

Neural control and coordination

Coordination is the process through which two or more organs interact and complement the functions of one another. All the organs must work in synchronised fashion under neural & endocrine system.

Neural system provides point to point connections for a quick coordination.

NEURAL SYSTEM

It is composed of neurons which can detect, receive & transmit different kinds of stimuli. In hydra it is composed of a network of neurons in insects a brain is present along with a no. Of ganglia & neural tissues.

CENTRAL NERVOUS SYSTEM

Brain & spinal cord which involve information processing and control.

PERIPHERAL NERVOUS SYSTEM

Nerves of body associated with CNS i.e. afferent fibres (tissue to CNS) and efferent fibres (CNS to tissue).

Visceral nervous system

Include complexes of nerve fibres ganglia or plexus relating with viscera & CNS.

Somatic nervous system

Relays impulse from CNS to skeletal muscle

Autonomous nervous system

Transmits impulse from CNS to the involuntary organs & smooth muscles

Sympathetic nerve fibres

Parasympathetic nerve fibres

They work antagonist

NEURON

- > Structural and functional unit of neural system
- > composed of 3 parts - cell body, dendrites, axon. Dendrites contain nissli granules (modification of endoplasmic reticulum).
- > each branch of axon terminates into synaptic knob (bulb like) which possess synaptic vesicles containing neurotransmitter.

They can be of 3 types on the basis of no. Of dendrites:- MULTIPOLAR (1 axon + many dendrites & found in cerebral cortex) or BIPOLAR (1axon + 1 dendrite and found in retina of eye) or UNIPOLAR (only axon and found in embryonic stage.

Neuron can be of 2 types on the basis of presence or absence of myelin sheath. MYELINATED:- enveloped by shwann cells which produce myelin sheath. They are found in spinal and cranial nerves. They transfer the signal more faster.

NON-MYELINATED:- enveloped by shwann cells which do not produce myelin sheath. They are found in autonomous and somatic neural system.

Gaps b/w two adjacent myelin sheath is known as node of ranvier.

GENERATION AND CONDUCTION OF NERVE IMPULSE

Their membranes are in a polarised state. The ion channels are selectively permeable to diff. ions. When the neuron is resting the axonemal memb. is more permeable to K^+ & impermeable to Na^+ . Hence the membrane is impermeable to negative charged proteins present in axoplasm. The axon contains more K^+ conc. & -vely charged proteins & less Na^+ conc. The fluid outside contain less K^+ & more Na^+ . Hence a conc. Gradient is formed which is maintained by active pump which transports $3Na^+$ outward & $2K^+$ inward. Hence outer membrane becomes +ve and inner -ve. The electric potential difference across the resting plasma memb. is known as resting potential. When a stimulus is applied the membrane becomes freely permeable to Na^+ hence polarity is reversed. Hence the membrane gets depolarised & electric potential difference at that site is called action potential which is termed as a nerve impulse at the inner site the impulse flows from A to B. i.e. from + to - and from outer side B to A i.e. from + to -.

Transmission of impulse

A synapse is formed by the membranes of a presynaptic neuron & a postsynaptic neuron which may or may not be separated by a gap called synaptic cleft.

Synapse is of two types

ELECTRICAL SYNAPSE

- > the synaptic cleft is very small
- > directly can flow from 1 neuron into the other across this synapse
- > it is so similar to impulse conduction in axon
- > it is faster than chemical synapse
- > they are rare in our system

CHEMICAL SYNAPSE

- > pre & post synaptic neurons are separated by fluid filled space called synaptic cleft.
- > neurotransmitter are used
- > telodendron contain vesicle filled with neurotransmitter
- > during the passage of impulse vesicle fuse with the memb. and release the chemicals in cleft. The chemicals bind to their specific receptors this opens ion channels which generate new potential in postsynaptic neuron. The new potential generated may be excitatory or inhibitory.

CENTRAL NERVOUS SYSTEM

Brain act as command and control system. The human is well protected by skull, cranial meninges (duramater, arachnoid and piamater)

Forebrain

Consist of cerebrum, thalamus & hypothalamus a deep cleft divides cerebrum into 2 cerebral hemispheres which are interconnected by tract of nerve fibres called corpus callosum. Cerebral cortex are thrown in prominent folds & referred as grey matter because of conc. Of neuron. Cerebral cortex contain motor and sensory areas and largely areas which have neither function which are known as association areas. They are responsible for inter sensory association, memory and communication. Fibres of tract are covered with the myelin sheath. Which constitute the inner part of cerebral hemisphere they give an opaque white appearance to the layer (white matter)

The cerebrum wraps around a structure called thalamus, which is major coordinating centre for sensory & motor signalling. The hypothalamus contains a no. Of centres for thermoregulation, urge for drinking & eating. It have some neurosecretory cells which secrete hypothalamic hormones. Inner parts of cerebral hemispheres consist of associated deep structure like amygdala, hippocampus form limbic system/limbic lobe along with hypothalamus it is involved in regulating sexual behaviour, expression of emotional reactions. (Eg-excitement, pleasure, rage & fear) and motivation.

Midbrain

Located b/w thalamus/ hypothalamus of forebrain & pons of hind brain. A canal called cerebral aqueduct passes through midbrain. It's dorsal portion consist of 4 round swollen (lobes) called corpora quadrigemina

Brain stem = mid brain + hind brain except cerebellum. Brain stem connects brain to spinal cord.

Hindbrain

PONS- consist of fibre tracts that interconnect different regions of brain.

CEREBELLUM- has very convoluted surface in order to provide additional space for many neurons.

MEDULLA- connected to spinal cord, control respiration, cardiovascular reflexes, gastric secretions.

REFLEX ACTION & REFLEX ARC

The entire process of response to a conscious effort or thought and requires involvement or a part of the CNS is called a reflex action.

Reflex arc:-



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SENSE ORGAN

NOSE:- mucous coated olfactory receptors (made of olfactory epithelium consist of 3 cells). Neurons from surrounding comes to bean sized organ called olfactory bulb (limbic system). Nose & tongue detect dissolved chemical. Gustation and olfactory functions similarly & interrelated. In tongue we have taste buds in which gustatory receptors are present.

EYE!

- > located in sockets of skull (orbits)
 - > eye ball is spherical in structure which is composed of 3 layers.
 - > external layer is sclera (composed of dense connective tissue. Its anterior portion is called the cornea
 - > middle layer/choroid- bluish in colour (contain many blood vessels) it is thin over the posterior 2/3rd of the eye ball but it becomes thick in anterior part to form ciliary body. Ciliary body continues forward to form a pigmented opaque structure called iris (visible coloured portion of eye).
 - > crystalline lens is held by ligaments attached to ciliary body. Pupil is surrounded by iris whose diameter is regulated by the muscle fibres of iris.
 - > inner layer/retina- contains 3 layers of nerve cell. Outer photoreceptor cells, middle bipolar cells, inner ganglion cells. Photoreceptor cells light sensitive proteins called photopigments.
- RODS**:- twilight/scotopic vision, contain rhodopsin (purplish-red protein) its also called visual purple and is a derivative of Vit A
- CONES**:- daylight (photopic) & coloured vision. They are of three types which responds to red, green & blue light. (If stimulated equally then sensation of white light is produced)
- Optic nerve leave & retinal b.v. enter it at a point (slightly above the posterior pole of eyeball) where photoreceptor cells are not present i.e. called as blind spot.
- Lateral to blind spot a yellow spot is present with greatest visual acuity (resolution) due to dense packing of cones. That point is known as maculae lutea with central pit called fovea.

MECHANISM OF VISION:-

Light generate potential in rods & cones → photopigments composed of opsin & retinal (aldehyde of vit A) → dissociation of retinal and change in structure of opsin → membrane permeability changes & p.d. generated in rods & cones. → action carried in ganglion cells through bipolar cells → via optic nerve it travels to visual cortex of brain and nerve impulses are analysed & image is formed on retina which is recognised based on earlier memory.

EAR! 💡

Outer ear

- > pinna + external auditory meatus (canal)
- > pinna collect sound vibrations.
- > meatus Leads vibration upto tympanic membrane (eardrum)
- > various hairs, wax secreting substance/ glands are present.
- > tympanic membrane = connective tissue + skin outside + mucous membrane inside.

Middle ear

- Consist of ear ossicles (malleus incus and stapes) arranged in chain like fashion.
- > vibration from eardrum
 - > malleus -> incus -> stapes -> oval window of cochlea.
- Ear ossicles increase efficiency of transmission of sound waves.
- Eustachian tube connects middle ear to pharynx which equalises pressure on either side of ear drum.

Inner ear

- Fluid filled inner ear called labyrinth (bony labyrinth- series of channels & membranous labyrinth- present in that channels)
- > membranous labyrinth is filled with fluid called endolymph and is surrounded by fluid called perilymph. Coiled portion of membranous labyrinth is called cochlea.
 - > cochlea constitutes 2 membranes (reissners and basilar) which divide bony labyrinth (surrounding perilymph filled) into upper scala vestibuli & lower scala tympani.
 - Space within cochlea is known as scala media & filled with endolymph.
 - > at the base of cochlea the scala vestibuli ends at the oval window, while scala tympani terminates at round window which opens to the middle ear.

Organ of corti is present on basilar membrane which contain hair cells that act as auditory receptors and are present in rows on the internal side of organ of corti.

Basal end of hair cell is in contact with the afferent nerve fibres & stereocilia are present at its apical part.

Above hair cells, then elastic membrane called tectorial membrane is present.

VESTIBULAR APPARATUS:- present above cochlea & is composed of 3 semicircular canal & otolith (macula is the sensory part of saccule & utricle)

Each semi circular canal lies in a different plane perpendicular to each other. The membranous canals are suspended in the perilymph of the bony canals. The base of canals is swollen and called ampulla which contains a projecting ridge called crista ampullaris which has hair cells. The saccule & utricle contain a projecting ridge called macula (crista & macula are specific receptors of vestibular apparatus responsible for body balance and posture maintenance).

MECHANISM OF HEARING:-

Eardrum vibrates due to sound vibration → vibration is sent to oval window via ossicles → vibrations are passed in fluid of cochlea which generate waves in lymph. → this induce ripple in basilar membrane → basilar membrane bend hair cells pressing them against tectorial membrane → nerve impulse is generated in afferent fibres which travel to auditory cortex in brain via auditory nerves → and thus sound is recognised.

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