# Peripheral nervous system

Peripheral nervous system comprises:

## A) Cranial nerves:

12 in number, arise mainly from brain stem.

## **B)** Spinal nerves:

arise from spinal cord, varies in number according to species.

C) Autonomic nervous system :

1-Sympathetic (thoracolumbar) division.2-Parasympathetic (craniosacral) division.

# **Cranial nerves**

- ➢ They are 12 pairs
- General features:
- They are known by roman numbers from (rostral to caudal).
- Some nerves take their names according to:
  - \* Function as olfactory and abducent
  - \* Distribution as facial and hypoglossal
  - \* Shape as trigeminal.

 All cranial nerves have superficial origins on ventral aspect of brain except trochlear nerve originates from dorsal aspect of brain.

-All cranial nerves except first one originate from brain stem.

 Each nerve emerges from cranial cavity through a foramen.

- All cranial nerves except vagus distributed generally in head region.
- 3,7,9,10 cranial nerves carry parasympathetic fibers.

- Classification of cranial nerves:
- They are classified according to the function into: 1-Sensory nerves: 1,2,8.
  2-Motor nerves: 3,4,6,11,12.
  3-Mixed nerves: 5,7,9,10.





Brain, lateral view



Brain, ventral view

# I- Olfactory nerves

#### <u>Type:</u>

- Sensory for smell.
- Represented by bundles of nerve fibers, not form trunk.

# Origin:

• Central processes of olfactory cells of olfactory region of nasal cavity.

#### <u>Course:</u>

• They pass though cribriform plate to join olfactory bulb.

# Vomeronasal nerve:

• It arises from vomeronasal organ ,passes through medial border of cribriform plate to terminate in olfactory bulb.

# II- Optic nerve

#### Type:

• Sensory for vision.

# Origin:

• Central processes of ganglion cells of retina.

#### <u>Course:</u>

- Fibers converge toward optic papilla forming optic nerve, emerges from eyeball.
- Then passes through optic foramen and decussates with its fellow to form optic chiasma.

# **III- Oculomotor Nerve**

## Type:

- motor nerve.
- It carries parasympathetic fibers.

# Origin:

• Medial aspect of cerebral crus.

#### <u>Course:</u>

- It passes through orbital foramen
- It divides into dorsal and ventral branches.

## **Distribution:**

1) Dorsal branch supplies: -levator palpebrae superiori muscle. -dorsal rectus muscle. 2) Ventral branch is longer: It carries ciliary ganglion. It supplies: -Medial rectus muscle. -Ventral rectus muscle. -Ventral oblique muscle.

+ levotor palp. superiorus H. + dorsal necteus H. dersal branch C. Ciliary ganglion Oculomotor N. orbital foramen \* Ventral nectus M. Ventral branch. - Medial nectus M. + ventral oblique M.

# **IV-Trochlear nerve**

## Type:

• motor nerve. Smallest cranial nerve.

# Origin:

- From rostral cerebellar peduncle behind corpora quadrigemina.
- The only cranial nerve appears on dorsal surface of brain

#### Course:

- Passes through orbital foramen or (trochlear foramen).
   <u>Distribution:</u>
- Supplies superior oblique muscle of eyeball.

# V-Trigeminal nerve

# Type: Mixed nerve. largest cranial nerve Origin:

 It arises from lateral part of pons by two roots: A) large sensory root: carries semilunar or trigeminal ganglion from which arise ophthalmic, maxillary and mandibular nerves. B) Small motor root: is incorporated with mandibular nerve.

**Course and distribution:** 

• It divides into :

1-Ophthalmic nerve (sensory nerve)2-Maxillary nerve (sensory nerve)3-Mandibular nerve (mixed)



# A) Ophthalmic nerve

#### <u>Type:</u>

• Sensory nerve. Smallest branch of trigeminal nerve.

#### <u>Course:</u>

- It passes through orbital foramen to be in orbit where it divides into:
  - 1- Frontal N.
  - 2- Lacrimal N.
  - 3-Zygomaticotemporal N.
  - 4- Nasociliary N.

#### **Distribution:**

#### **1. Frontal nerve:**

- It emerges from supraorbital foramen as supraorbital nerve.
- Ramifies in skin of forehead and upper eyelid
  2.Lacrimal nerve:
- Ramifies in lacrimal gland and upper eyelid.
- **3.Zygomaticotemporal branch:.**
- Ramifies in skin of temporal region.

**4.Nasociliary nerve:** 

It gives off:

A-Communicating branch to ciliary ganglion. B-Long ciliary nerves: to pierce sclera. C-Ethmoidal nerve: enters nasal cavity. **D-Infratrochlear nerve: supplies skin of medial** angle of eye.





#### **Trigeminal nerve (Ophthalmic and maxillary nerves)**

# B) Maxillary nerve

#### Type:

It is sensory nerve.

## Course:

- It passes through foramen rotundum to reach pterygopalatine fossa where it gives off:
  - 1- zygomaticofacial branch.
  - 2- pterygopalatine nerve
  - 3- infraorbital nerve.

# Distribution:

**1. Zygomaticofacial branch:** Ramifies in in skin of lateral angle and lower eyelid 2. pterygopalatine nerve: a)Caudal nasal nerve: Passes via sphenopalatine foramen to nasal cavity. b) Greater palatine nerve: Passes through palatine canal to supply hard palate, gums and soft palate. c) Lesser palatine nerve: Passes through palatine groove to supply in soft palate.



Fig. 119. Distribution of the maxillary N.; diagramatic

## 3. Infraorbital nerve:

- It passes through infraorbital canal where it gives alveolar branches to teeth, alveolar periosteum and gums.
- After leaving the canal it gives off:
   a) External nasal branches:
   Supplies nasal region and nasal diverticulum.

b) Internal nasal branches:

Supplies upper lip, nostrils and nasal vestibule. c) Maxillary labial branches: Supplies cheek and upper lip.



# C) Mandibular nerve

## Type:

• Mixed nerve.

# <u>Course:</u>

- It passes through oval foramen.
- Supplies muscles of mastication.

# <u>Distribution:</u>

1. Masseteric nerve:

Passes through mandibular notch to masseter M.

# 2. Deep temporal nerves:

2-3 branches to temporal muscle.

#### **3. Buccal nerve:**

Supplies lateral pterygoid, cheeks and buccal glands. 4. Medial pterygoid nerve:

supplies medial pterygoidand and tensor veli palatini.

5. Auriculotemporal nerve: It divides :

a) Transverse facial branch:

ramifies in skin of cheek.

b) Ventral branch:

Unites with the ventral buccal branch of facial nerve.

6. Mandibular alveolar nerve: It enters mandibular canal, emerges at mental foramen

#### It gives off:

#### a) Mylohyoid nerve:

It supplies mylohyoid, rostral belly of digastric and skin of intermandibular space rostrally.

#### b) Alveolar branches:

Supply lower alveoli, teeth and gums.

#### c) Mental nerve:

Ramifies in lower lip and chin.

#### 7. Lingual nerve:

-It supplies m.m. of rostral 2/3 of tongue

-it joins chorda tympani of facial nerve.

Cranial auricularN. N. deep temporal N. Transverse facial N. Cphthatmie N. Maxillary N. Masseteric N-N-spinosum Semilunar gangotic gang. Buccal N. terygoid Nn. Mandibular N. f. ovale Lingual N superficial branc Mandibular alveolar N. Mytohyoid N. branc. deep Tendibutavatueolav Canal Incisor bri Mental N.

Fig. 120. Distribution of the mandibular N.; diagramatic

# VI- Abducent nerve

# <u>Type:</u>

• Motor nerve.

# Origin:

 from medulla oblongata caudal to pons and just lateral to the pyramid.

# <u>Course:</u>

- Passes through orbital foramen with oculomotor and ophthalmic nerves
- Divides into two branches.

# **Distribution:**

It supplies:

1- Retractor oculi muscle. 2 -Lateral rectus muscle.

# VII- The facial nerve

#### <u>Type</u>

- mixed nerve. It carries parasympathetic fibers.
   Origin
- from lateral part of trapezoid body of medulla oblongata.
   <u>Course:</u>
- It passes via internal acoustic meatus with 8th nerve to enter facial canal ,then leaves it at stylomastoid foramen.
- It bears geniculate ganglion.

## **Distribution:**

A) Inside facial canal it gives off:

- **1. Greater petrosal nerve:**
- it gives a filament to typmanic plexus.
- It receives deep petrosal nerve from carotid plexus of sympathetic to form nerve of pterygoid canal (Vidian nerve) which ends in pterygopalatine plexus and ganglia.

# 2. A delicate branch:

 It unites with tympanic nerve of glosspharyngeal to form lesser petrosal nerve which ends in otic ganglion.

# 3. The stapedial nerve:

- It supplies stapedial muscle of middle ear.
  4. Chorda tympani:
- It joins lingual nerve of mandibular nerve and sends twigs to mandibular ganglia.
- It gives fibers to taste buds of rostral 2/3 of tongue.

# B) After emergence from facial canal it gives:1. Caudal auricular nerve:

- It innervates caudal and dorsal auricular muscles & skin of convex surface of external ear.
- 2. Internal auricular branch:
- It supplies skin of concave surface of external ear.
- **3. Digastric branch:**
- Innervates caudal belly of digastric, occipitomandibularis, stylohyoideus and occipitohyiodeus muscles.
- 4. Parotid branches:
- To parotid gland.

#### 5. Auriculopalpebral nerve:

- It divides into :
- a) Rostral auricular branches:
- It shares in formation in of auricular plexus which supplies auricularis rostralis, parotidoauricularis.
- b) Zygomatic (Temporal) branch:
- It runs to medial angle of eye.
- It innervates orbicularis oculi, levator anguli oculi medialis, levator nasolabialis.

#### 6. Cervial branch (ramus colli):

- Descends in neck.
- Anastomoses with cutaneous branches of 2-6 cervical nerves.
- 7. Dorsal buccal branch:
- Supplies muscles of upper lip and nostrils.
- Anastomoses with infraorbital nerve and ventral buccal branch.
- 8. Ventral buccal branch:
- Supplies depressor labii mandibularis, buccinator and cutaneous fasciei muscles.



Fig. 122. Distribution of the facial N.; diagramatic



# VIII- Vestibulocochlear (acoustic) nerve

# <u>Type</u>

Sensory nerve.

# <u>Origin:</u>

• From lateral aspect of medulla oblongata caudal to origin of facial nerve.

#### <u>Course:</u>

• Enters internal acoustic meatus where it divides into, vestibular and cochlear parts.

# **Distribution:**

#### **1. Vestibular part:**

- Distributed in vestibule of internal ear.
- Bears vestibular ganglion.
- Responsible for position and equilibrium of body

# 2. Cochlear part:

- Distributed in cochlea of internal ear.
- Responsible for hearing.

# IX- Glosspharyngeal nerve

#### <u>Type:</u>

- mixed nerve. carries parasympathetic fibers.
   Origin:
- lateral aspect of medulla oblongata with 10,11,12 nerves.

#### <u>Course:</u>

- It emerges from foramen lacerum caudalis (jugular foramen) with 10,11 nerves.
- It bears jugular and petrous ganglia (often fused).
- It terminates by dividing into pharyngeal and lingual branches.

# **Distribution:**

# **1. Tympanic nerve:**

 It shares in formation of tympanic plexus which supply m.m.of tympanum and auditory tube.

# 2. Considerable branch to carotid sinus:

- Gives filament to pharyngeal plexus.
- Shares in formation of carotid plexus on termination of carotid artery.
- Carotid body presents in this plexus.

3. Branch to aboral stylopharyngeal muscle :

# 4. Terminal branches:a) Pharyngeal branch:

Smaller, it shares in pharyngeal plexus, which supplies muscles and m.m. of pharynx.
Lingual branch:

-It supplies sensory fibers to m.m. and taste buds of caudal 1/3 of tongue.

# X-Vagus nerve

#### <u> Type:</u>

- mixed, longest cranial nerve.

- Carries parasympathetic fibers.

## Origin:

lateral aspect of medulla oblongata.

#### Course:

extends in head, cervical, thoracic and abdominal regions.

A) In head and cervical region:

- passes through jugular foramen where it bears jugular ganglion . Here it gives meningeal and auricular branches .
- In neck, it joins sympathetic trunk forming vagosympathetic trunk.

# **B) In thoracic region:**

- Each vagus divides into dorsal and ventral branches.
- Both right and left dorsal as well as ventral branches unite forming dorsal and ventral vagal trunks.
- These run caudally with esophagus to enter abdomen through esophageal hiatus.

# C) In abdominal region:

#### **Dorsal trunk :**

forming caudal gastric plexus, celiacomesenteric ganglion and intermesenteric plexus.

forming cranial gastric plexus

# <u>Distribution:</u>

It gives collateral branches as:

#### **1-Pharyngeal branch:**

- It shares in formation of pharyngeal plexus with 9,11 cranial and sympathetic nerves
- The plexus supplies muscles of pharynx and soft palate (except tensor veli palatini supplied by mandibular nerve). And cervical part of esophagus

#### 2. Cranial laryngeal nerve:

- It passes through thyroid foramen of thyroid cartilage.
- It supplies m.m. of larynx, floor of pharynx and entrance of esophagus.
- It supplies cricothyroid and cricopharyngeus muscles.

# 3. Recurrent laryngeal nerve:

- *a) Right nerve:* turns around costocervical trunk, runs craniad in neck on ventral face of trachea.
- b) b) left nerve: turns around aortic arch, continues in neck like right one.
- It terminates as caudal laryngeal N.
- It supplies all intrinsic muscles of larynx except cricothyroid. It gives branches to trachea, esophagus and cardiac plexus.

## 4. Cardiac branches:

- Form cardiac plexus with sympathetic and recurrent laryngeal nerves.
- 5. Tracheal and esophageal branches:
- Form caudal tracheal and esophageal plexuses with recurrent laryngeal, vertebral and cervicothoracic ganglion of sympathetic.
- 6. Bronchial branches:
- Form pulmonary plexus with sympathetic.



## **XI-** Accessory nerve

Type: motor nerve.

Origin: from two parts :

Cranial part: lateral aspect of medulla oblongata. Spinal part: from cervical part of spinal cord. It enters foramen magnum and joins cranial part .<u>Course:</u>

It passes through foramen lacerum caudalis and divides into; internal and external branches.

#### **Distribution:**

#### A) Internal branch:

from cranial root, runs caudaoventrally with vagus to share in formation of pharyngeal plexus .
B) External branch: divides into:
1-Dorsal branch: extends along brachiocephalic muscle (in flexuous manner) and ends in trapezius muscle.

2-Ventral branch: enters sternocephalic muscle.

# XII- Hypoglossal nerve

#### <u>Type:</u>

motor nerve.

# Origin:

ventral face of medulla oblongata lateral to pyramid.

#### <u>Course:</u>

 It passes through hypoglossal foramen, runs rostroventrally caudal to linguofacial trunk to reach tongue.

# **Distribution:**

It supplies muscles of tongue and geniohyoideus.

# **Spinal nerves**

# **General consideration:**

- >Arranged in pairs.
- With exception of cervical and caudal nerves, spinal nerve emerges behind vertebra of same number.
   1<sup>st</sup> and 2<sup>nd</sup> cervical nerves emerge through LVF of atlas, and axis. Therefore, there are 8 cervical nerves.
- > There are fewer pairs of caudal nerves.

# Formation of typical spinal nerve:

- Each spinal nerve has two roots:
- **1. Dorsal root:**
- Sensory root.
- Afferent as conveys impulses from organ towards CNS.
- Carries dorsal root (spinal) ganglion.
- It is axons of neurons lie in dorsal root ganglion.

#### 2. Ventral root:

- It is motor root.
- Is smaller than dorsal root
- No ganglion on ventral root.
- It is efferent , conveys impulses from CNS to organ.

# **Basic distribution of spinal nerve:**

- The two roots unite to form typical spinal nerve, emerges through intervertebral foramen.
- Each nerve gives small meningeal branch then divides into :
- **1. Dorsal primary branch:**
- Smaller one except in cervical regions.
- Distributed, in muscles and skin of dorsal part of body (epaxial region).







POSITION OF THE TRUNK OF THE SPINAL NERVE

- 1. dorsal root.
- 2. dorsal root ganglion.
- 3. intervertebral foramen.
- 4. trunk of spinal nerve.
- 5. ventral root.



Schematic representation of a reflex chain in which an interneuron is interposed

1. skin receptor 2. afferent neuron 3. synapse at interneuron 4. synapse at efferent neuron 5. muscle 6. spinal cord

# 2. The ventral primary branch:

- larger one except in cervical region.
- It distributes in muscles and skin of lower part of body (hypoaxial region) including limbs.
- Each spinal nerve or its ventral branch connected by ramus communicans to adjacent sympathetic ganglion.

#### Spinal nerves in horse are 42 pairs :

Cervical spinal Nn.
Thoracic spinal Nn.
Lumbar spinal Nn.
Sacral spinal Nn.
Caudal spinal Nn.
pairs



#### ATTACHMENTS OF SPINAL NERVES

The spinal nerves are attached to the sides of the spinal cord by dorsal and ventral roots.

dorsal root of spinal nerve.
 ventral root of spinal nerve.
 trunk of spinal nerve.
 dorsal root ganglion.

