

Exam 1 Overview

Lect 2 and 3 Overview of the nervous system

Cerebrum and cerebellum have their grey matter flipped

Reflex vs Reaction: Reflex is below the level of consciousness

So it does not reach the cerebrum.

Spinal cord organization: Dorsal = sensory (Afferent)
Ventral = motor (Efferent)

Spinal cord segments

C ₁ -C ₅	C ₁ -C ₅	C ₁ -C ₅	C ₁ -C ₅	C ₁ -C ₅
C ₆ -T ₂	C ₆ -T ₂	C ₆ -T ₂	C ₆ -T ₂	C ₆ -T ₂
T ₃ -L ₃	T ₃ -L ₃	T ₃ -L ₃	T ₃ -L ₃	T ₃ -L ₃
L ₄ -S ₃	L ₄ -S ₃	L ₄ -S ₃	L ₄ -S ₃	L ₄ -S ₃

Cerebrum: Cerebral hemispheres + Basal Nuclei

- Everything inside skull except cerebellum and brainstem

Voluntary movement is initiated by the cerebrum and executed by the muscles

Cerebrum is the initiator "instigator"

Muscles execute

Basal Nuclei

↳ Caudate Nucleus

- Lenticular Nuclei

- Claustrum

- Amygdaloid body

Dysfunctions of Basal Nuclei

- INVOLUNTARY MOVEMENTS AT REST (human = Parkinson's)
- Dystonia
- Difficulty initiating movements
- Circling

Cerebellum: Coordinates all subsystems involved in movement and posture

- Coordinates motor activity initiated elsewhere in the NS
- Equilibrium

Cerebellar Disease

Does NOT cause paresis/paralysis

Does result in the inability to measure + regulate motor funct.

Signs:

Dysmetria (hypermetria)

Ataxia (uncoordinated gait)

Increased muscle tone

Broad-based stance

Head tremor

Specific Cortical Areas

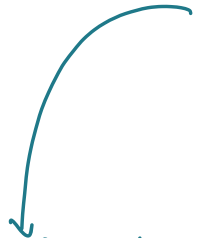
Association Cortex - Cognition and decision making

Basal Nuclei - Initiation and planning of movements

Cerebrum Disease

* Seizures

- Disturbances of consciousness
- Cognitive dysfunction
- Paresis of voluntary movement
- Disturbances of sensory function



Altered mental state

Changes in behavior

Abnormal movement and posture

↳ Pacing

Compulsive walking

Circling

Head pressing

"Cerebral Syndrome"

- Postural reaction deficits **Contralateral limbs**
- Visual impairment **Contralateral w/ Normal PLR**
- +/- Abnormal Respiration
- +/- Tremors

Practice

▼ Cranial Nerve Case
Angel - 3 yr FS Labrador presenting with a 2 day history of ataxia and <u>left-sided head tilt</u>
Yesterday: Owner noticed progressive generalize ataxia, leaning to <u>left</u> , dysphagia with food falling out of <u>left</u> side of mouth, <u>drooling</u> on the left side only, left head tilt, and quiet mentation
Physical exam: Unremarkable
Neurological Exam:
Mentation: Obtunded, occasional staring at space
Gait/posture: Ambulatory, leaning to <u>left</u> , drifting to <u>left</u> , ataxia in all four limbs, tetraparesis; head tilt to Left
Cranial Nerves:
<u>Decreased menace</u> OS (left eye) compared to OD (right eye)
Visually tracks cotton balls in both right and left visual fields; normal PLRs OU CN II OK and VI
Corneal reflex absent OS V Ophthalmic
Atrophy of the <u>left temporalis and masseter muscles</u> V mandibular
Droopy left ear and left lip
Left head tilt: positional ventral strabismus OS, present physiologic <u>nystagmus</u> in both eyes, positional dysconjugate nystagmus (OS rotary to vertical; OD slow rotary moving different directions)
Reduced gag reflex IX
Wrinkled tongue on left side (normal on right side) XII
Postural Reactions: difficult to assess due to severe leaning to left, but appear present on right limbs, and absent in left limbs (thoracic and pelvic)
Segmental <u>Reflexes</u> : Normal in all limbs C
Palpation: No apparent pain on palpation or manipulation

Usualy towards lesion

Lecture 4 Cranial Nerves

- Afferent: Carry Sensory input towards the brain + Spinal Cord
- Efferent: Carry motor output away from the brain or spinal cord

All Cranial nerves except for I and II are part of the peripheral nervous system

S, S, M, M, B, M, B, S, B, B, M, M

Afferent only Cranial Nerves I, II, VIII

Efferent only Cranial Nerves III, IV, VI, XI, XII

Mixed Cranial Nerves: V, VII, IX, X

Cranial Nerves with parasympathetic fibers: III, V, IX, X

Skull Foramina

The Round Foramen = Rostral alar Foramen * Maxillary nerve

Jugular Foramen = Tympanooccipital Fissure: Glossopharyngeal, Vagus,
+ Accessory Nerve

Cranial nerves and their Foramina

- I. Olfactory (smell) Cribriform Plate
- II. Optic (vision) Optic Canal
- III. Oculomotor (supplies motor to the dorsal rectus, medial rectus, ventral rectus, and ventral oblique eye muscles)
* Horses have a levator palpebrae muscle
Parasympathetic Innervation - Constricts pupils
Orbital Fissure
- IV. Trochlear Nerve (supplies motor to extraocular muscle Contralateral dorsal oblique muscle) * Think of a Pulley System
① → ① ↶
Emerges dorsally + crosses to innervate contralateral side
Orbital Fissure
- V Trigeminal Nerve: Ophthalmic: Orbital Fissure
Maxillary: Round Foramen / Rostral alar Foramen
Mandibular: Oval Foramen
- VI Abducens Nerve: (motor to extraocular muscles; lateral rectus, retractor bulbi)
Orbital Fissure
- VII Facial Nerve: (Taste + sensory info to small area of the ear, motor to muscles of facial expression)
Parasympathetic Innervation for glands of the head
Stylomastoid Foramen
- VIII Vestibulocochlear Nerve: (hearing and balance)
* Only CN that does
Internal Acoustic Meatus Not exit the skull
- IX Glossopharyngeal Nerve: (sens. info to upper pharynx + caudal 1/3 tongue
Motor to the muscles of the pharynx)
Jugular Foramen Parasympathetic: visceral Sensation Chemoreceptors
Tympanooccipital Fissure and baroreceptors in the carotid body + sinus
and Innervation to the parotid + zygomatic sali. gland

X Vagus Nerve: (Sensory info from pharynx, back of the ear and external meatus, taste from epiglottic region
 Jugular Foramen)
 Tympanooccipital fissure
 motor to muscles of pharynx and most of larynx)

Parasympathetic Innervation of smooth muscle glands of pharynx, larynx, and viscera of thorax + abdomen.

Sensory info from larynx, esophagus, trachea, abdominal and thoracic viscera, stretch receptors of aortic arch + chemoreceptors of aortic bodies.

Stimulation: Cardiac. ↓HR

Resp. ↑ Bronchial secretions + bronchoconstrict

GI ↑ Secretion + motility

XI Accessory Nerve (motor to the muscles of the larynx and esophagus, motor to neck + shoulder muscles)
 Jugular Foramen)
 Tympanooccipital fissure

*Cranial + Spinal root

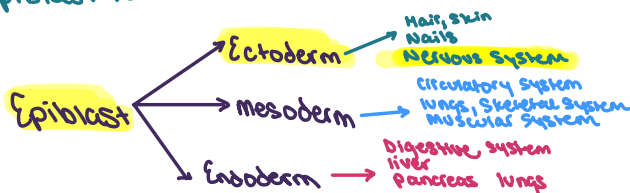
XII Hypoglossal Nerve (motor to the intrinsic and some extrinsic muscles of the tongue)

Hypoglossal Foramen

Embryology of the Nervous System lectures 9-10
 Zygote → morula → Blastula

Trophoblast forms placenta

Epiblast-Ns

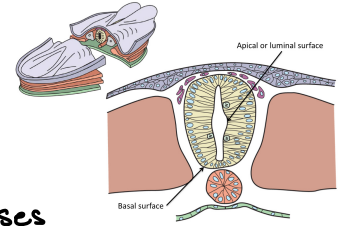


Primitive Streak defines bilateral symmetry Caudal → rostral

Notochord is mesodermal



Neurulation: Neural Tube



Notochord - Induces neurulation, formation of head process, formation of Somites

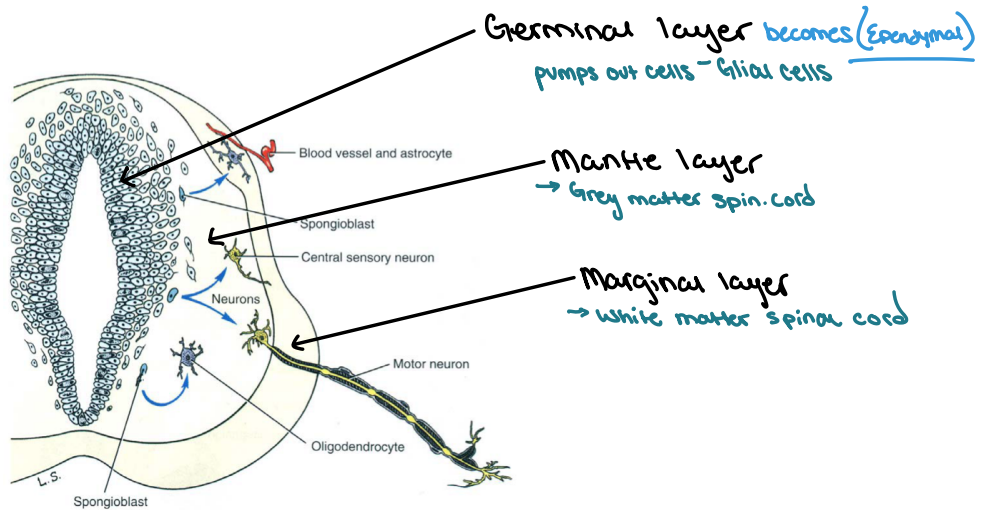
↳ basically disappears in mammals → nucleus pulposus

→ **Secretes Sonic Hedgehog!**

→ Signals to neuroectoderm which makes it start to fold

Neural tube closes rostral → caudal

Differentiation



*microglia come from the blood (immune cell)

*sulcus limitans defines dorsal + ventral in the spinal cord (sensory vs motor)

Clinical Application

- Spinal dysraphism: Neural tube defect causing abnormal formation of the neural tube → spinal cord

* Weimaraners

NKX2-8 Homeobox Hox gene

- Disorganized mantle/marginal layers

Somites ! → Mesodermal

↳ Primitive blocks of mesoderm bilateral to notochord

↳ Develop cranially → caudally

Sclerotome - vert. ribs skull base

Myotome - skeletal muscles

Dermatome - skin dermis

Somite blocks split and fuses w/ rostral aspect of previous somite

Clock and wave  Notch, Wnt, FGF pathways

Now Notochord Dissipates and the Nucleus pulposus Forms!

↑ Driven by same pathways

Hansen's Type 1 IVDD

Fgf4 extra copy on Chromosome 12 Notochordal cells die early
↑
originally on Chromosome 18

Chondrification + Ossification can also go wrong

Spina Bifida - Usually incidental finding but can cause clinical issues

- Failure of neural tube closure
- Bulldogs

Manx cats - vertebral hypoplasia or aplasia +/- myelodysplasia

- Inherited autosomal dominant

Hemivertebrae - Failure of formation of part of vertebral body

- * Deformity
- Screw-tailed dogs * myelopathy
- DVL2 mutation Wnt pathway

Butterfly vertebrae - Notochord Persists

Block vertebrae - Failure of Segmentation

Peripheral Nervous System Development

Neural Crest Cells - Form

- Spinal ganglia (Dorsal root)

- Peripheral Nerve (sensory)

- Autonomic (post ganglionic) sympathetic, sacral parasymp.

Neural Crest Derivatives

↳ Melanoblasts **tyrosine metab.**

Vasculature

(lepto) meninges

Enteric NS

Schwann cells **PNS**

Adrenal medulla **tyrosine metab.**

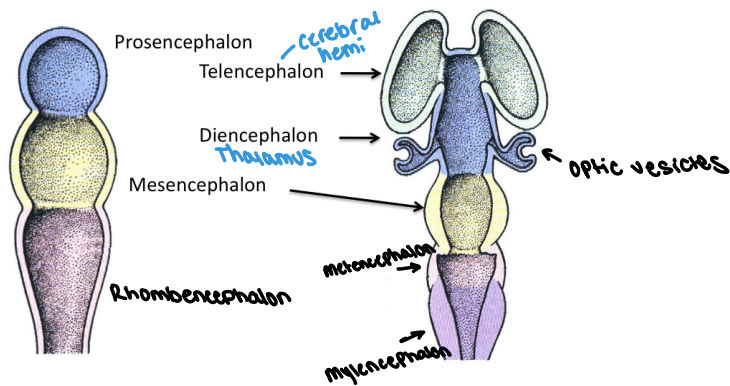
Autonomic NS (ganglial) **tyrosine metab.**

Great vessel walls, thyroid

Bone/cartilage Skull

↓
to nosepi.

Differentiation of the Brain Vesicles



Pharyngeal Arches: mesodermal outpocketings

gives rise to CN structures

Somite derived muscle CN III, IV, VI, XII (eyes + tongue) * nerves come of ventrally

Brainstem

medulla Oblongata: lots!

CN VIII SP, SSA

CN VII, IX, X GVA, SVA

CN VII, IX, X GVE

CN VII, IX, X, XI SVE

CN V, XII GSE

metencephalon (cerebellum + Pons): CN V

mesencephalon (midbrain): CN III, IV

Thalamus came from diencephalon: Relay for sensory info

Regions of the Cerebral Cortex

- Paleopallium - primitive (olfactory)
- Archipallium - limbic system
- Neopallium - cortical surface Basal nuclei
 - Projection axons
 - association axons
 - commissural axons