

# Neuroanatomy - Group C - Charleen Schade

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## 47) The autonomic system - general structure

has structural part in **CNS + PNS** ☐ regulates **involuntary physiologic processes** (heart rate, blood pressure, respiration, digestion)

divides into **sympathetic + parasympathetic parts**

### 1) **Sympathetic** [also called thoracolumbar part]

- found within **thoracolumbar** division of spinal cord (T1-L2)
- functions for **fight or flight responses** ☐ increased **heart rate + dilated pupils**
- neurons form sympathetic **trunk ganglia, sup/middle/inf cervical ganglion**
- short preganglionic fibers: **acetylcholine** major transmitter
- long postganglionic fibers: **norepinephrine** major transmitter

### 2) **parasympathetic** [also called craniosacral part]

- found in **craniosacral** division of brainstem
- “rest and digestive” process ☐ digestion, salivation, sexual arousal and lacrimation
- long preganglionic + short postganglionic fibers ☐ **acetylcholine** main transmitter

ganglia: **ciliary + submandibular + optic + pterygopalatine ganglions**

nuclei: sup/inf salivatory nucleus + dorsal vagal nucleus

## 48) The ascending tracts of the spinal cord

afferent, transmit sensory information from **peripheral nerves to cerebral cortex**

a) **Spinothalamic tracts**: lat/ant

b) **Tracts of post funiculus**: Gracilis + cuneatus fasciculus

c) **Spinocerebellar tracts**: ant/post

### Spinothalamic tracts:

- **ant**: touch sensation ☐ runs through ventral funiculus
- **lat**: pain + temperature sensation ☐ runs through lat funiculus

### Spinocerebellar tracts:

- **ant + post** spinocerebellar tracts ☐ **unconscious** proprioception to cerebellum

### Tracts of post funiculus:

- **Gracilis**: fine touch + conscious proprioception of **lower limb**
- **cuneatus fasciculus**: fine touch + conscious proprioception of **upper limb**

Conscious proprioception: ability to activate movement of muscles voluntary

## 49) The descending tracts of the spinal cord

made up by **neuro axons** that sends efferent motor signals from brain to lower motor neurons  
☑ then directly innervate muscles to produce movement  
can divide into 2 motor systems ☑ **lateral + medial**

1) Lateral motor system: fine precise motor skills in hand

- **Pyramidal tracts** [ant/lat corticospinal]: **voluntary** movement + carry info brainstem and spinal cord
- Rubrospinal tract

b) Medial motor system: **innervate lower motor neurons**

- **extrapyramidal tracts** for involuntary movements
- Reticulospinal
- Tectospinal
- Vestibulospinal

## 50) Meninges of spinal cord

consist of 3 membranes: **spinal dura mater + arachnoid mater + pia mater**

1) Spinal dura mater

- most external, separated from vertebral canal by **epidural spaces**
- extends from foramen magnum to filum terminale
- forms **Dural sac** (tubular sheath within vertebral canal)
- **subdural space** separates dura mater from arachnoid mater with **bridging veins**

2) Arachnoid mater

- Not attached to dura mater but pressed against it by pressure of CSF
- Separated from pia mater by **subarachnoid spaces** (contains CSF, arachnoid tubercle, denticulate ligaments)

c) Pia mater

- Innermost meninges, covers spinal cord, its nerves + its blood vessels
- bt nerve roots it thickens to make **denticulate ligaments** (that attach to dura mater) to suspend spinal cord in vertebral canal
  - ☐ Inferiorly it fuses with **filum terminale**

## 51) Meninges of the brain

Cranial Meninges: 3 layer membrane

**Dura matter** (composed of 2 layers):

1) Peritoneal - outer layer (attaches to bone) formed by periosteum

2) Meningeal - inner layer (closer to brain)

- both lamina of dura matter fused, except to **dural sinuses**

there are 2 sites where both layers are separated:

1. **sup surface of petrous part of temporal bone** (impression for trigeminal ganglion)

2. **dural sinus cavity** ☐ made by splitting of periosteal + meningeal within cella turcica

- **dura matter reflections:** divide cranial cavity into compartments: **flax cerebi, tentorium cerebelli, falx cerebelli, diaphragma sellae**

**Arachnoid layer:**

- subdural space bt dura matter + arachnoid
- avascular + non-innervated membrane
- **subarachnoid space** with CSF, arachnoid tubercles
- contains arachnoid granulations (IMP for reabsorption of CSF)

**Pia matter, delicate (follows folds + convolutions):**

- innermost meningeal layer
- thin, highly vascularized membrane + network of BVs + adheres to surface of brain

## 52) Circulation of cerebrospinal fluid

**clear watery fluid**, produced by **choroid plexus** in ventricles + **ependymal cells** ☐ surround brain + spinal cord (loc in subarachnoid space + central canal)

E:

- lowers weight of brain
- protection
- homeostasis

Pathway:

a) from **lat ventricle** ☐ **3rd** by **interventricular foramen**

b) 3rd to **4th** ventricle by **cerebral aqueduct**

c) From 4th ventricle some to **spinal cord** or **median aperture + paired lat aperture into subarachnoid space**

d) Then absorbed into the **bloodstream by arachnoid villi** to the **sup sagittal sinus**

## 53) The visual pathway

responsible for light energy into electrical action potentials → sends visual information from **retina** to **primary visual cortex** (Brodmann area 17)

has 4 order neurons

- 1st two are inside retina within **ganglion layer of retina + ganglion layer of optic nerve**
- 3rd is **optic nerve to optic tract, chiasm then lat geniculate body**
- lat geniculate body to optic radiation to the primary visual cortex**

retina > optic nerve > optic tract and chiasm > lat geniculate body > optic radiation > primary visual cortex

light will be refracted in cornea, when passing into eye.

light from **both temporal parts of retina** will run on same to **lat geniculate body**  
**two in nasal part** will cross **optic chiasm**

## 54) The optic nerve CN II

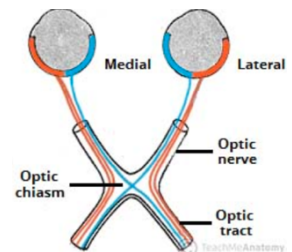
**sensory** nerve, composed of **retinal ganglion cell axons + glial cells**, it transmits **visual information from retina to primary visual cortex**

→ covered by the **brain meninges**

Q: in retina as axons of retinal ganglion cells → leave eye in **optic disc** + form **optic nerve**

3 parts:

- Extend from **optic disc** to the **optic chiasm** → optic nerves meet
- From optic chiasm → **med fibers cross** whole, lat stay **ipsilateral** → make the **optic tract**
- From optic tract, **nerve end in lat geniculate body of thalamus** → passes info to primary visual cortex



## 55) The auditory pathway

special **sense of hearing** → info travels from receptors in **organ of corti** to **CNS** by **vestibulocochlear nerve**

Has 4 order neurons

a) From spiral ganglion to brainstem

inner ear:

1) **hair cells of organ of corti** will get in motion (fluid of cochlear moves) via **vibration of ossicles** esp. stapes → **receptors** will send info to **cochlear nerve** → together with vestibular nerve =

**vestibulocochlear nerve**

2) vestibulocochlear nerve enters cranium through **int acoustic meatus** → then enters brainstem at **cerebellopontine angle** → then divided into 50% that go **contralateral** + 50% **ipsilateral**

- make the **trapezoid body** within the pons
- within midbrain: **spinal lemniscus** for **superficial sensation** + trigeminal on both **superficial + deep**; **medial lemniscus** for **deep sensation**
- short lateral lemniscus passing the auditory impulses to **inf colliculus**

3) all fibers arrive at **inf colliculus** of mesencephalon, then project to **med geniculate body** in thalamus → send info to **primary auditory cortex** for temporal lobe

organ of corti > cochlear nerve > vestibulocochlear nerve > int acoustic meatus > cerebellopontine angle > contra + ipsi > trapezoid body > spinal lem - sup + deep > inf colliculus > med geniculate body > primary auditory cortex

## 56) The olfactory nerve and olfactory tract

shortest cranial nerve → **visceroaffarent sensory**, transmits **sense of smell from olfactory receptors to brain**

Olfactory tract: loc inf surface of frontal lobe in **olfactory sulcus**, runs post + widens to form olfactory trigone → splits into 2 neuron tracts:

1) 1st neuron tract: leaves through **cribriform plate** to synapse with **mitral cells in olfactory bulb**

2) 2nd neuron tract: passes through **olfactory tract** to divide into **med + lat stria**

→ lat: carries info to amygdaloid body to **primary olfactory cortex**

→ med: passes through **ant commissure** to go to the **olfactory structures** → nuclei in **subcallousal** area with **septal nuclei**, info to **habenular hippocampus**

→ crossed fibers: **ant olfactory nucleus** in **olfactory trigone** info to **olfactory bulb**

**1: cribriform plate** → synapses with **mitral cells of olfactory bulb**

**2: olfactory tract** → med + lat → lat: amygdaloid body → **primary olfactory cortex**

→ med: ant commissure → **olfactory structures (subcallousal, septal nuclei)** → **habenular hippocampus**

## 57) The cranial nerves - oculomotor, trochlear and abducent

Oculomotor: CN3

F: **motor + parasympathetic** inn to **3 rectus muscles** of eye

Q: **sup colliculus** mesencephalon ☒ emerge from **interpeduncular fossa** + exits skull through **sup orbital fissure**

**1) nucleus:** inn **extrinsic eye muscles**

**2) Accessory nucleus:** inn **ciliary muscles + sphincter pupillae**

3 branches: **sup + inf + ciliary ganglion**

Trochlear: CN4

F: **somatic motor** inn to **sup oblique muscle**

Q: **trochlear nucleus** post aspect mesencephalon ☒ emerges + exits skull via **sup orbital fissure**

abducent: CN6

F: **somatic motor** inn lat rectus muscle

Q: **abducens nucleus in pons** ☒ emerges + exit skull through **sup orbital fissure**

## 58) Nuclei of the trigeminal nerve

CN5 + largest cranial nerve + **4 nuclei** (mesencephalic, sensory, motor, spinal) MMSS

☒ emerges from **pons**

1) Main sensory nucleus: **somatic afferent**

L: post aspect of pontine tegmentum ☒ **sensation info from skin of face**

2) Motor nucleus:

L: mid pons, deep to rhomboid fossa ☒ inn **pterygoid muscle, masseter, temporalis muscle**

3) Mesencephalic nucleus:

L: paired neurons extend from **pons** ☒ processing **proprioception**

central + peripheral branches

☒ central: input from muscle of mastication

☒ peripheral: originates from those muscles

4) Spinal nucleus of trigeminal nerve: **somatic + visceral afferent**

☒ relays various sensory modalities (**temp, deep or crude touch, pain from ipsilat portion of face**)

has 3 main branches: **ophthalmic, maxillary and mandibular**

## 59) Nuclei of facial nerve

CN7, emerges from **pons** + exits skull through **stylomastoid foramen**  
has 3 nuclei:

1) Main motor nuclei: inn **muscles of facial expressions**

L: caudal part of **pontine tegmentum** ☐ **visceral efferent**

2) sup salivatory nucleus: inn **glands ex. sublingual, submandibular, lacrimal, mucus, palatine**

L: **pontine tegmentum** ☐ **visceral efferent** (parasympathetic nuclei)

3) solitary tract nucleus: supplies **taste with taste information, sensory from middle ear**

L: **dorsal medulla + lower pons** ☐ **sensory nuclei**

contributes to: facial, glossopharyngeal + vagus

## 60) Nuclei of glossopharyngeal nerve

CN9, emerges from **medulla oblongata** + exit skull through jugular foramen (motor + sensory)  
has 4 nuclei

1) ambiguous nucleus: inn **stylopharyngeus muscle** (swallowing)

2) solitary nucleus: sensory info from **carotid body, carotid sinus + taste** from tongue

3) spinal nucleus of trigeminal nerve: sensory info about **pain + temp from face** + pharynx

4) inf salivatory nucleus: inn motor fibers in **parotid gland**

**Motor:** ambiguous + inf salivatory nucleus

**Sensory:** spinal of trigeminal nerve + solitary tract nucleus

☐ **Ambiguous, spinal and solitary nuclei connect with vagus nerve**

## 61) Nuclei of the vagus nerve

CN10, longest nerve, emerges from **medulla oblongata** + exits skull through **jugular foramen** ☐  
**efferent + afferent fibers (pain, touch, temp from throat + ear)** int organs in neck, chest, abdomen  
(esophagus, heart, digestive tract)

Has 4 nuclei

1) Ambiguous nuclei: **special visceral efferent** ☐ **muscles of pharynx + larynx**

L: pons + medulla

2) Solitary nucleus: **general + special visceral efferent** ☐ **taste, carotid body + sinus**

3) Dorsal vagus nuclei: **general visceral efferent** ☐ inn **lungs, heart, abdominal viscera**

4) Spinal nucleus of trigeminal nerve: **general somatic afferent** ☐ info about **meninges, ext acoustic meatus**

**Motor:** ambiguous + dorsal vagal nuclei

**Sensory:** spinal nucleus of trigeminal nerve + solitary tract nucleus

## 62) The nucleus of the accessory nerve

CN11, **motor** that emerges from **medulla oblongata** + exits skull through **jugular foramen**

**has spinal + cranial roots**

Has 2 nuclei: **motor ambiguous + sensory spinal nucleus of accessory nerve**

Inn: **sternocleidomastoideus muscle + trapezius muscle**

Ambiguous nucleus: **muscles of larynx, pharynx, palate**

L: medulla oblongata ☑ **special visceral efferent**

Spinal nucleus of accessory nerve: **trapezius muscle + SCM**

L: cervical spinal cord ☑ **general somatic efferent**

## 63) Nuclei of the hypoglossal nerve

CN12, emerges from medulla, is **purely motor + has 1 hypoglossal nucleus**

supplies: **extrinsic + intrinsic muscles of tongue**

L: **hypoglossal trigone** in medulla ☑ **general somatic efferent**

Course: fibers leave hypoglossal nuclei on each side of brainstem ☑ descend to same side of tongue to stimulate muscles of **tongue** from below (except palatoglossus)

IMP: for **eating, speaking, swallowing**

## 64) The vestibulocochlear nerve

CN8, emerges from **cerebellopontine angle** to enter **int acoustic meatus** ☑ divide into **vestibular + cochlear nerves**

has vestibular + cochlear nuclei ☑ **both sensory**

1) cochlear nuclei: **hearing** (part of auditory pathway)

O: **inf cerebellar peduncle** (mesencephalon)

☑ begins in inner ear, **neurons make connections with receptors cells of organ of corti** ☑ sends auditory signals to cochlear portion of nerve

2) vestibular nuclei: **balance + position**

O: **lower pons + upper medulla**

☑ **receives info from hair cells in vestibular apparatus**, travels through vestibular nuclei ☑ neurons leave from 4 nuclei to project to various areas in brain + brainstem to coordinate head, eye, balance

**vestibulocochlear nerve** exit skull via **int acoustic meatus** ☑ splits into vestibular + cochlear nerve (combine in pons to form vestibulocochlear nerve)