CRANIAL NERVES

OUTLINE –

The cranial nerves are a group of 12 paired nerves that originate from the brain and innervate various structures in the head, neck, and face.

INTRODUCTION

➢ The 12 pairs of cranial nerves arise from the brain inside the cranial cavity and pass through various

foramina in the bones of the cranium.

➢ Divides into 3 functions: Sensory nerves, Motor nerves and Mixed nerves.

Introduction

12 pairs are:-

• Olfactory nerve (I)

• Optic nerve (II)

• Oculomotor nerve (III)

• Trochlear nerve (IV)

• Trigeminal nerve (V)

• Abducens nerve (VI)

• Facial nerve (VII)

• Vestibulocochlear nerve (VIII)

• Glossopharyngeal nerve (IX)

• Vagus nerve (X)

• Accessory nerve (XI)

• Hypoglossal nerve (XII)

Olfactory nerve (I)

• Sensory nerve

• Contain axons that conduct impulses for olfaction, the sense of smell.

• The olfactory epithelium occupies the superior part of the nasal cavity, covering the inferior surface of the cribriform plate and extending down along the superior nasal conchae.

• The olfactory receptors within the olfactory epithelium are bipolar neuron.

• Each has a single odor sensitive dendrite projecting from one side of the cell body and an unmylinated axons extending from the other side.

• Bundle of axons of olfactory receptors extend through about 20 olfactory foramina in the cribriform plate of the ethmoid bone.

Olfactory nerve (I)

• Olfactory nerves end in the brain in paired masses of grey matter called the olfactory bulbs. Two extensions of the brain that rest on the cribriform plate.

• Within the olfactory bulbs, the axon terminals of olfactory receptor form synapses with the dendrite and cell bodies of the next neurons in the olfactory pathway.

• The axons of these neuron make up the olfactory tract, which extend posteriorly from the olfactory bulbs.

• Axons in the olfactory tract end in the primary olfactory area in the temporal lobe of the temporal cerebral cortex.

Optic nerve (II)

• Sensory nerve

• Contains axons that conduct nerve impulses for vision.

• In the retina, rods and cones initiate visual signals and relay them to bipolar cells, which transmit the signals to ganglion cells.

• Axons of all ganglion cells in the retina of each eye join to form an optic nerve, which pass through the optic foramen.

Optic nerve (II)

• Posterior to the eyeball, the two optic nerves merge to form the optic chiasm.

• Within the chiasm, axons from the medial half of each eye cross to the opposite side, axons from the lateral half is remain on the same side.

• Posterior to the chiasm, the regrouped axons, some from each eye, form the optic tracts.

• Most axons in the optic tracts end in the lateral geniculate nucleus of the thalamus.

• There, they synapse with neuron whose axons extend to the primary visual area in the occipital lobe of the cerebral cortex.

• A few axons pass through the optic chiasm and then extend to the superior colliculi of the midbrain.

• They synapse with motor neurons that control the extrinsic (move the eyeball) and intrinsic eye muscles (control light intensity).

Oculomotor nerve (III)

• Motor nerve

• Oculomotor nerve extends anteriorly and divides into superior and inferior branches, both of which pass through the superior orbital fissure into the orbit.

• Axons in the superior branch innervate the superior rectus (extrinsic eyeball muscle) and the levator palpebrae superioris (muscles of upper eyelid).

Oculomotor nerve (III)

• Axons in the inferior branch supply the medial rectus, inferior rectus and inferior oblique muscles (all extrinsic eyeball muscles).

• Theses somatic motor neurons control movements of the eyeball and upper eyelid.

• The inferior branch of the oculomotor nerve also provides parasympathetic innervation to intrinsic eyeball muscles, which are smooth muscles.

• They include the ciliary muscles of the eyeball and the circular muscles (sphincter pupillae) of the iris.

• Parasympathetic impulses propagate from oculomotor nucleus in the midbrain to the ciliary ganglion, a relay centre of the autonomic nervous system.

• From the ciliary ganglion, parasympathetic axons to the ciliary muscles, which adjust the lens for near vision.

• Other parasympathetic axons stimulate the circular muscles of the iris to contract when bright light stimulates the eye, causing decrease in the size of the pupil (constriction).

Oculomotor nerve (III)

• Proprioceptive sensory axons from the extrinsic eyeball muscles begin their course towards the brain in the oculomotor nerve but eventually leave the nerve to join ophthalmic branch of trigeminal nerve.

• They do not return to the brain in the oculomotor nerve.

• The cell bodies of the sensory axons reside in the trigeminal ganglion, and they enter the midbrain via trigeminal nerve.

• These axons convey nerve impulses for proprioception, the nonvisual perception of the movements and position of the body, from extrinsic eyeball muscles.

Trochlear nerve (IV)

• Motor nerve

• Smallest cranial nerve

• Arises from posterior part of the brainstem.

Trochlear nerve (IV)

•The motor neurons originate in the trochlear nucleus in the midbrain, and axons from the nucleus pass through the superior orbital fissure of orbit.

• These somatic motor axons innervate the superior oblique muscles of the eyeball. (Extrinsic eyeball muscle that control movement of the eyeball)

• Proprioceptive sensory axons from the superior oblique muscle begin their course toward the brain in the trochlear nerve but eventually leave the nerve to join ophthalmic branch of the trigeminal nerve.

• They do not return to the brain in the trochlear nerve.

• The cells body of sensory neurons reside in the trigeminal ganglion, and they enter the midbrain via trigeminal nerve.

• Like those of the oculomotor nerve, these axons convey nerve impulses for proprioception, the nonvisual perception of the movements and position of the body, from extrinsic eyeball muscles.

Trigeminal nerve (V)

• Mixed nerve

• Largest cranial nerve

• 2 roots from ventrolateral of the pons

• Have large sensory root and small motor root

Trigeminal nerve (V)

• Large sensory root

– Has swelling part

– trigeminal ganglion

– Trigeminal ganglion located in the fossa inner surface of petrous portion.

– The trigeminal ganglion contains cell bodies of most of the primary sensory neurons.

• Small motor root – Originate from nucleus in the pons

Trigeminal nerve (V)

• Consists 3 branches

– Ophthalmic

– Maxillary

– Mandibular

Trigeminal nerve (V)

• Ophthalmic Branch

– Smallest branches of T.N

– Enter orbit through superior orbital fissure

– Contain sensory axon from;

(1) skin over upper eyelid,

(2) eyeball,

(3) lacrimal gland,

(4) upper part of nasal cavity,

(5) side of the nose, forehead, anterior half of the scalp.

Trigeminal nerve (V)

• Maxillary Branch

– Intermediate in size

– Enter the foramen rotundum of sphenoid

– Contain sensory axon from;

(1) mucosa layer of the nose,

(2) palate,

(3) part of the pharynx,

(4) upper teeth,

(5) upper lips,

(6) lower eyelid.

Trigeminal nerve (V)

• Mandibular Branch

– Largest T.N

– Exits through the foramen ovale of sphenoid

– Contain sensory axons from:

(1) anterior 2/3 tongue,

(2) cheek and mucosa deep into it,

(3) lower teeth,

(4) skin over the mandible and side of the head anterior to the ear,

(5) mucosa of the floor of the mouth.

• The sensory axons from 3 branches enter the trigeminal ganglion and terminate in the nuclei in the pons.

• The trigeminal nerve also contains sensory fiber from proprioceptors located in the muscles of the mastication

Trigeminal nerve (V)

• Somatic motor axons of the trigeminal nerve are part of the mandibular nerve and supply muscles of mastication.

• Masseter, temporalis, medial and lateral pterygoid, anterior belly of digastric, mylohyoid and tensor tympani.

• Important- control chewing movements.

Abducens nerve (VI)

• Motor nerve

• Origin – abducens nucleus of the pons

Abducens nerve (VI)

• Somatic motor axons extend from the nucleus to the lateral rectus muscle of the eyeball, through the superior orbital fissure of the orbit.

• Nerve impulses cause abduction of the eyeball

Abducens nerve (VI)

• Proprioceptive sensory axons from the lateral rectus muscle begin their course toward the brain in the abducens nerve but eventually leave the nerve to join ophthalmic branch of the trigeminal nerve.

• They do not return to the brain in the abducens nerve.

• The cells body of sensory neurons reside in the trigeminal ganglion, and they enter the midbrain via trigeminal nerve.

• These axons convey nerve impulses for proprioception, the nonvisual perception of the movements and position of the body, from extrinsic eyeball muscles.

Facial nerve (VII)

• Mixed nerve

• Sensory axons extend from the taste buds of the tongue (anterior 2/3) through the geniculate ganglion (a cluster of cell bodies of sensory neuron that lies beside facial nerve, and end in the pons)

• Sensory portion of the facial nerve also contain axons from proprioceptors in muscles of the face and scalp and from skin in the ear canal.

Facial nerve (VII)

• Axons of somatic motor neurons arise from nucleus in the pons, pass through petrous portion of temporal and innervate facial, scalp and neck muscles.

• Innervations these axons cause contraction of facial expression muscles, plus stylohyoid, posterior belly of digastric, and stapedius in the ear.

Facial nerve (VII)

• Axons of parasympathetic neuron that are part of the facial nerve end in 2 parasympathetic ganglia; pterygopalatine and submandibular ganglion.

• From these 2 ganglia, other parasympathic axons extends to the lacrimal gland, nasal gland, palatine gland, sublingual and submandibular gland.

. **Vestibulocochlear nerve (VIII)**

• Acoustic @ Auditory nerve

• Sensory nerve

• Has 2 branches; vestibular and cochlear branches.

Vestibulocochlear nerve (VIII)

• Vestibular branch

– Carry impulses for equilibrium

– Sensory axons in the vestibular branch arise from semi-circular canals, the saccule, and the utricle of the inner ear.

–Then extend to the vestibular ganglion, where the cell bodies are located.

– And end in the vestibular nuclei in the medulla oblongata.

– Some sensory axons enter the cerebellum via the inferior cerebellar peduncle.

Vestibulocochlear nerve (VIII)

• Cochlear Branch

– Carry impulses for hearing

– Sensory axons in the cochlear branch arise in the spiral organ (Organ of Corti) in the cochlea of the inner ear.

– The cell bodies of cochlear branch sensory neurons are located in the spiral ganglion of the cochlea.

– From there axons extend to cochlear nuclei in the medulla oblongata.

Glossopharyngeal nerve (IX)

• Mix nerve

• Sensory axons of GN arise from:

– Taste buds and somatic sensory receptor on the posterior 1/3 of tongue

– Proprioceptors in swallowing muscles supply by motor portion

– Baroreceptors in the carotid sinus

– Chemoreceptor in the carotid body.

Glossopharyngeal nerve (IX)

•The cell bodies of these sensory neurons are located in the superior and inferior ganglia.

• From these ganglia, sensory axons pass through the jugular foramen and end in the medulla oblongata.

Glossopharyngeal nerve (IX)

• Axons of motor neurons in GN arise in nuclei of the MO and exit the skull through the jugular foramen.

• Somatic motor neuron innervates the stylopharyngeus muscle and autonomic motor neurons

(parasympathetic) stimulate the parotid gland to secrete saliva.

• Some of the sell bodies of parasympathetic motor neuron are located in the otic ganglion.

Vagus nerve (X)

• Mixed nerve

• Sensory axon arises from:

– Skin of the external ear

– A few tastes bud in the epiglottis and pharynx

– Proprioceptors in muscles of the neck and throat

– Baroreceptor in the arch of aorta

– Chemoreceptor in the aortic bodies

– Visceral sensory receptors in the most organs of thoracic and abdominal cavities.

Vagus nerve (X)

.• These axons pass through the jugular foramen and end in the MO and pons

• The somatic motor neurons, arise from nuclei in the MO and supply muscle of the pharynx, larynx, and soft palate that used in swallowing and vocalization.

• Axons autonomic motor neuron (parasympathetic) in the vagus nerve originate in nuclei of MO and end in the lungs and heart.

• Vagal parasympathetic axons also supply gland of GIT and smooth muscles of respiratory tract, oesophagus, stomach, gallbladder, small intestine and most of the large intestine.

Accessory nerve (XI)

.• Motor nerve

• Motor axons arise in the anterior grey of the 1st 5 segments of the cervical portion of the

spinal cord.

• The axons from the segment exit the spinal cord laterally and come together, pass through the foramen magnum and exit through the jugular foramen along with the vagus nerve.

Accessory nerve (XI)

. • The AN convey motor impulses to the sternocleidomastoid and trapezius muscles to coordinate head movement.

• Sensory axons in the AN originate from proprioceptors in the muscles supplied by its motor neurons begins their course toward the brain in the AN but eventually leave the nerve and to join the cervical plexus.

• From cervical plexus, they enter the spinal cord via the posterior root of the cervical spinal nerve to pass to and end in the MO.

• The sensory axon do not return to the brain in the AN and, like all sensory axon, have their cell bodies in posterior root ganglion.

Hypoglossal nerve (XII)

• Motor nerve

• Somatic motor axons originate in the hypoglossal nuclei in the MO, pass through the hypoglossal canal, and supply the muscles of the tongue.

• These axons conduct impulses for speech and swallowing.

• Sensory axons that originate from proprioceptors in the tongue muscles begin their course towards the brain in the hypoglossal nerve.

• They leave the nerve and join cervical spinal nerve and end in the MO, again entering the CNC via posterior root of cervical spinal nerve.

• The sensory axons do not return to the brain in the hypoglossal nerve.