

The nervous system •

The nervous system divided into: 1- central nervous system (C.N.S.): A-Brain: it •
consists of Fore-brain :Which consists of cerebrum and diencephalon(consist of
thalamus&hypothalamus).Mid-brain .Hind-brain including pons, medulla
oblongata and cerebellum. B-spinal cord

2- peripheral nervous system (P.N.S.): A-cranial nerves. B-Spinal •
nerves. Spinal cord: It is a cylindrical structure, present in the
spinal(vertebral)canal.

A-Brain •

B-spinal cord •

The spinal cord occupies 2/3 of the vertebral column length. It starts at the level of •
foramen magnum and end at the vertebral level of L1 – L2 in adult While in children
at level of L2-L3 .Below this level, the spinal cord tapers forming what is called conus
medullaris.

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B-spinal cord •

At the tip of conus medullaris, Filum terminalis which is a pia matter. The filum •
terminalis extend from the tip of conus medullaris, descending downward to be
attached to the back of the coccyx through sacral hiatus. Its length is about 20 cm ,
its upper 3/4 is surrounded by dura and arachnoid matter , while the lower
remaining 5 cm is surrounded by dura matter only .The spinal cord is surrounded by
the same three layers of meninges ,as that of brain ,with the subarachnoid space
filling with C.S.F., till sacral two.

B-spinal cord •

Along the whole length of the spinal cord ,central canal is present and is filled with •
the C.S.F. The spinal cord is considered as the passage of many bundles of nerve
fibers .These nerve bundles calls tract .

These tract are of two types:- •

1- Ascending tracts :- •

These tracts convey information from the external environments to the higher •
centers of C.N.S.

2- Descending These tracts transmit the orders of the higher center in the brain to •
the peripheral targets

The peripheral nervous system •

The peripheral nervous system :- •

The peripheral nervous system (P.N.S) is responsible for the interaction between the C.N.S. and the external system (targets) (Richard,2010)..

Anatomically , the peripheral nerves could be classify into:-

1- somatic nerves :-

a- cranial nerves :-

The peripheral nervous system

a- cranial nerves :-

These nerves are twelve pairs of nerves, represented the processes (axons or dendrites) of the nerve cell (neuron) which are present in a form of collection called nuclei that are embedded in the brain substance. These nerves emerge from the skull through multiple foramina in the skull.

The peripheral nervous system

b- Spinal nerves :-

These are thirty one pairs of spinal nerve categorized as the following :-

Eight pairs are cervical spinal nerves.

Twelve pairs are thoracic spinal nerves.

Five pairs are lumbar spinal nerves.

Five pairs are sacral spinal nerves.

One pair coccygeal spinal nerves.

b- Spinal nerves

The spinal nerves are the process of the neurons which are located in the gray matter, of the spinal cord. These neurons are situated in the ventral and dorsal horn of the spinal cord ,The ventral horns neurons give the ventral root ,while the dorsal root arises from the dorsal horns neurons. The ventral horn considers functionally to be motor in function .Yet the dorsal root is responsible for conduction of the sensory responses to the dorsal horn of the spinal cord. The dorsal root ganglion ,that located nearby its origin is formed by cluster of sensory neurons

2-Autonomic nervous system:

2-Autonomic nervous system:- This system is classified as :-

a-sympathetic nervous system.

b-Parasympathetic nervous system Both components includes afferent and efferent visceral fibers besides parasympathetic and sympathetic, autonomic ganglia ..

2-Autonomic nervous system •

The autonomic nerve fibers arise from the intermediate lateral horn of the spinal cord, regarding in consideration that sympathetic nerve fibers arise from thoracolumbar region while parasympathetic nerve fibers originate from the brain and sacral segments of spinal cord

2-Autonomic nervous system •

The neuron of the autonomic nervous system ,that is located in the gray matter, of the spinal cord is considered to be as 1st presynaptic (preganglionic) neurons. While the 2nd order neurons are located outside, the spinal cord in a form of clusters of nerve cells called autonomic ganglia. The location of the autonomic ganglia differ according to the type of autonomic nervous system. The sympathetic division of the autonomic nervous system arise from thoracolumbar area of the spinal cord specifically from the 1st thoracic spinal segments till the 2nd or 3rd lumbar spinal segment .Their 1st order neurons arise from the lateral horn of the spinal cord .Their 2nd order neurons ,which are located within the autonomic ganglia are located along the sides of the spinal cord (pre and para vertebral ganglia).

2-Autonomic nervous system •

The neuronal process of the 1st order neuron called pre synaptic fibers ,which in turn relay and synapse with the 2nd order neuron within autonomic ganglia . Therefore the presynaptic nerve fibers of the sympathetic system are short .The neuronal extension of the 2nd order neuron are called postsynaptic nerve fibers.They are long in length. These postsynaptic nerve fibers are transmitted the nerve orders to the targets(organs). Here the neurotransmitter is noradrenaline in general(except in case of sweat gland).The whole part of the body are involved by the distribution of the sympathetic component of the autonomic nervous tissue.

2-Autonomic nervous system •

The parasympathetic component arise mainly from the brain and the sacral segments of the spinal cord ,Regarding 1st order neuron ,that originated from the brain is mainly emerge in 3rd cranial nerve nucleus ,superior and Inferior salivatory nuclei of the nervous intermedus , 9th and 10th cranial nerve nuclei.

The spinal part of parasympathetic nervous component includes its 1st order neurons originate at 2nd, 3rd, and/or 4th sacral spinal segment which involve in the formations of the inferior hypogastric plexus.

The characteristic features of the 2nd order neuron of this component of autonomic nervous system (autonomic ganglia) is that the position of these ganglia are located

near by their targets. In another word, the localization of these ganglia make the pre synaptic nerve fibers are longer than post synaptic fibers(Sinnatamby,2011).

The viscera of the body are the only parts that innervated by the parasympathetic component. The neurotransmitter of the para sympathetic component is acetylcholine

spinal nerves •

The formation of the spinal nerves could summarized as follows: •

The peripheral nerves could be defined as a bundle of neuronal extension (axons and / or dendrites) of neurons situated in the gray matter of spinal cord. Each spinal nerve is originated from each spinal segment as two roots, ventral and dorsal roots(Richard *et al*,2008;Keith and Arthur,2005).

The dorsal root has its neuron in the dorsal horn of the spinal cord. The nerve fibers of the dorsal root represent the dendrites of the spinal neurons. To be more precise in the description , the nerve fiber of the dorsal root represents the sensory component of the spinal nerves that

convey the information from the body to the C.N.S. •

spinal nerves •

At the end of the course of the dorsal root, there is cluster of neurons called dorsal root ganglion(Richard *et al*,2008;Keith and Arthur,2005).

The ventral root represents, the cytoplasmic extension of the neurons in the spinal ventral horn . Usually the ventral root involve the motor part of the spinal nerve. To be more specific, it is formed of axons of the ventral horn neurons. It is responsible for transmission of orders from C.N.S to the peripheral organs (targets),Ventral and dorsal roots united together forming spinal nerves. which exists through intervertebral foramina(Figure 2-1) .

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spinal nerves •

Outside the vertebral column, the spinal nerves. , now consists of a mixture of sensory and motor somatic nerve fibers. The spinal nerve then divided into small posterior ramus and large anterior ramus. These two rami, now will be distributed to innervate the whole body by motor and sensory sensations

spinal nerves •

These nervous distribution could be either done through single spinal nerve which emerges from vertebral column to various parts of the body or through formation of plexuses .There are two main plexuses in the body ,brachial plexus and lumbosacral

plexus. For this reason there are spinal expansion at the cervical and lumbar regions respectively .

In all vertebrates ,these plexuses are composed of multiple spinal nerves. However these spinal nerves represented only by anterior rami only. In another word the posterior rami of spinal nerves do not share in the formation of these plexuses. The nerves arise from brachial plexus are responsible for the motor and sensory innervations of the upper limb. On the other hand ,the lumbosacral plexus is responsible to the

spinal nerves •

innervations of the lower limb. The targets(effectors) involved by innervations of these plexuses include the muscles ,skin , joints and bones. The largest and longest nerve in the body is sciatic nerve which is the biggest branch originates from the lumbosacral plexus,

Generally the constituents of these nervous plexuses undergo division into anterior and posterior division(Richard,2010) .

The limbs could be marked randomly into anterior and posterior compartments by the superficial veins . The neural supplement of the anterior compartment usually obtains by the anterior neural division of these plexuses ,while the posterior compartment of the limbs are usually supplied by the posterior division of the plexuses (Richard,2010).

The single spinal segmental nerve usually supplied limited area of the skin . This limited area of the skin called dermatome. While muscle mass that is supplied by single spinal segmental nerve is called myotome.

spinal nerves •

The anterior rami of the spinal nerves is larger than the posterior one. This could be attributed to the fact that the flexor mass of body (including muscles and skin) , which is usually occupies the anterior aspect of the body that is located in front of the posterior axillary line, usually constitutes the larger and bigger mass of the body in comparison with that of the extensor (posterior) compartment. The extensor compartment is usually supplied by the posterior rami division of the spinal nerve which is smaller than that of anterior one

spinal nerves •

From the previous information, one can conclude a fact that the flexor compartment is richer in innervations and this lets its muscles are quicker in response, action and functioning are controlled more precisely by voluntary orders. Besides, it permits the flexor muscles, mainly distal area's muscles, to perform delicate and fine movements.

In addition, the richer skin innervations of the flexor (anterior compartment) makes the skin of this area more sensitive to any stimuli (whatever it's type) than that of the extensor (dorsal compartment skin) •