NEUROANATOMY

1. What are Upper Motor Neurons (UMN)?

UMN are known as 1st order neurons that have their cell bodies either in the motor region of the cerebral cortex or in the brain stem. They carry motor information down to the lower motor neurons. Axons of UMNs do not project out into the PNS (aka skeletal muscles).

2. What are Lower Motor Neurons (LMN)?

LMN are known as 2nd order neurons. Cell bodies of LMNs of cranial N are located in the brainstem, while cell bodies of LMNs of spinal N are located in the anterior/ventral horn of the spinal cord. Cell bodies of LMN are located in the CNS, but their axons project out into the PNS to target the skeletal muscles that they innervate.

3. What is a motor unit?

A motor unit is made up of a motor neuron and all the skeletal muscle fibers innervated by that motor neuron.

4. What is a Neuromuscular Junction (NMJ)?

An NMJ is a synapse or a junction between an axon terminal of a motor neuron and muscle fibres.

5. What are the differences between sensory and motor neurons?

Sensory (afferent) neurons send signals from the senses, skin, muscles and internal organs to the motor neurons. Cell bodies of sensory neurons are located in the dorsal root ganglia. Motor (efferent) neurons transmit commands from the CNS to the muscles, glands and organs. Cell bodies of motor neurons are located in the motor cortex, brainstem and ventral horn of spinal cord.

6. Explain the concept of dermatomes and myotomes.

A dermatome is an area of skin that is innervated by a single spinal nerve. A myotome is the group of muscles that a single spinal nerve innervates.

7. What is a mixed spinal nerve? How many pairs of spinal nerves are there?

A mixed spinal nerve carries motor, sensory and autonomic signals between the spinal cord and the body. There are 31 pairs of spinal nerves – 8 cranial, 12 thoracic, 5 lumbar, 5 sacral, 1 coccygeal.

8. What is a peripheral nerve? List some examples.

A peripheral N often comprises of multiple spinal nerves. Phrenic N (C3, C4, C5) innervates the diaphragm, Radial N (C5-C8, T1), Median N (C5-C8, T1) and Ulnar N (C8, T1).

9. What are the different types of nerve plexuses?

Cervical, Brachial (C5-C8, T1), Lumbosacral (T12-S5). The Brachial plexus innervates the upper limbs, while the lumbosacral plexus innervates the lower limbs.

10. What is are the similarities/ differences between somatic and autonomic nervous system?

The somatic and autonomic nervous systems are part of the peripheral nervous system. The somatic NS is associated with voluntary control of body movements via skeletal muscles, while the autonomic nervous system is associated with involuntary control, such as breathing, the heartbeat and digestive processes. The visceral efferent segment of the somatic NS is composed of chains of 2 motor neurons – pre-ganglionic and post-ganglionic neurons. Their cell bodies are located in the lat horn of the spinal cord. The visceral efferent segment of the autonomic NS is composed of 1 motor neuron projecting from the ant horn of the spinal cord.

11. What is the Autonomic Nervous System?

It is an effector system in the CNS and PNS mediating unconscious homeostatic control of organ and body physiology. There are 2 main divisions: sympathetic and parasympathetic outflow. The sympathetic ganglion is located close to the spinal cord and far from the viscera, while the parasympathetic ganglion is located far from the spinal cord close to the viscera.

12. List all the cranial nerves.

Olfactory, Optic, Oculomotor, Trochlear, Trigeminal, Abducens, Facial, Vestibulocochlear, Glossopharyngeal, Vagus, Accessory spinal N, Hypoglossal N.

13. What are the key features of the brain?

The brain is made up of 4 lobes – Frontal, Parietal, Occipital and Temporal lobes. The central sulcus separates the frontal and parietal lobes. The pre-central gyrus (pri somatomotor cortex) is located ant to the central sulcus, while the post-central gyrus (pri somatosensory cortex) is located post to the central sulcus. UMNs are situated within the pre-central gyrus. Ant to the pre-central gyrus is the pre-motor cortex.

14. Why are the cervical and lumbar spinal cord segments larger than the thoracic spinal cord?
Tissues that need an increased motor control will have a greater number of motor neurons, hence this explains the differing size of spinal cord segments. The cervical enlargement corresponds with the attachments of the large nerves which supply the upper limbs. The lumbar enlargement is a widened area of the spinal cord that gives attachment to nerves which supply the lower limbs.

15. What are the features of the spinal cord?
The spinal cord occupies only the upper 2/3 of the vertebral column. The caudal tip of the spinal cord ends at around L2 and is known as the conus medullaris. The cauda equina is composed of nerve fibres from L2 to Co1 that stay within the vertebral column, but exit through their respective IV foramen. The cauda equina is contained inside the dural sac, and so are bathed in CSF. Within the cauda equina is the filum terminale, which is a delicate strand of fibrous tissue extending inf from the conus medullaris to the coccygeal bone. It is one of the modifications of pia mater.

16. What is the hierarchical organisation of motor cortices?
Motor command is planned and initiated in the prefrontal cortex, transferred to sec motor cortices (Supplementary motor cortex and premotor cortex) and exits the brain via the pri motor cortex. The SMC and PMC contribute to learning sequence of movements, store skills, sensory integration and bilateral coordination.

17. What are the different types of motor pathway lesions?
Lesion to UMN or the pri motor cortex causes spastic paralysis, which results in stiff limbs. Involuntary muscle contractions may be elicited by reflexes or irritation of nervous tissue. Lesion to LMN (in the spinal cord/ anterior root/ nerve) causes flaccid paralysis, which results in a reduced muscle strength due to the blockage of motor output. Lesion to the premotor cortex/ supplementary motor area/ other movement planning areas causes apraxia, which is the inability to learn.

18. What is the Corticospinal tract?
It is the pathway which the axons of the UMN takes in order to synapse with the LMN. The axons of the UMN originate from the grey matter of the cerebral cortex, travel through the white matter of the brain, pass through the brainstem (midbrain, pons and medulla), travels to the opposite side of the medulla and goes down that side of the spinal cord before synapsing onto the LMN.

19. What percentage of the UMN cross to the contralateral side of the nervous system.
100% of UMN cross to the contralateral side of the nervous system. 80% of UMN take the lat corticospinal tract while 20% of UMN take the ant corticospinal tract.

20. Name the 2 main motor descending pyramidal tracts. How are they different?
The 2 main descending pyramidal tracts are the pyramidal system and the extrapyramidal system. The pyramidal system is composed of the lat and ant corticospinal tracts. It is responsible for voluntary movement. The extrapyramidal tract is composed of rubrospinal, vestibulospinal, reticulospinal and tectospinal tracts. It is responsible for the coordination of movement and control posture and muscle tone.

21. What are the tracts of the extrapyramidal system?
The rubrospinal tract originates in the red nucleus of the midbrain, travels through the lat (cervical) funiculus and extend to the spinal cord. It is responsible for upper limb control. The reticulospinal tract fibres originate in the medulla and pons reticular formation and descend the length of the spinal cord through the lat (medulla) and ant (pons) funiculus. This pathway coordinates autonomic movements and posture. The vestibulospinal tract is a group of efferent fibres found in the ant funiculus. The vestibulospinal tract originates in the vestibular nuclei. It controls the lower limb muscle tone for upright posture and balance. Lastly, the tectospinal tract originates in the midbrain colliculi and travels through the ant (cervical) cuniculus. It mediates automatic postural movements of head in response to visual and auditory stimuli.

BACK

1. What are the subdivisions in the vertebral column and how many vertebrae contribute to each region.
Cervical (8), Thoracic (12), Lumbar (5), Sacrococcygeal (6)

2. The vertebral column has primary and secondary curvatures. Which are primary and which are secondary curvatures? Why are the curves secondary?
Thoracic and Sacrococcygeal spines are primary curvatures, while cervical and lumbar spines are secondary curvatures. Secondary curves develop after the birth for the achievement of an erect posture.

3. Abnormal curvatures commonly occur. What are they?
Lordosis, Kyphosis and Scoliosis. Abnormal lordosis is an exaggeration of forward convexity of the lumbar spine, and it is commonly developed during pregnancy. Abnormal kyphosis is an exaggeration of the primary curvature of the thoracic spine, and this is often seen in elderly. Scoliosis is the lateral curvature of the spine.