Anatomy Team
MED 439

Revised & Approved

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MED439
KING SAUD UNIVERSITY

Development of the Cerebrum & Cerebellum

CNS Block

Don't forget to check the Editing File

Color index:

Content
Male slides
Female slides
Important
Doctors notes
Extra information, explanation

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Objectives

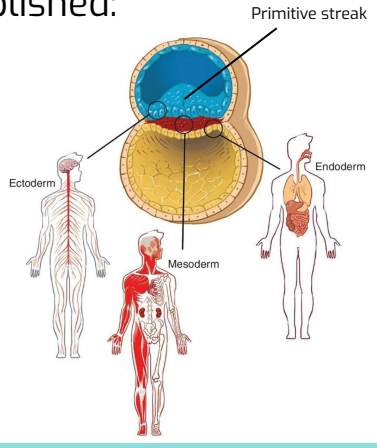
At the end of the lecture, students should be able to:

- Describe the formation of the neural tube.
- List the 3 brain vesicles and their derivatives.
- Describe the brain flexures.
- Describe briefly the development of the cerebrum.
- Describe briefly the development of the cerebellum.

INTRODUCTION

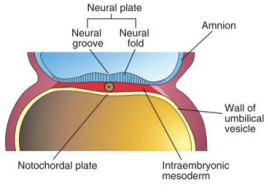
By the beginning of the **3rd week** of development, three germ cell layers become established:

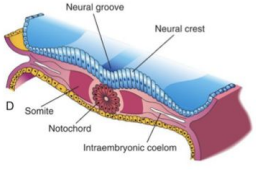
Ectoderm — Mesoderm — Endoderm

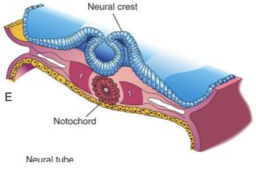


Early development

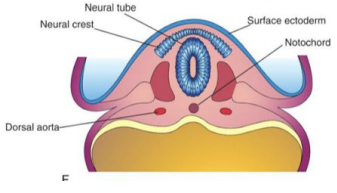
- During the middle of the 3rd week(16-17 days) the dorsal midline ectoderm undergoes thickening to form the neural plate (neuroectoderm).







- The 2 margins of the plate elevate, forming neural folds.
- A longitudinal, midline depression, called the neural groove is formed.
- The 2 neural folds approximate then fuse together, thus sealing the neural groove and creating the neural tube. (complete close).
- Formation of neural tube is completed by the middle of 4th week.



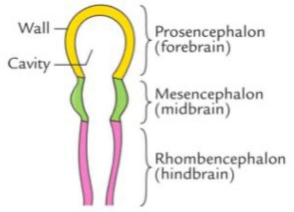
Neural Tube Development

end of 4th week

Three- primary brain vesicles stage , Neural tube upper end dilates and shows 3 vesicles:

The brain develops from the cranial part of neural tube

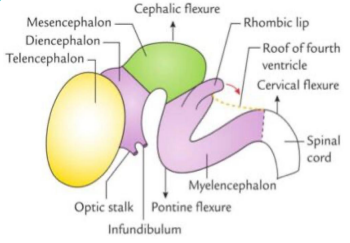
- Prosencephalon (Forebrain)
- Mesencephalon (Midbrain)
- Rhombencephalon (Hindbrain)



by 4th week

The neural tube grows rapidly and faster than the cranial cavity. So it bends twice ventrally, producing two flexures. later on it bend once dorsally producing 3rd flexures :

- **Midbrain flexure:** (cephalic) between the prosencephalon & the mesencephalon (midbrain)
- **Cervical flexure:** between the Rhombencephalon (hindbrain) & the spinal cord
- Later **Pontine flexure:** appears in the hindbrain, in the opposite direction, resulting in thinning of the roof of the hindbrain.



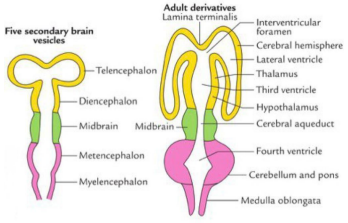
5th week

five secondary brain vesicles stage

- **Prosen**cephalon divides into:
  - 2 lateral **Telen**cephalon (cerebral hemisphere)
  - 1 median **Dien**cephalon (Thalamus family)
- **Mesen**cephalon (Midbrain)
- **Rhomben**cephal on divides into:
  - **Meten**cephalon (Pons-Cerebellum)
  - **Myelen**cephalon (Medulla oblongata)

Extra info:
Why does the bending occur in these particular sites?

Because they grow less than the other major sites in the brain thus making them easily flexible.

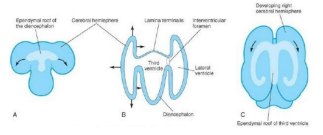


Differentiation of Forebrain Vesicle:

-The lumen gives the **2 lateral ventricles** and the (median)**3rd ventricle** Both cavities communicating with each other through **a wide interventricular foramen**.

-The cerebral hemispheres **expand in all directions** (as it grows it continues to enclose the rostral end of the cranial tube).

- Its medial wall becomes **thin**, **flat** and it is **the site of choroid plexus of the lateral ventricle**.



Neural Tube Development

*Male slides

PRIMARY BRAIN VESICLES	SECONDARY BRAIN VESICLES	DERIVATIVES IN MATURE BRAIN	CAVITY
PROSENCEPHALON (FOREBRAIN)	TELENCENPHALON	CEREBRAL HEMISPHERE	LATERAL VENTRICLES
	DIENCEPHALON	THALAMUS, HYPOTHALAMUS, EPITHALAMUS, SUBTHALAMUS	THIRD VENTRICLE
MESENCEPHALON (MIDBRAIN)	MESENCEPHALON	MIDBRAIN	CEREBRAL ACQUEDUCT
RHOMBENCEPHALON (HINDBRAIN)	METENCEPHALON	PONS, CEREBELLUM	FOURTH VENTRICLE
	MYELENCEPHALON	MEDULLA OBLONGATA	

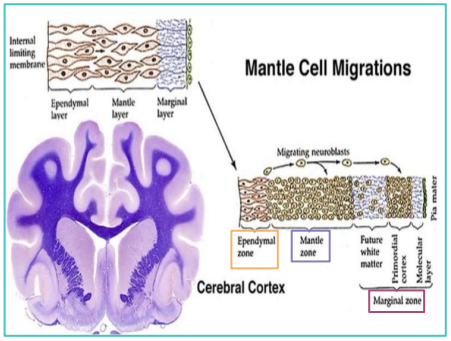
Development of the cerebrum

The cerebrum develops from the **Telencephalon** is formed of <u>3 layers</u> :

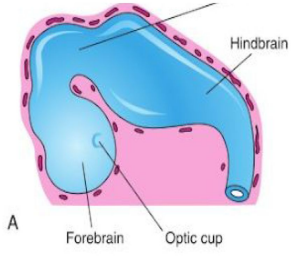
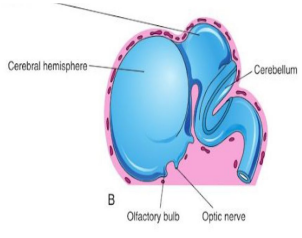
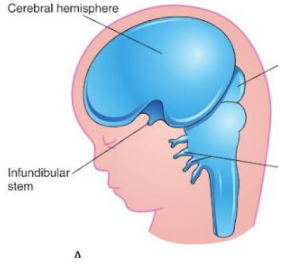
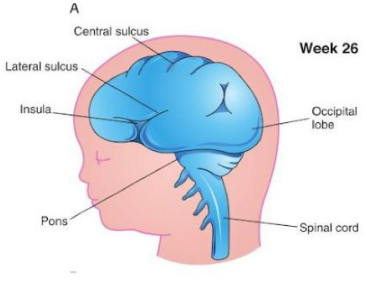
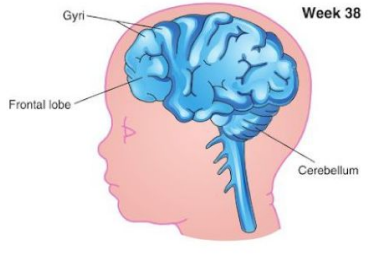
1- Ependymal: lining the cavity of the lateral ventricle.

2- Mentle: nerve cells forming the grey matter.

3- Marginal: nerve fibers forming the white matter.



As development proceeds the following changes occur:
Most of the nerve cells in mantle layer migrate to the marginal layer forming the cerebral cortex. Some cells do not migrate and remains to form the **basal ganglia**

Day 32	Week 16	End of 3rd month	4th month
The cerebral hemisphere first appear as a pair of bubble-like outgrowth of the telencephalon	The rapidly growing hemispheres are oval and have expanded back to cover the diencephalon.	The surfaces of the cerebral hemispheres are smooth.	The grey matter grows faster than the white matter, so , the cortex becomes folded into gyri separated by sulci. The gyri and sulci effectively increase the surface area of the brain . The detailed pattern of gyri & sulci varies to some extend from individual to individual.
			 

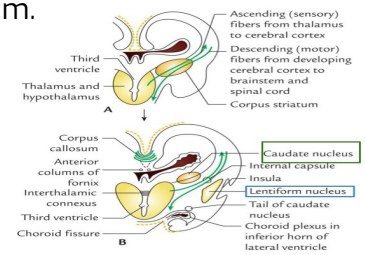
Development of the cerebrum (cont.)

Development of Corpus striatum (it's a part of the basal ganglia):

- It appears in **6th week** in the floor of each cerebral hemisphere.

As the cerebral cortex differentiates and the fibers passing to and from it, they pass through the corpus striatum.

- The corpus striatum now divides into: caudate nucleus. lentiform nucleus
- This fiber pathway forms the internal capsule
- Further expansion of cerebral hemisphere gives C- shape appearance to the hemisphere itself as well as its cavity (lateral ventricle).
- Also the caudate nucleus elongates and assumes the shape of the lateral ventricle and remains related to it.

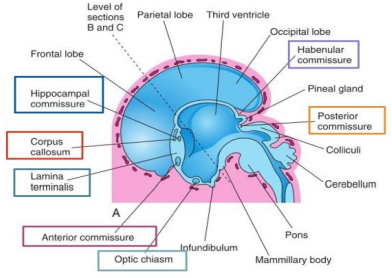


Development of cerebral commissures:

As the cerebral cortex develops, group of fibers, (commissures), connect the corresponding regions of the cortex. These are:

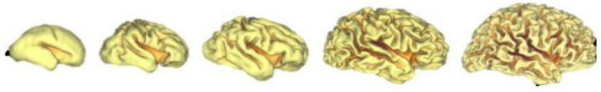
1- Lamina terminalis.
2-Optic chiasma.
3- Anterior commissure
4-Posterior commissure
5-Hippocampal commissure.
6-Habenular commissure.
7-Corpus callosum (the largest):
(is a major commissural fibres that connect the two cerebral hemispheres)

Note:
All these commissure fibers pass through the lamina terminalis EXCEPT for the posterior commissure.



Development of insula:

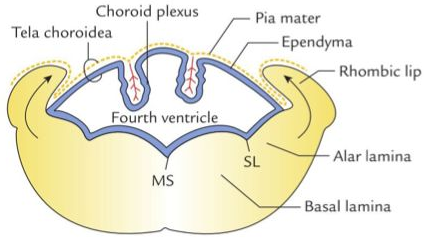
The cortex covering the surface of the **corpus striatum** grows relatively slower than the other cortices, so it is overgrown by the rest of the hemisphere and lies in the depth of the lateral sulcus. So, the insular lobe is a portion of cerebral cortex that has been hidden to lie deep within the lateral sulcus.



Development Of Cerebellum

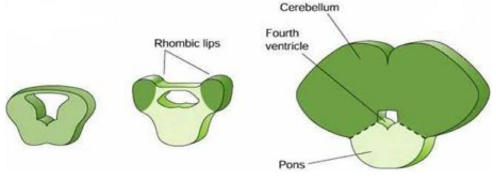
It develops from the dorsal part of the Metencephalon The metencephalon develops into the pons (anteriorly) and overlying Cerebellum (posteriorly) Pontine flexure results in:

1- Moving the alar plates (It is part of dorsal side of neural tube) laterally then pending medially
2- Stretching and thinning of the roof plate.
3- Widening of the cavity to form the 4th ventricle.



Metencephalon : Changes In Alar Plates

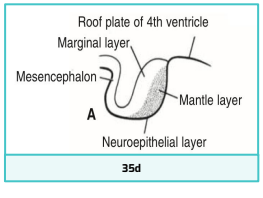
- The two lateral sides of dorsal parts thicken to form Rhombic lips, that will give rise to the cerebellum.
- Some neuroblasts migrate from the mantle layer to the marginal layer and form the cerebellar cortex.
- Others remains in the mantle layer and give rise to the deep cerebellar nuclei.
- The cerebellar peduncles develop later as the axons of the neurons of the cerebellar nuclei grow out to reach the brain stem.

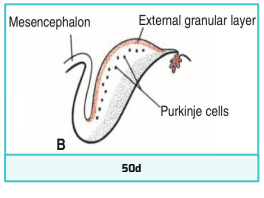


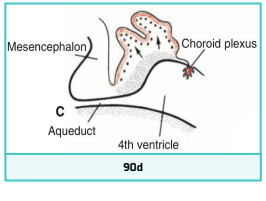
The Surface Of The Cerebellum

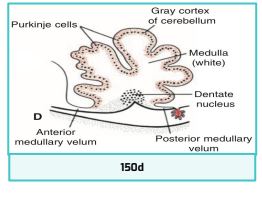
As the cerebellar hemispheres develops they undergo a complicated process of transverse folding to form closely packed, leaf-like transverse gyri called folia & fissures.

These processes of fissure formation and foliation continue throughout embryonic, fetal, and postnatal life, and they vastly (extremely) increase the surface area of the cerebellar cortex.



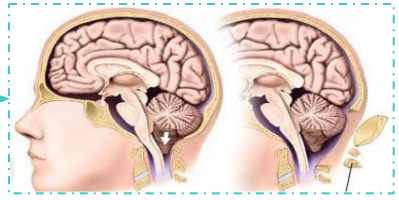






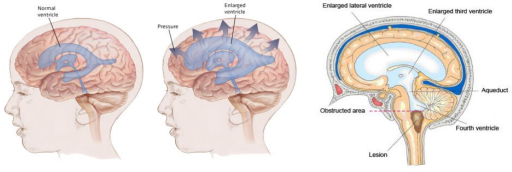
Congenital Anomalies of The Brain

The most Common Congenital Anomalies of The Brain



Hydrocephalus

The most common cause is a flow obstruction, by hindering the free passage of CSF through the ventricular system and subarachnoid space.



Arnold-Chiari malformation

Herniated part of cerebellum through the foramen magnum leading to CSF obstruction. so Hydrocephalus results.**Aqueductal stenosis and brain tumors . A condition in which brain tissue extends into the spinal canal. It occurs when a part of the skull is abnormally small, pressing on the brain and forcing it downward**

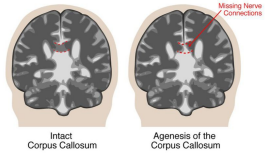
Cranium bifidum

Cranium bifidum with or without meningocele & meningoencephalocele.

Most of the Anomalies Manifested by:

- Seizures (Changes in electrical activity).
- Mental retardation.
- Cerebral palsy.

Agenesis of corpus callosum



Microcephaly

Abnormal small head which is a congenital condition associated incomplete brain development.

Anencephaly

the brain and skull are minute and the infant does not survive. is the absence of a major portion of the brain, skull, and scalp that occurs during embryonic development. It is a cephalic disorder that results from a neural tube defect that occurs when the rostral (head) end of the neural tube fails to close

MCQ

Q1: The distinguish of five secondary brain vesicles from the primary vesicles is in:			
A: 3rd month	B: 5th week	C: 5th month	D: 4th week

Q2: : Metencephalon develops into:			
A: Medulla	B: Midbrain	C: Pons and cerebellum.	D: A&C

Q3: The cerebral hemisphere first appear as a pair of bubble-like outgrowth of the telencephalon in:			
A: Week 16	B: End of 3rd month	C: Day 32	D: 4th month

Q4: Development of corpus striatum appears in which weak:			
A: 5th week	B: 3rd week	C: 4th week	D: 6th week

Q5: lateral ventricles and the third ventricle Both cavities communicating with each other by:			
A: Jugular foramen	B: Hypoglossal canal	C: Optic canal	D: interventricular foramen

Q6: Is the major commissural fibers that connect the two cerebral hemispheres:			
A: Anterior commissure	B: Corpus callosum	C: Posterior commissure	D: Hippocampal commissure

Answer key:
1 (B) , 2 (C) , 3 (C) , 4 (D) , 5 (D) , 6 (B)

MCQ

Q7: Telencephalon develops into:			
A: Thalamus	B: Midbrain	C: Medulla	D: Cerebral hemisphere

Q8: which part of the embryonic ectoderm will thicken to form the neuroectoderm :			
A: inner cell layers	B: margins of the dorsal ectoderm	C: the dorsal midline ectoderm	D: A&B

Q9: which of the following appears in the hindbrain and in the opposite direction :			
A: Cervical flexure	B: Midbrain flexure	C: Forebrain flexure	D: Pontine flexure

Q10: These processes of fissure formation and foliation continue throughout :			
A: Embryonic	B: Fetal	C: Postnatal life	D: All of them

Q11: It's abnormal small head associated with incomplete brain development:			
A: Hydrocephalus	B: Microcephaly	C: Agenesis of corpus callosum	D: Arnold-Chiari malformation

Q12: The brain and skull are minute and the infant does not survive:			
A: Hydrocephalus	B: Agenesis of corpus callosum	C: Anencephaly	D: Cranium bifidum

Answer key:
7(D) , 8(C) , 9(D) , 10(D) , 11(B) , 12(C)

SAQ

Q1: Enumerate the secondary brain vesicles ?

Q2: Enumerates the commissures that connects the corresponding regions of the cortex ?

Q3: Mention the derivatives in mature brain that located in the third ventricle ?

Q4: Most of the Anomalies manifested by ?

Answers

1 : Telencephalon - Diencephalon - Mesencephalon - Metencephalon - Myelencephalon.

2 :
1- Lamina terminalis.
2-Optic chiasma.
3- Anterior commissure
4-Posterior commissure
5-Hippocampal commissure.
6-Habenular commissure.
7-Corpus callosum.

3 : THALAMUS - HYPOTHALAMUS - EPITHALAMUS - SUBTHALAMUS.

4: Seizures (changes in electrical activity) , Mental retardation and Cerebral palsy.

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- Abdulaziz Alkraida
- Abdulaziz Alomairy
- Abdulaziz Alrabiah
- Abdulaziz Alsuhaim
- Abdulrahman Almugren
- Ahmed Alkhayatt
- Bader Alrayes
- Basel Fakeeha
- Fahad Alajmi
- Faisal Alotaibi
- Fayez Altabbaa
- Feras Alqaidi
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