

Nervous System

Reflexes

1. Describe the reflex arc

Consists of a sense organ, an afferent neuron, one or more synapses and efferent neuron and an effector.

Activity starts in a sensory receptor with a receptor potential whose magnitude is proportionate to the stimulus. This generates “all-or-none” action potentials in the afferent nerve. The afferent neuron enters the CNS via the dorsal root and the cell body is in the dorsal root ganglia. The efferent fibres leave via the ventral root or corresponding cranial nerve and land on the effector. The effector can be skeletal muscle and responses received summate to produce an action potential that brings about contraction of the muscle.

2. What is the stretch reflex?

When skeletal muscle is stretched, this is a stimulus that is detected by the muscle spindle and travels to the CNS via fast sensory fibres that pass directly to motor neurons which supply the same muscle to cause contraction. The neurotransmitter is glutamate.

3. What is the withdrawal reflex?

The withdrawal reflex is a polysynaptic reflex that occurs in response to a noxious and usually painful stimulus. The response is flexor muscle contraction and inhibition of extensor muscles causing withdrawal. With a strong stimulus, there is also extension of the opposite limb called the “crossed extensor response”.

Cutaneous, Deep and Visceral Sensation

1. What is referred pain?

Irritation of a viscus frequently produces pain that is felt not in the viscus, but in some somatic structure that may be a considerable distance away. When pain is referred it is usually to a structure that developed from the same embryonic segment or dermatome as the structure in which the pain originates. Eg. the diaphragm migrates from the neck region to its adult location between the chest and abdomen and takes its nerve supply, the phrenic nerve, with it. One third of the phrenic nerve fibres are afferent and they enter the spinal cord at the level of the second to fourth cervical segments, the same location at which afferents from the tip of the shoulder enter. Similarly the heart and the arm have the same segmental origin and the testicle has migrated with its nerve supply from the primitive urogenital ridge from which the kidney and ureter have developed.

Vision

1. What is the “near response”

It is a three part response – accommodation, convergence of the visual axes and pupillary constriction.

2. Describe the pupillary light reflex

When light is directed into one eye, the pupil constricts (pupillary light reflex) and the pupil of the other eye constricts (consensual light reflex). The optic nerve fibres that carry the impulses leave the optic nerve near the lateral geniculate bodies. On each side, they enter the midbrain via the brachium of the superior colliculus and terminate in the pretectal nucleus. From this nucleus, the second order neurons project to the ipsilateral and contralateral Edinger-Westphal nuclei. The third order neurons pass from these nuclei to the ciliary ganglion in the oculomotor nerve and the fourth order neurons pass from this ganglion to the ciliary body. This pathway is dorsal to the pathway for the near response. Consequently, the light response is sometimes lost while the response to accommodation remains intact (Argyll Robertson pupil) which occurs in syphilis and other selective mid brain lesions.

Autonomic nervous system

1. Describe the distribution of the peripheral sympathetic nervous system

The axons of the sympathetic preganglionic neurons leave the spinal cord with the ventral roots of the first thoracic to the third or fourth lumbar spinal nerves. They pass via the white rami communicantes to the paravertebral sympathetic ganglion chain where most of them end on the cell bodies of the post ganglionic neurons. The axons of some of the post ganglionic neurons pass to the viscera in the various sympathetic nerves. Others re enter the spinal nerves via the grey rami communicantes from the chain ganglia and are distributed to autonomic effectors in the areas supplied by these spinal nerves.

2. Describe the parasympathetic nervous system

There is cranial outflow and sacral outflow. The cranial outflow supplies the visceral structures in the head via the oculomotor, facial and glossopharyngeal nerves and those in the thorax and upper abdomen via the vagus nerves. The sacral outflow supplies the pelvic viscera via the pelvic branches of the second to fourth sacral spinal nerves. The preganglionic fibres in both outflows end on short post ganglionic neurons located on or near the visceral structures.

3. What are the chemical mediators used?

Acetylcholine and noradrenaline with a bit of dopamine in some sympathetic interneurons and GnRH in some preganglionic neurons. Cholinergic neurons are all preganglionic neurons, parasympathetic postganglionic neurons and sympathetic post ganglionic neurons that go to sweat glands and blood vessels in skeletal muscles. The rest are noradrenergic. The adrenal medulla is essentially a sympathetic ganglion in which the post ganglionic cells have lost their axons and secrete noradrenaline, adrenaline and some dopamine directly into the bloodstream.