LECTURE 8.

Anatomy: Nervous system

Nervous System

To view the **ventral nerve cord**, examine the ventral region of the roach's body cavity (or specimen you performed the dorsal dissection on) for something that resembles a railroad track running from the head posteriorly to the abdominal region. The "railroad track" is made up of two nerve cords (**connectives**) that run longitudinally with a series of node-like **ganglia**.

The anterior most region of the ventral nerve cord is called the **subesophageal ganglion**.

Just dorsal to that structure is the insect "brain" (or **supraesophageal ganglion**).

The basic component in the nervous system is the nerve cell or neuron, composed of a cell body with two projections (fibers) the dendrites that receive stimuli and the axon that transmits information, either to another neuron or to an effector organ such as a muscle. Axon may have lateral branches called Collateral and terminal arborization and synapse. Insect neurons release a variety of chemicals at synapses either to stimulate or to inhibit effector neurons or muscles. Acetylcholine and catecholamines such as dopamine are the important neurotransmitters involved in the impulse conduction. Neurons are of following types based on structure and function.

A. On structural basis

i. Monopolar: neuron with a single axon

ii. Bipolar: neuron with a proximal axon and a long distal dendrite.

iii. Multipolar: neuron with a proximal axon and many distal dendrites.

B. Functional basis

i. Sensory neuron: It conducts impulse from sense organs to central nervous system
(CNS).
ii. Motor neuron: It conducts impulse from CNS to effector organs
iii. Inter neuron (association neuron): It inter-links sensory and motor neurons.
The cell bodies of inter neurons and motor neurons are aggregated with the fibers
inter connecting all types of nerve cells to form nerve centers called **ganglia.**
Mechanism of impulse conduction: Impulses are conducted by the neurons by two
means.
Axonic conduction: Ionic composition varies between inside and outside of axon
resulting in excitable conditions, which leads to impulse conduction as electrical
response.
Synaptic conduction: Neurochemical transmitters are involved in the impulse
conduction through the synaptic gap. Neurotransmitters and the type of reactions helping
in the impulse conduction are as follows.
Nervous system can be divided in to three major sub-systems as
i. Central nervous system (CNS)
ii. Visceral nervous system (VNS)
iii. Peripheral nervous system (PNS)
i. Central nervous system: It contains double series of nerve centers (ganglia). These
ganglia are connected by longitudinal tracts of nerve fibers called **connectives** and
transverse tracts of nerve fibers called **commissures**. Central nervous system includes the
following.
a. **Brain**: Formed by the fusion of first three cephalic neuromeres.
Protocerebrum: Large, innervate compound eyes and ocelli.
Deutocerebrum: Found beneath protocerebrum, innervate antennae.

Tritocerebrum: Bilobed, innervate labrum.
Brain is the main sensory centre controlling insect behaviour.
b. **Ventral nerve cord**: Median chain of segmental ganglia beneath oesophagus.
c. **Sub esophageal ganglia**: Formed by the last three cephalic neuromeres which
innervate mandible, maxillae and labium.
d. **Thoracic ganglia**: Three pairs found in the respective thoracic segments, largest
ganglia, innervate legs and muscles.
e. **Abdominal ganglia**: Maximum eight pairs will present and number varies due to
fusion of ganglia. Innervate spiracles.
f. **Thoraco abdominal ganglia** : Thoracic and abdominal ganglia are fused to form a
single compound ganglia. Innervate genital organs and cerci.
ii. Visceral nervous system: The visceral (sympathetic) nervous system consists of three
separate systems as follows: (1) the stomodeal/stomatogastric which includes the frontal
ganglion and associated with the brain, aorta and foregut; (2) Ventral visceral, associated
with the ventral nerve cord; and (3) Caudal visceral, associated with the posterior
segments of abdomen. Together the nerves and
Acetylase
Acetyl CO-A + Choline chloride Acetyl choline
Acetyl Choline Esterase
Acetyl choline Choline + Acetic acid
ganglia of these subsystems innervate the anterior and posterior gut, several endocrine
organs (Corpora cardiaca and Corpora allata), the reproductive organs, and the tracheal
system including the spiracles.
iii. Peripheral nervous system: The peripheral nervous system consists of all the motor
neuron axons that radiate to the muscles from the ganglia of the CNS and

visceral
nervous system plus the sensory neurons of the cuticular sensory structures (the sense
organs) that receive mechanical, chemical, thermal or visual stimuli from an
environment.

Sources

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