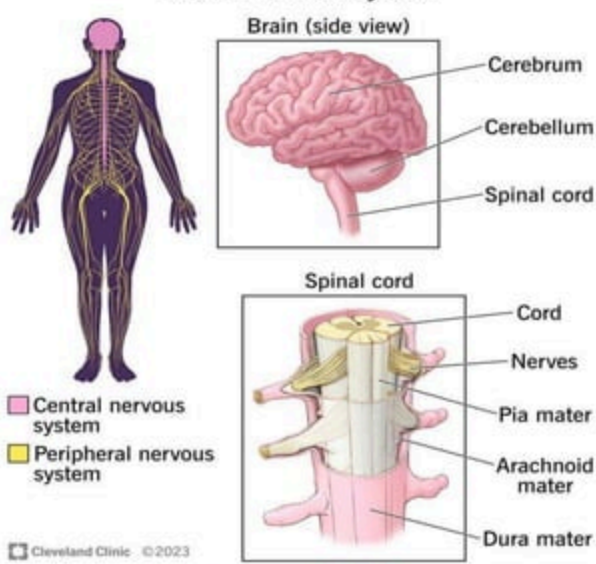
The brain and spinal cord form the CNS. The brain processes sensory information, initiates responses, and stores memories, while the spinal cord relays signals between the brain and the body.

- **Structure:**

Gray matter, composed mainly of nerve cell bodies, and white matter, comprising nerve fibers (axons). The gray matter is where processing occurs, while the white matter facilitates communication between different brain regions.

- **Protection:**

The CNS is protected by the meninges (dura mater, arachnoid mater, and pia mater) and cerebrospinal fluid, which cushion and support the brain and spinal cord.


Central nervous system
Brain (side view)
Cerebrum
Cerebellum
Spinal cord
Spinal cord
Cord
Nerves
Pia mater
Arachnoid mater
Dura mater
Central nervous system
Peripheral nervous system
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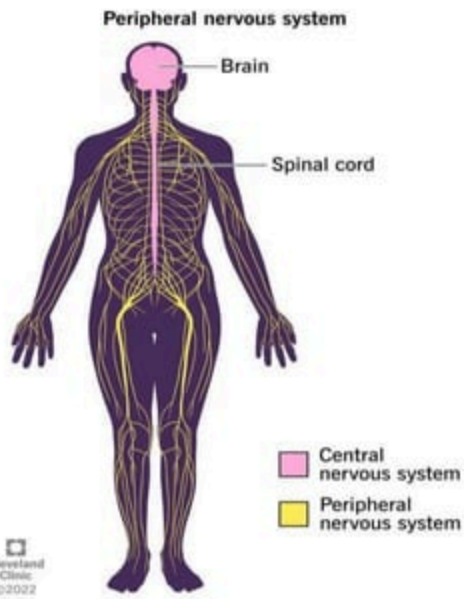
Peripheral Nervous System (PNS):

- **Components:**

The PNS consists of cranial nerves, spinal nerves, and ganglia. Cranial nerves originate from the brain, while spinal nerves arise from the spinal cord. Ganglia are clusters of neuron cell bodies outside the CNS.

- **Function:**

The PNS connects the CNS to the limbs and organs, transmitting sensory information to the CNS and carrying motor commands from the CNS to muscles and glands.


Peripheral nervous system
Brain
Spinal cord
Central nervous system
Peripheral nervous system
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Cranial Nerves:

- **Description:**

- There are 12 pairs of cranial nerves, each named and numbered, branching off the brainstem and upper spinal cord.

- **Distribution:**

- Cranial nerves innervate structures in the head and neck, with functions ranging from sensory perception (e.g., vision, taste) to motor control (e.g., facial expressions, swallowing).

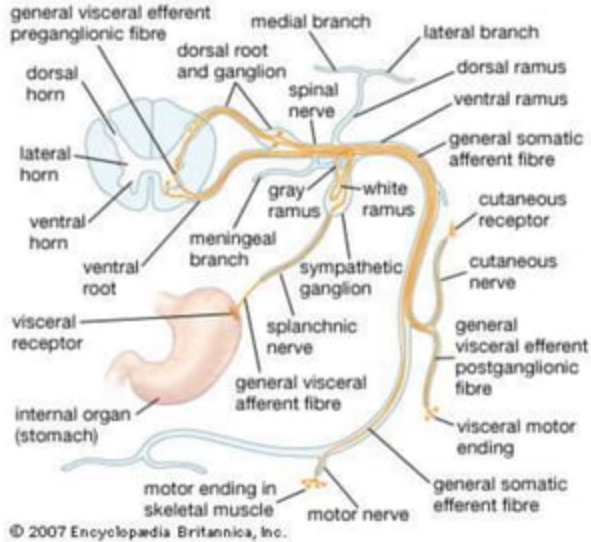
Spinal Nerves:

- **Description:**

31 pairs of spinal nerves emerge from the spinal cord and are named based on the region of the vertebral column they originate from.

- **Anatomy:**

Each spinal nerve has anterior and posterior roots, which merge to form the nerve. Anterior roots carry motor signals, while posterior roots carry sensory signals.


general visceral efferent preganglionic fibre
medial branch
lateral branch
dorsal root and ganglion
dorsal ramus
dorsal horn
spinal nerve
ventral ramus
general somatic afferent fibre
lateral horn
gray ramus
white ramus
cutaneous receptor
ventral horn
meningeal branch
sympathetic ganglion
cutaneous nerve
ventral root
visceral receptor
splanchnic nerve
general visceral efferent postganglionic fibre
general visceral afferent fibre
internal organ (stomach)
visceral motor ending
general somatic efferent fibre
motor ending in skeletal muscle
motor nerve
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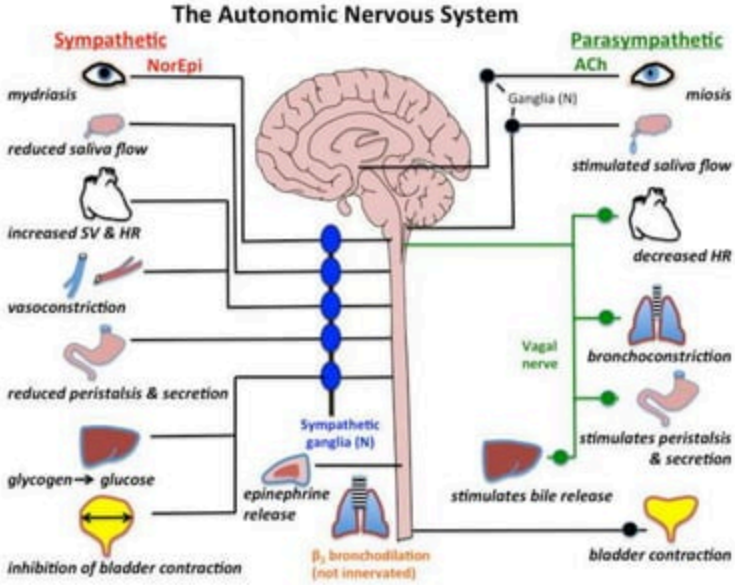
Autonomic Nervous System (ANS):

- **Description:**

The ANS regulates involuntary bodily functions, including heart rate, digestion, and respiratory rate.

- **Divisions:**

It is divided into the sympathetic and parasympathetic divisions, which often have opposing effects on physiological processes.


The Autonomic Nervous System
Sympathetic
NorEpi
mydriasis
reduced saliva flow
increased SV & HR
vasoconstriction
reduced peristalsis & secretion
glycogen → glucose
inhibition of bladder contraction
epinephrine release
Sympathetic ganglia (N)
β2 bronchodilation (not innervated)
Parasympathetic
ACh
Ganglia (N)
miosis
stimulated saliva flow
decreased HR
Vagal nerve
bronchoconstriction
stimulates peristalsis & secretion
stimulates bile release
bladder contraction

- **Anatomical differences:**

The ANS utilizes a two-neuron pathway, with a preganglionic neuron synapsing onto a postganglionic neuron, unlike the somatic nervous system, which follows a one-neuron pathway.

• Sympathetic Division:

• Description:

The sympathetic division mobilizes the body's resources in response to stress or danger, initiating the "fight or flight" response.

• Pathway:

Preganglionic neurons originate in the thoracolumbar region of the spinal cord, synapse in sympathetic ganglia, and then project to target organs.

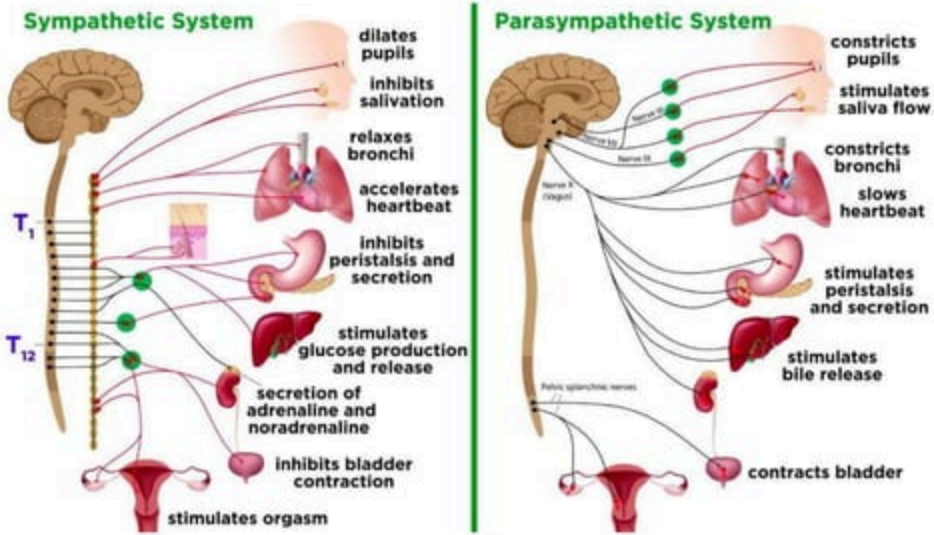
Parasympathetic Division:

- **Description**:

The parasympathetic division conserves energy and promotes restful activities, often called the "rest and digest" response.

- **Pathway:**

Preganglionic neurons originate in the brainstem and sacral spinal cord, synapse in peripheral ganglia, and then innervate target organs.


Sympathetic System
dilates pupils
inhibits salivation
relaxes bronchi
accelerates heartbeat
T1
inhibits peristalsis and secretion
T12
stimulates glucose production and release
secretion of adrenaline and noradrenaline
inhibits bladder contraction
stimulates orgasm
Parasympathetic System
constricts pupils
stimulates saliva flow
constricts bronchi
slows heartbeat
stimulates peristalsis and secretion
stimulates bile release
contracts bladder

Clinical Considerations:

- **Dermatomes:**

Areas of skin innervated by specific spinal nerves, important for diagnosing sensory deficits or neurological disorders.

- **Segmental innervation of muscles:**

Understanding which spinal nerves innervate specific muscles is crucial for assessing motor function and diagnosing nerve injuries.

- **Clinical modification of ANS activities:**

Drugs and surgeries can alter autonomic functions, such as regulating blood pressure or treating conditions like hypertension.