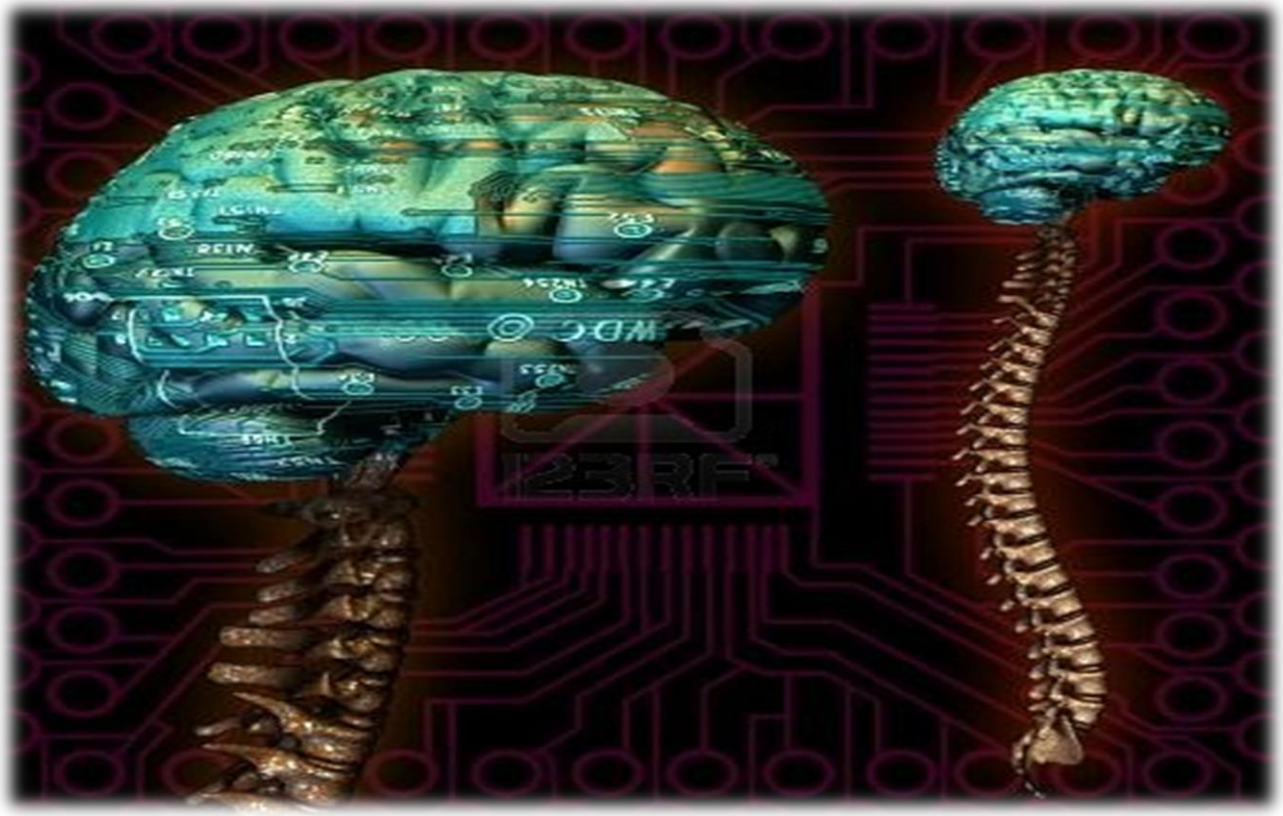
CNS Block



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DEVELOPMENT of CEREBRUM & CEREBELLUM

Contents :

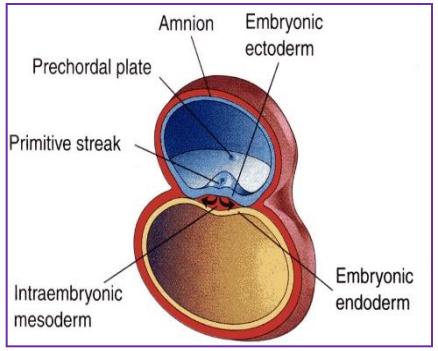
1) Introduction
2) General stages of brain development
3) Development of cerebrum
4) Development of cerebellum
5) Congenital disorders
6) Pictures
7) Review

OBJECTIVES :

- 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 and the cerebellum.
- List the most common congenital anomalies in brain development..

remember

By the beginning of the 3rd week of development, three germ cell layers become established, **Ectoderm, Mesoderm** and **Endoderm.**



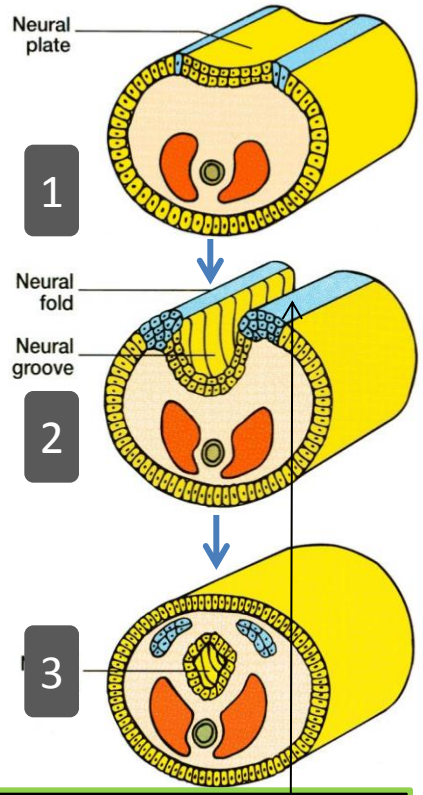
EARLY DEVELOPMENT

During the middle of the 3rd week, *the dorsal midline ectoderm* undergoes thickening to form the **neural plate.**

1. The 2 margins of the plate elevate, forming **neural folds**

2. So a longitudinal, midline depression, called the **neural groove is formed.**

3. The 2 neural folds approximate then fuse together, thus sealing the neural groove and creating the **neural tube.**



Extra note

Some cells are detached at the side of separation of the two neural folds and form neural crest which give some structure. like **spinal ganglia**, **parasympathetic ganglia** and medulla of suprarenal gland

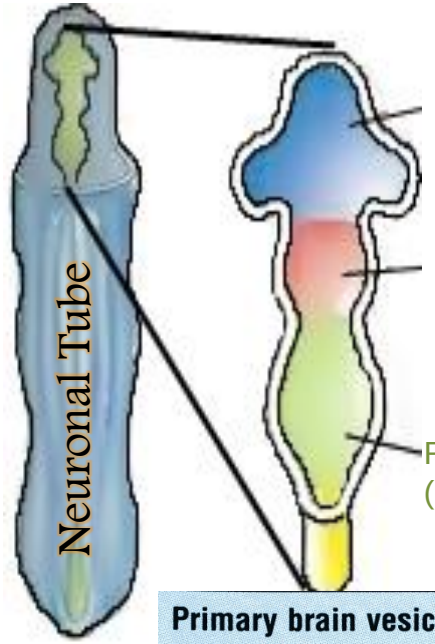
1) general stages of brain development

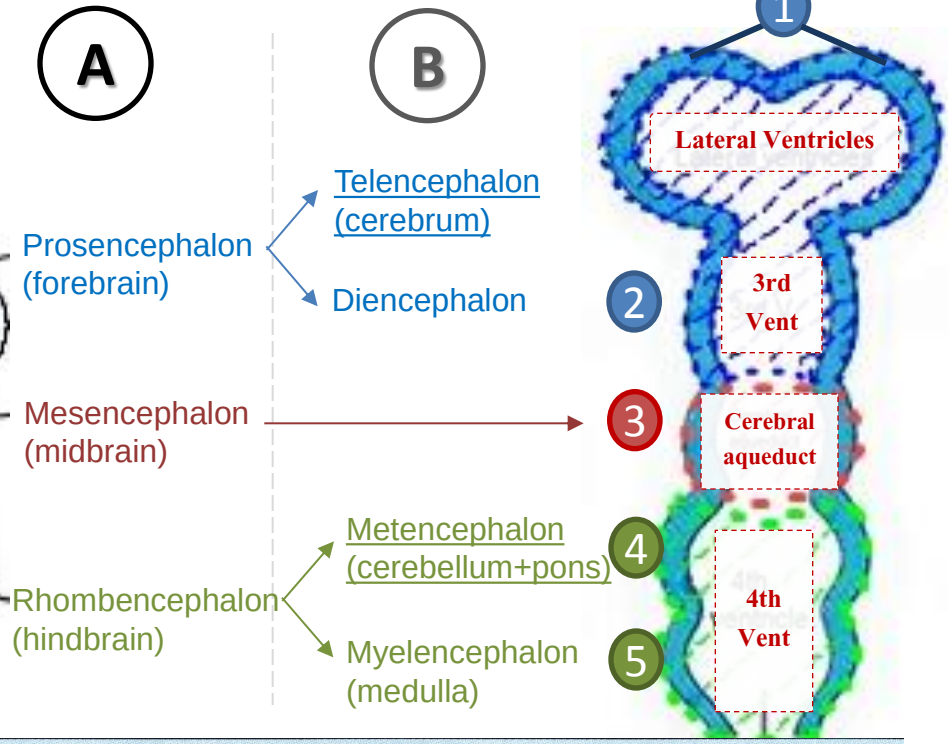
1) *Neural Tube (cranial part) development*

A- Three-vesicles stage (end of 4th week)
Its upper end dilates & shows 3 vesicle →

B- five 2ry brain vesicles stage (5th week)
- Prosencephalon divides into:
two lateral telencephalon , one median diencephalon
- Rhombencephalon divides into:
metencephalon , myelencephalon

*don't confuse : the blue area around the cavities is the one responsible of formation of gray and white mater.
Cavities will latterly form the ventricles of the brain

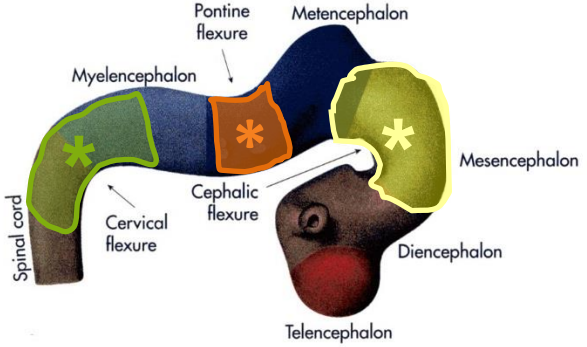




Primary brain vesicles	Secondary brain vesicles	Derivatives in mature brain
Prosencephalon (forebrain)	Telencephalon	Cerebral hemisphere
	Diencephalon	Thalamus
Mesencephalon (midbrain)	Mesencephalon	Midbrain
Rhombencephalon	Metencephalon	Pons, cerebellum
(hindbrain)	Myelencephalon	Medulla oblongata

2) *Brain Flexures (4th week)*

Rapid growing of neuronal tube leads to formation of flexures
* **Cervical** flexure:
Between the hind brain & the spinal cord.
* **Midbrain** flexure:
between Prosencephalon & mesencephalon (midbrain)
* **Pontine flexure (dorsal flexure)** appears later in the hindbrain, in the opposite direction → thinning of the roof of the hindbrain.

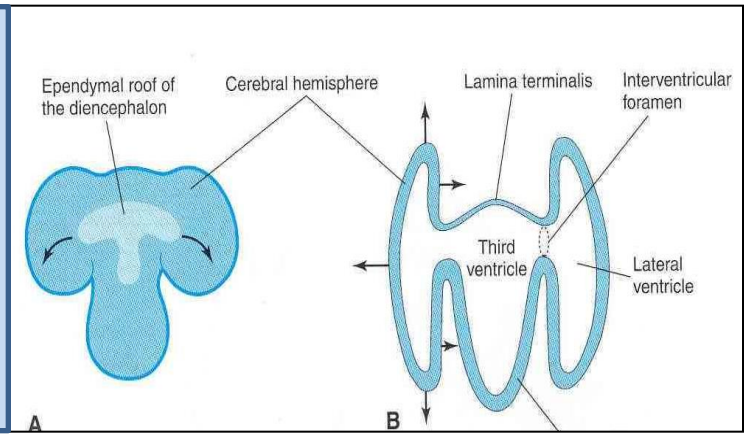


2) Development of the Cerebrum *(from forebrain vesicle)*

1) Differentiation of forebrain vesicle

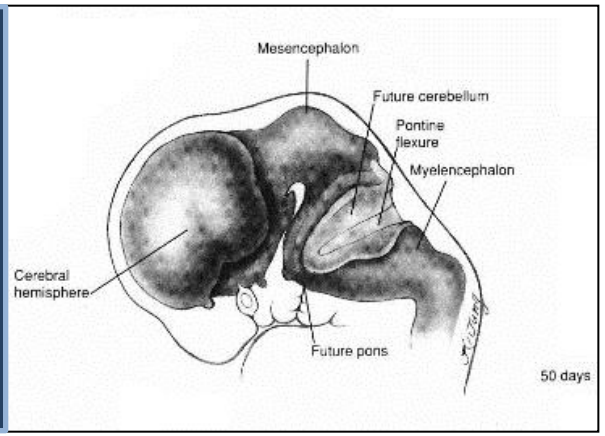
Forebrain differentiates into:
1) Telencephalon (it's cavity forms tow lateral ventricles)
2) Diencephalon (it's cavity forms 3rd ventricle)

Both communicates with each other by interventricular foramen.



2) Rapid growing (1st stage)

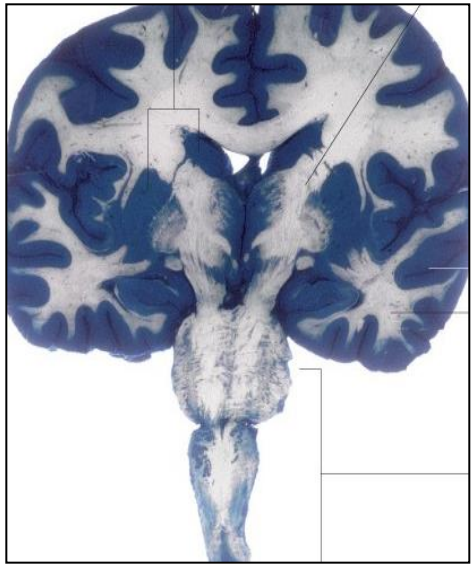
Formation of how hemispheres on day 32. by week 16, rapidly hemispheres are oval in shape and cover the diencephalon.



3) – A Differentiation of cells

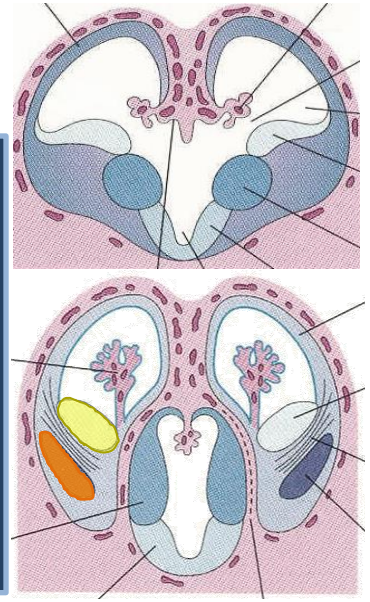
The wall of telencephalon divides into 3 layers :
1) Ependyma : lining ventricles' cavities.
2) Mantle layer : intermediate layer contains cell bodies (gray mater)
3) Marginal layer : outer layer contains nerve fibers (white mater)

Gray mater migrates to the outer aspect → forming cortex. Remaining parts will form basal ganglia.



3) – B Basal Ganglia

The basal ganglia appears in 6th week in the floor of each hemisphere. Cell bodies in the cortex differentiate and their fibers passing (as internal capsule) through basal ganglia (corpus striatum)
to divide it into caudate and lentiform nuclei.



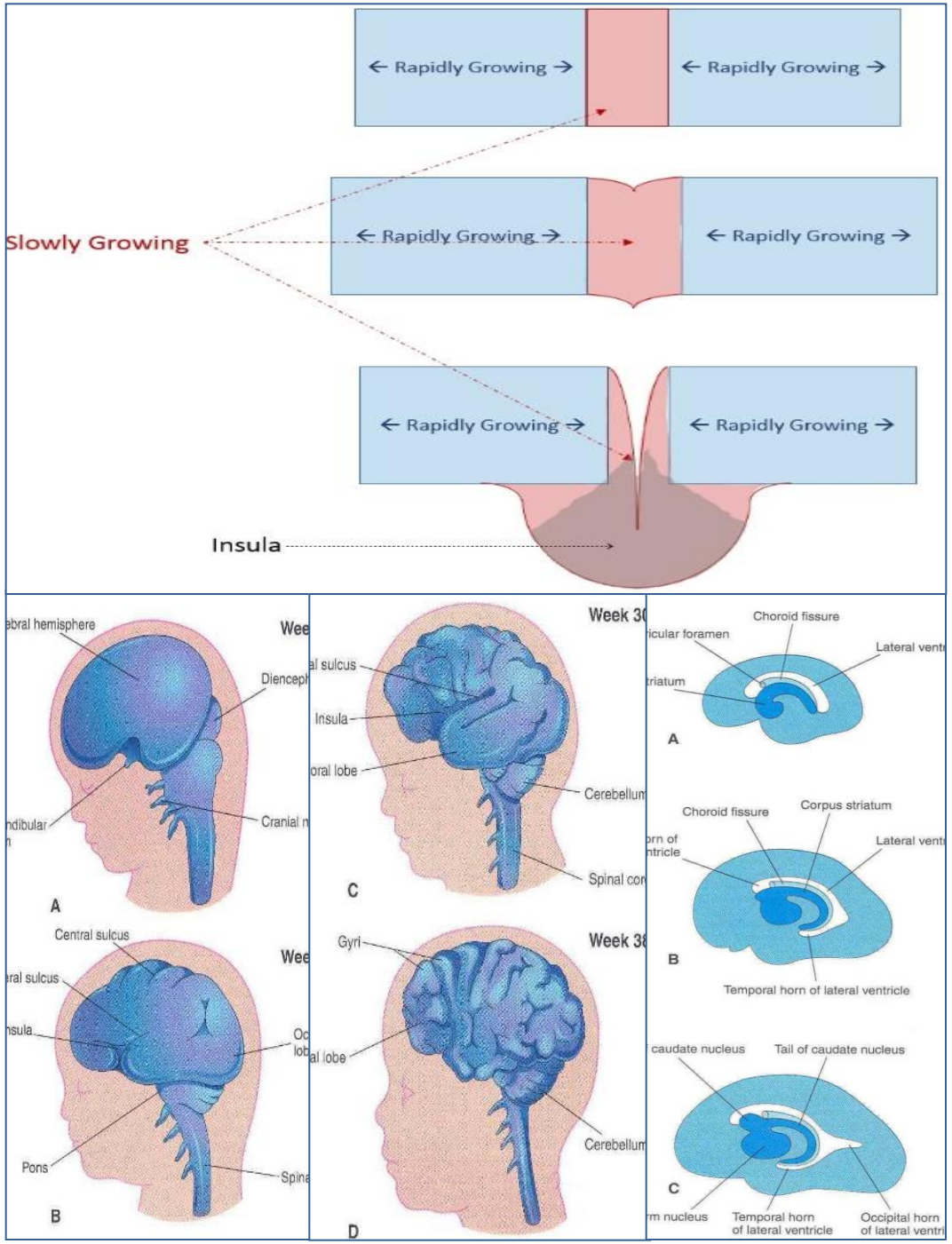
4) Rapid growing (sulci & gyri + C-shape + Insula)

Cerebral hemispheres expand in all directions , it's medial wall becomes flat , thin. It's the site of choroid plexus (tuft of capillaries) of lateral vent.

by the 4th month ,. gray mater is growing faster than white mater → folding of the cortex → formation of gyri and sulci. The detailed pattern of gyri & sulci varies between individuals.

There is a gray mater part which grows slowly compering to other area , and that will posh this area (called insula) inside to the depth of the brain.

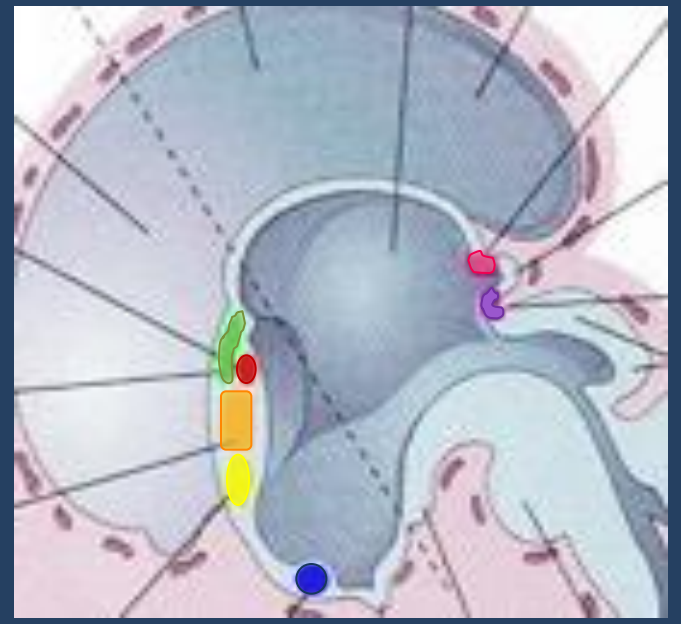
Further expansion of hemispheres gives it and it's components C-shape (including caudate nucleus which elongates to assume the C-shape)



5) Cerebral commissures

Cerebral cortex develops fibers connect between the corresponding regions in right and left hemisphere. These are :

- Lamina terminals
- Optic chiasma
- Anterior & posterior commissures.
- Hippocampal commissure.
- Habenular commissure.
- Corpus callosum.

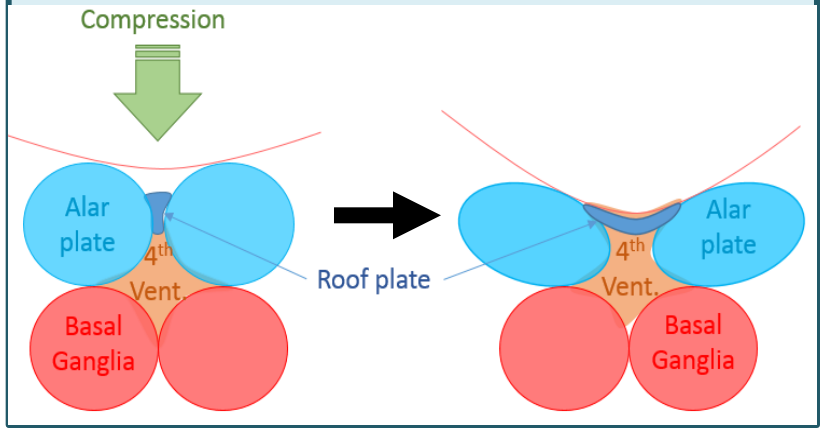


3) Development of the Cerebellum *(develops from Metencephalon)*

1

Pontine flexure results in:

1. Moving the alar plates laterally then pending medially.
2. Stretching and thinning of the roof plate
3. Widening of the cavity to form the 4th ventricle

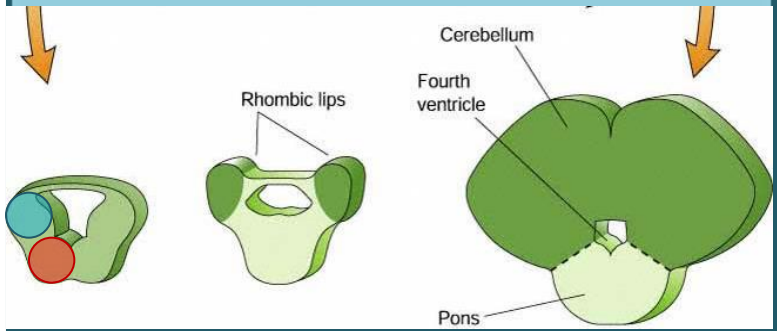


2

The dorsal parts thicken to form ***Rhombic lips*** , that will give rise to the ***cerebellum***.

Some neuroblasts migrate from the mantel layer to the marginal layer and form the cerebellar cortex. Others remains in the mantel layer and give rise to the cerebellar nuclei.

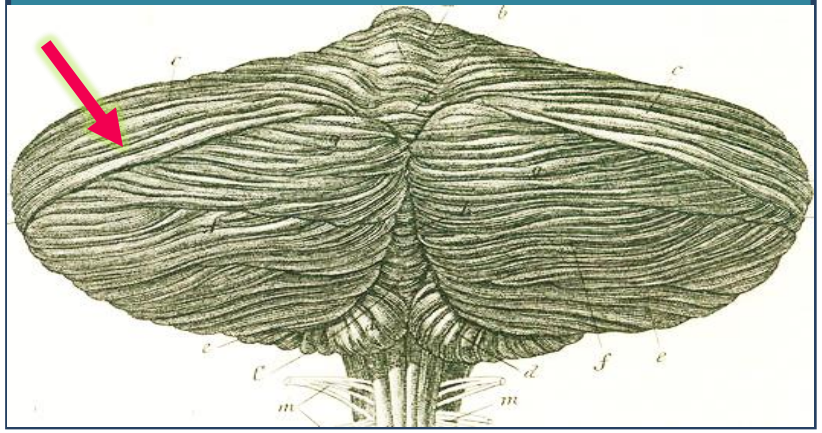
The cerebellar peduncles develop later on, as the axons of the neurons of the cerebellar nuclei grow out to reach the brain stem.



3

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

These processes continue until postnatal life, and they vastly increase the surface area of the cerebellar cortex.

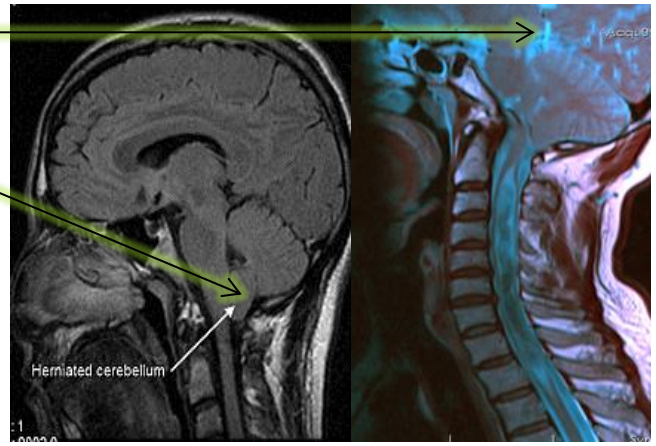


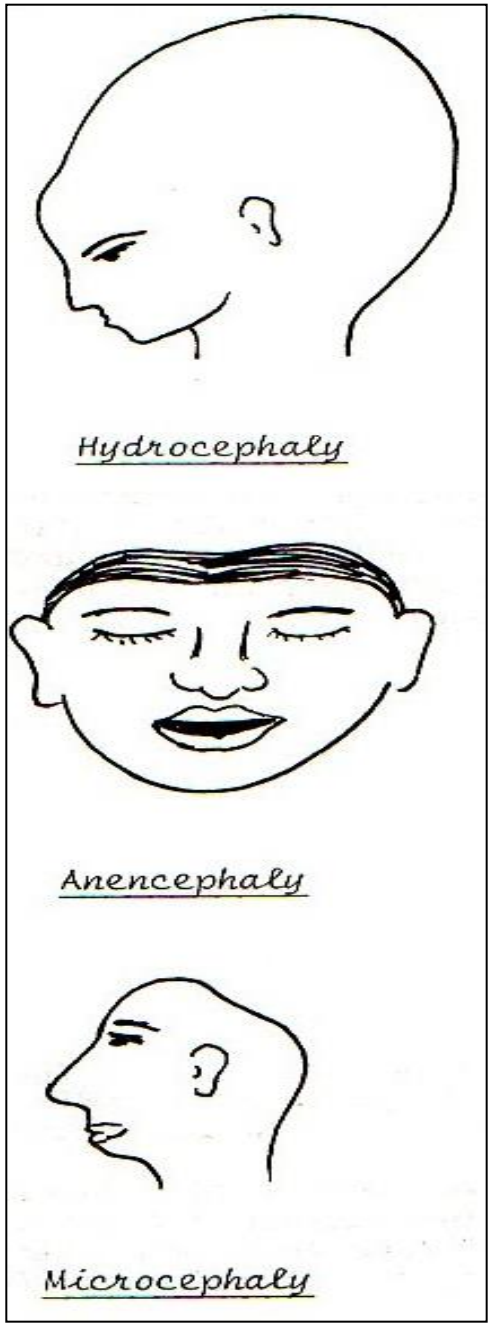
4) Congenital Anomalies of The Brain

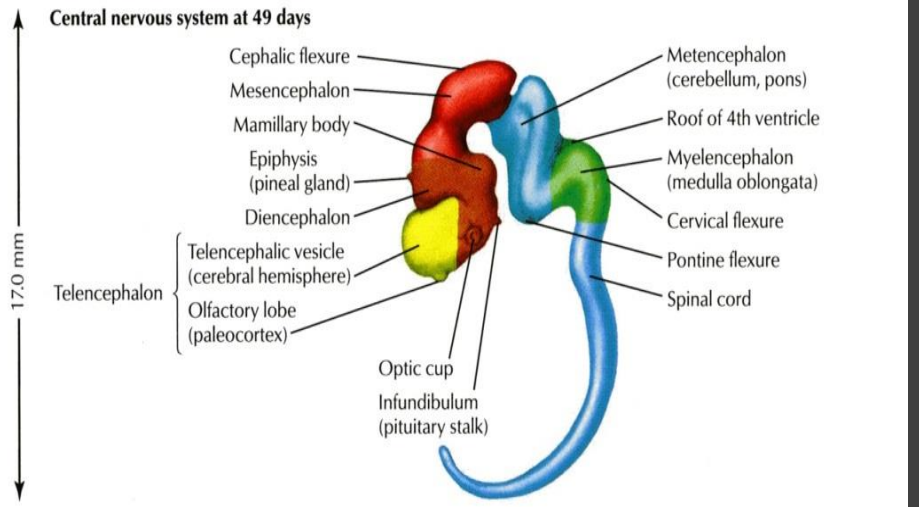
Might lead to :

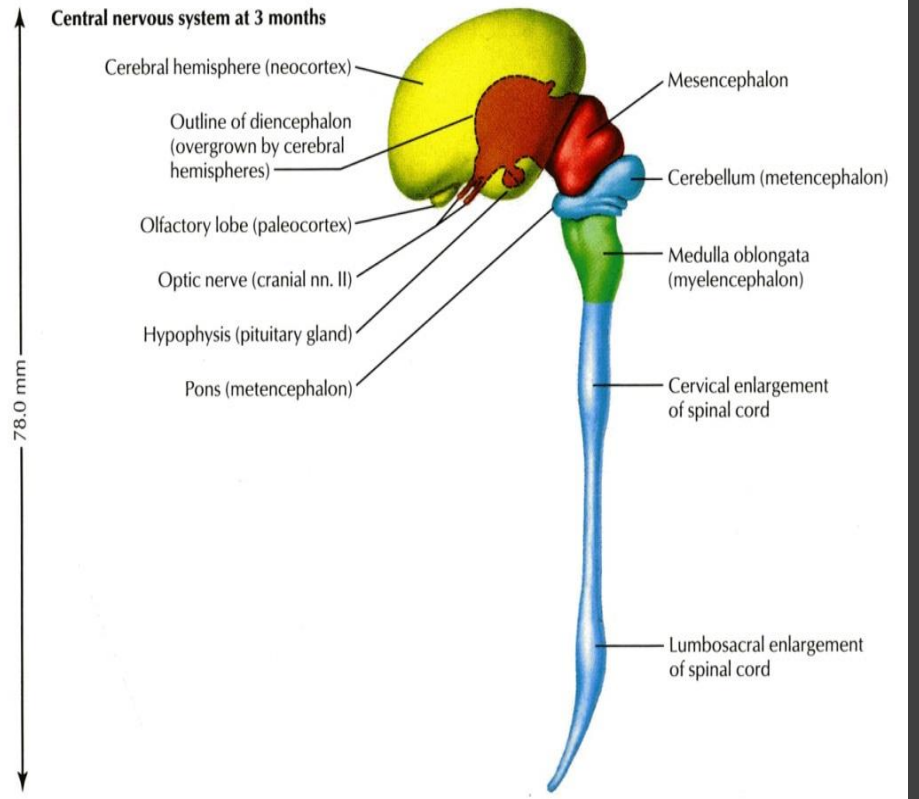
- Mental retardation.
- Seizures.
- Cerebral palsy.
- Cranium bifidum with or without meningocele & meningoencephalocele.
- Microcephaly.
- Agenesis of corpus callosum.
- Hydrocephalus. (Increase CSF)
- Arnold-Chiari malformation (Herniation of the cerebellar tonsils).
- Anencephaly.

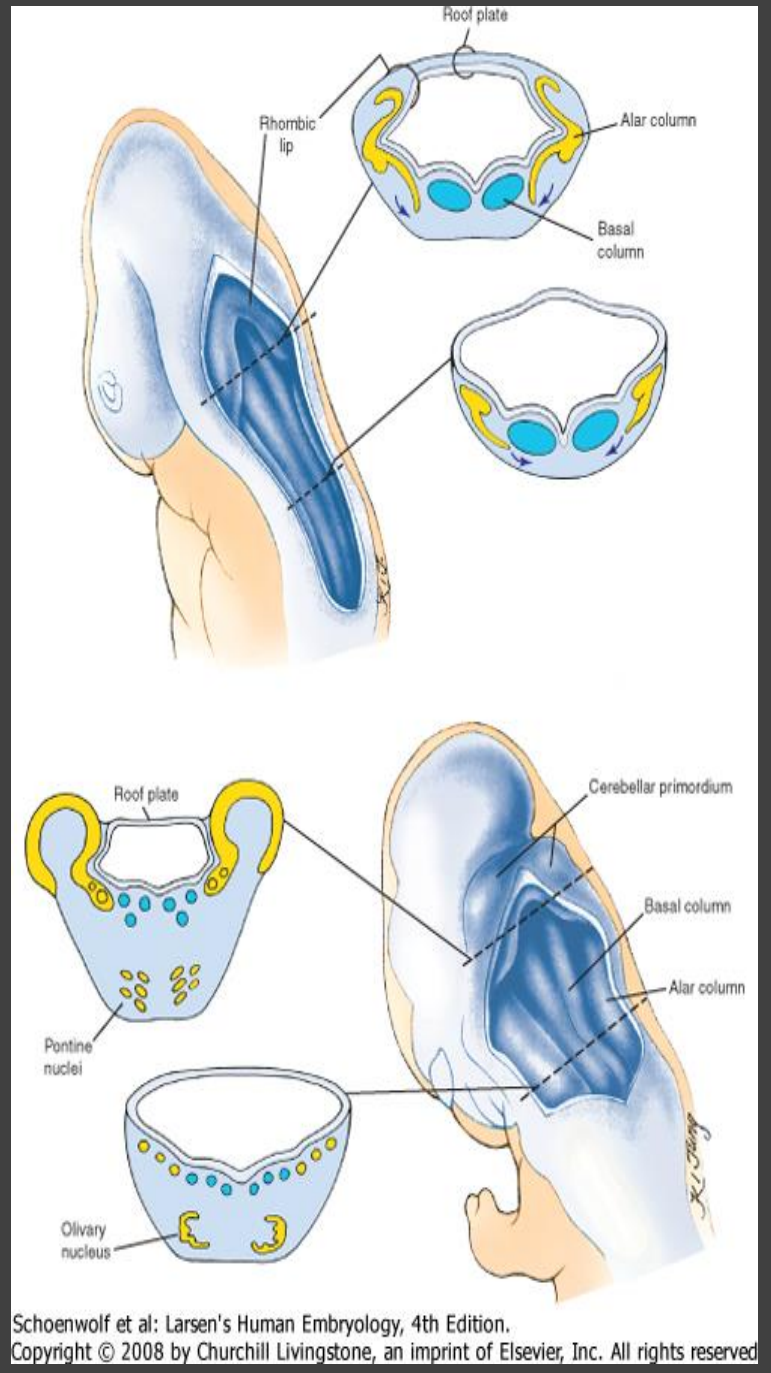
In **anencephaly**, the brain and skull are minute and the infant does not usually survive.











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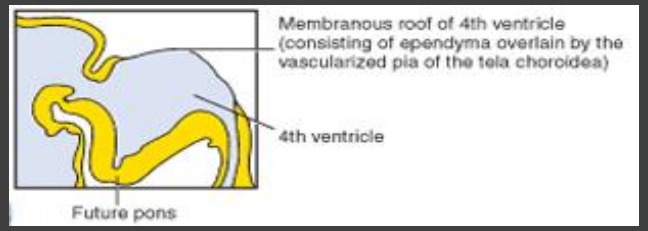

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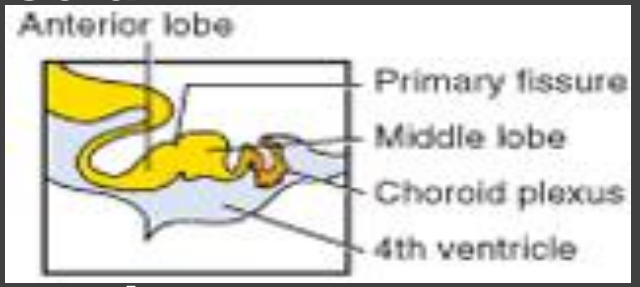

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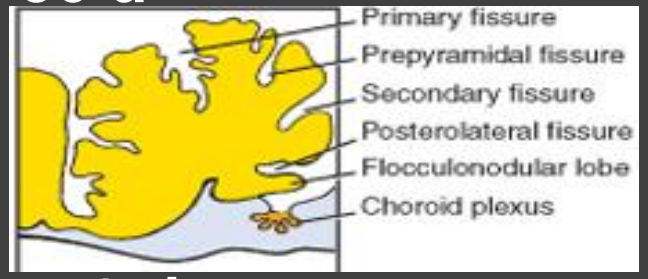

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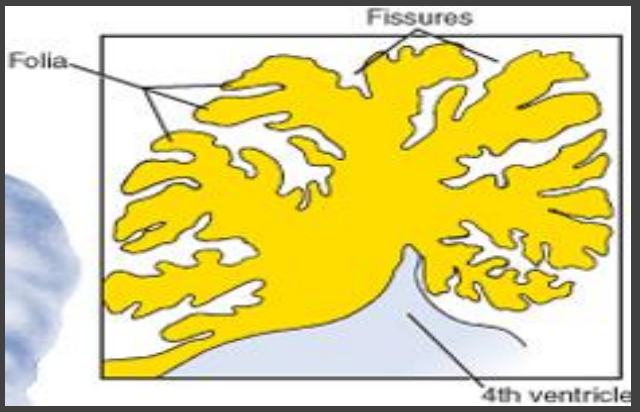

- Time line

time	event
Beginning of 3rd week	Established of three germ cell layers
Middle of 3rd week	Beginning of neural tube formation
Middle of 4th week	End of neural tube formation
End of 4th week	Three-vesicles stage
By 5th week	2ry brain vesicles formation (five-vesicles stage)
By the 4th week	Brain flexures formation
On day 32 (between 4th & 5th weeks)	The cerebral hemispheres appear as a pair of bubble
By 16 weeks	The hemispheres became oval and cover the diencephalon
End of 3rd month	Smooth surfaces of the cerebral hemispheres
By 4th month	The cortex became folded
6th week	Appearance of corpus striatum

- Questions

Which of the following form the cerebral hemosphers:
-Telencephalon
-Rhombencephalon
-Diencephalone
-mesencephalon

The cerebral aqueduct formed from the cavity of:
Mesencephalone
Diencephalon
Telencephalon
metencephalon