

وسهلا



أهلا

يُمنع أخذ السلايدات بدون  
إذن المحرر واي اجراء  
يخالف ذلك يقع تحت طائلة  
المسؤولية القانونية  
جميع المعلومات للاستخدام  
التعليمي فقط

# الأستاذ الدكتور يوسف حسين

أستاذ التشريح وعلم الأجنة - كلية الطب - جامعة الزقازيق - مصر

رئيس قسم التشريح والأنسجة والأجنة - كلية الطب - جامعة مؤتة - الأردن

دكتورة من جامعة كولونيا المانيا

جروب الفيس د. يوسف حسين (استاذ التشريح)

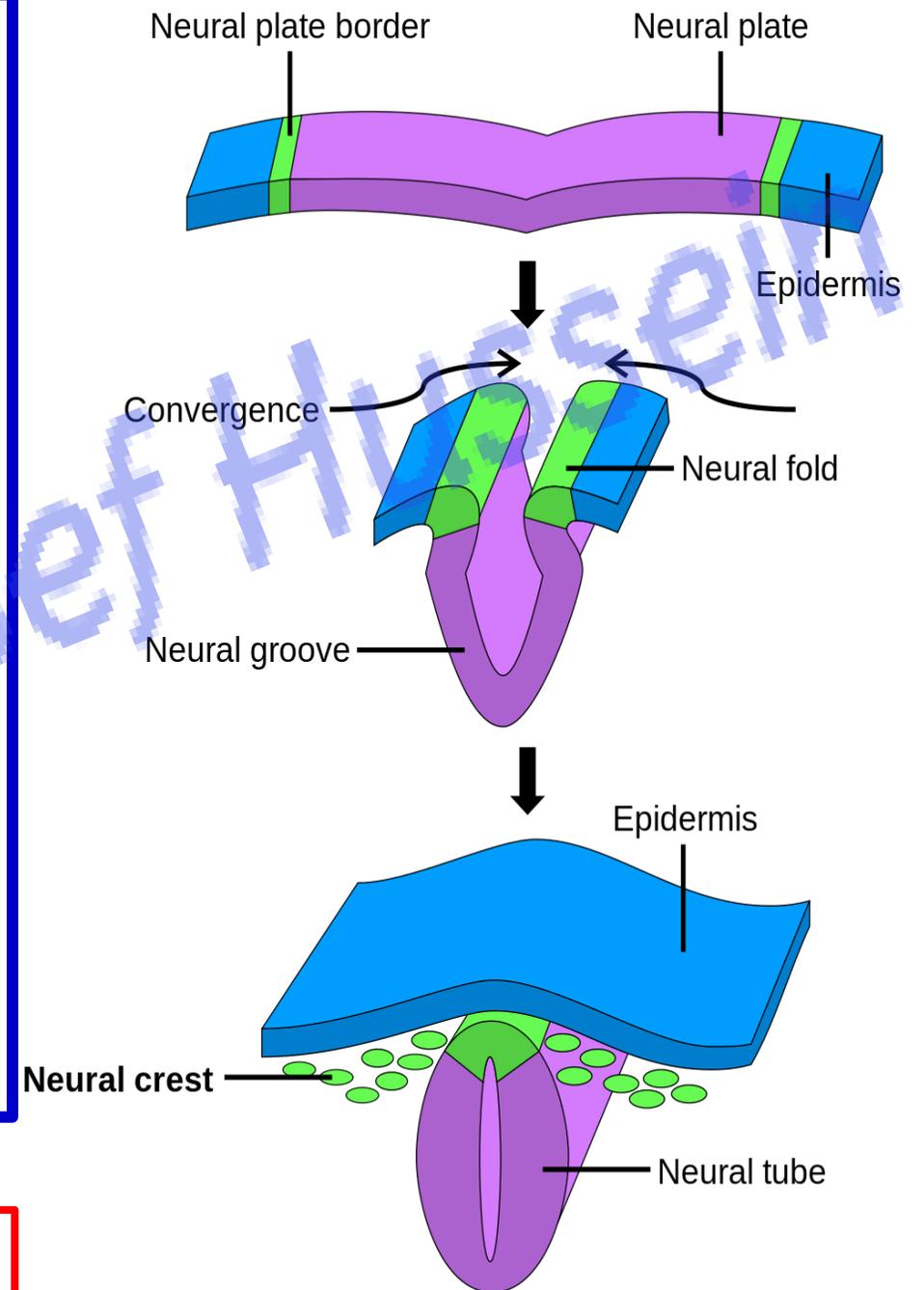
اليوتيوب د. يوسف حسين

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## Development of the neural tube:

- The neural tube develops as **neural plate** from the **ectoderm** dorsal to the notochord.
- A **neural pit** that forming the **neural groove**.
- The edges of the neural groove fused forming the **neural tube** that later on **separated** from the ectoderm.
- Neural tube lies opposite developed somites:
  - a- The part **cranial to the 4<sup>th</sup> somite** is dilated and forms the **brain**.
  - b- The part **caudal to the 4<sup>th</sup> somite** remains narrow and forms **the spinal cord**.



- Central and peripheral nervous systems origins
- Neuroepithelia in neural tube—CNS neurons, CNS glial cells (astrocytes, oligodendrocytes, ependymal cells).

- **Neural crest EMO PASSES**

1. **Enterochromaffin cells** in the epithelial layer of the entire gastrointestinal tract
2. **Melanocytes (Pigment cells** in the skin, iris and retina).
3. **Odontoblasts** (outer layer of the dental pulp)
4. **PNS ganglia** (cranial, dorsal root, autonomic)
5. **Adrenal medulla** (adrenal cortex is mesoderm)
6. **Schwann cells**
7. **Spiral membrane** (aorticopulmonary septum)
8. **Endocardial cushions** (also derived partially from mesoderm)
9. **Skull bones** (frontal, ethmoid, and sphenoid bones derives from ectodermal neural crest and others from mesoderm).
10. **Pia and arachnoid matters** of the meninges (dura matter is mesoderm).

# Development of Spinal cord

**\*\* Cyto-differentiation of the neural tube:**

**(I) Ependymal layer:** the **most inner layer** which contains 2 types of cells;

**a- Ependymal cells** line the cavity of the neural tube.

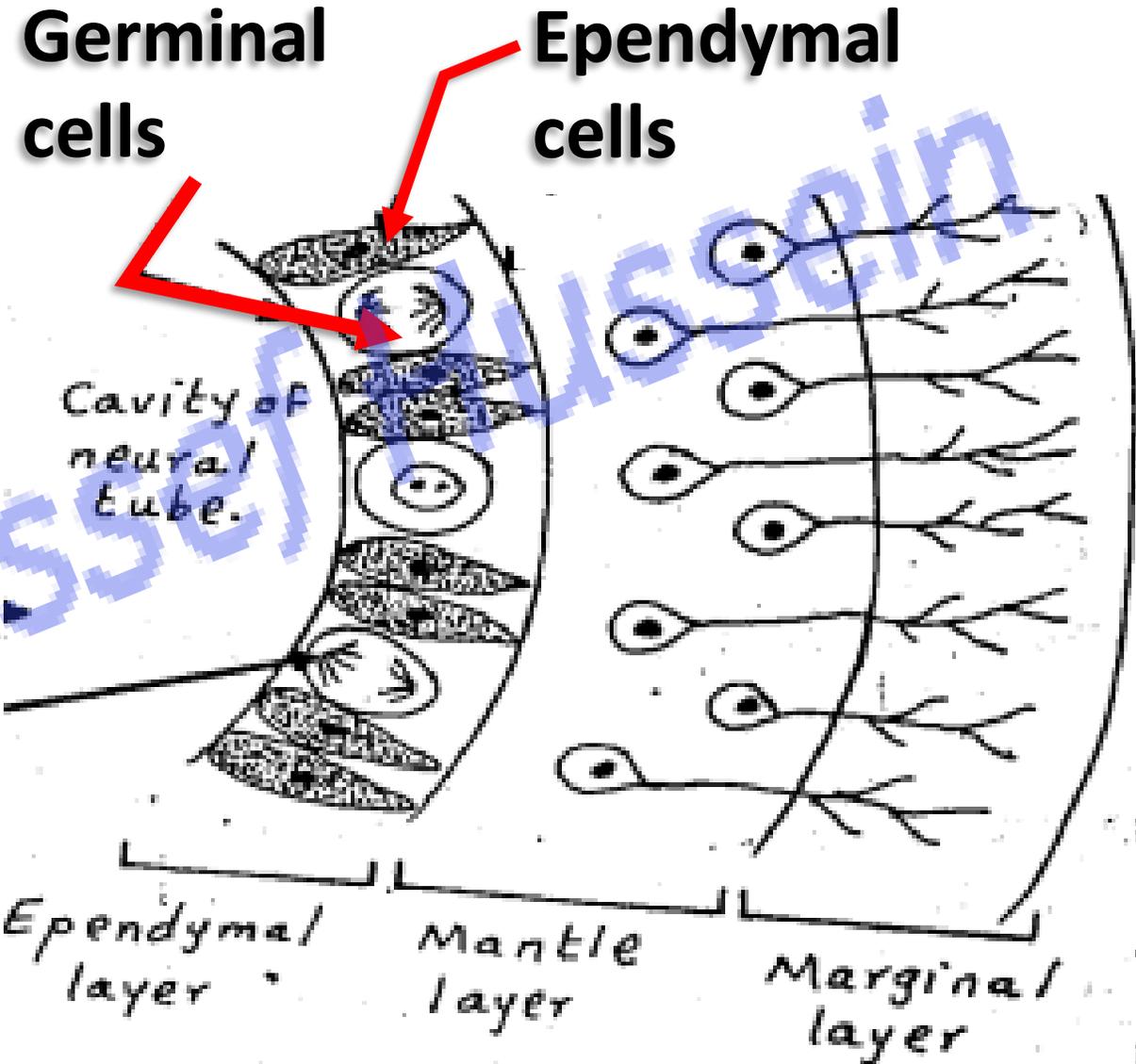
**b- Germinal cells** divide repeatedly and migrated peripherally to form the mantle layer.

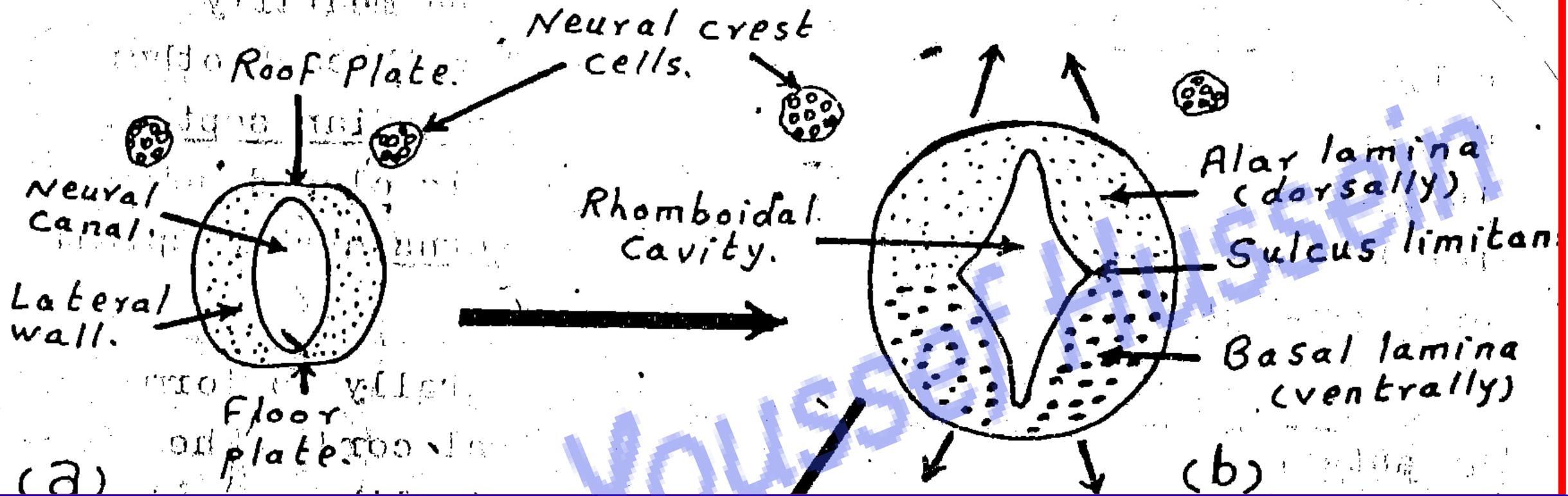
**(II) Mantle layer:** the middle layer; It forms the **grey matter** of the spinal cord and is formed of two types of cells:

**a- Neuroblasts** (nerve cells or neurons), the axons of these cells extend to the marginal layer.

**b- Neuroglial cells** (supporting cells).

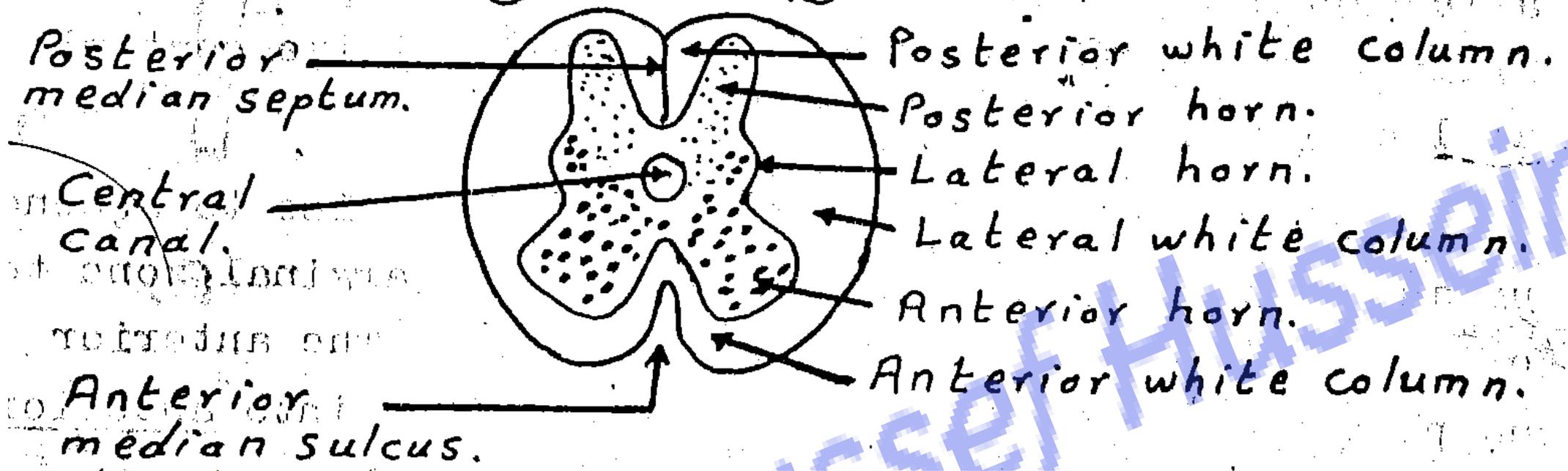
**(III) Marginal layer:** the outer layer containing ascending and descending tracts (**white matter** of the spinal cord).





\*\* At first, the **neural tube** has thick lateral wall, thin roof plate and floor plate, and a narrow slit-like lumen.

- **The ventral and dorsal parts** of the lateral wall become thick by proliferation of the cells in the mantle zone. As a result, it is divided by lateral sulcus called sulcus limitans into ventral part (**basal lamina**) and dorsal part (**alar lamina**) and the cavity becomes rhomboidal in shape:



**A- Ventral parts:** contain motor cells, form the anterior and the lateral horns of the spinal cord.

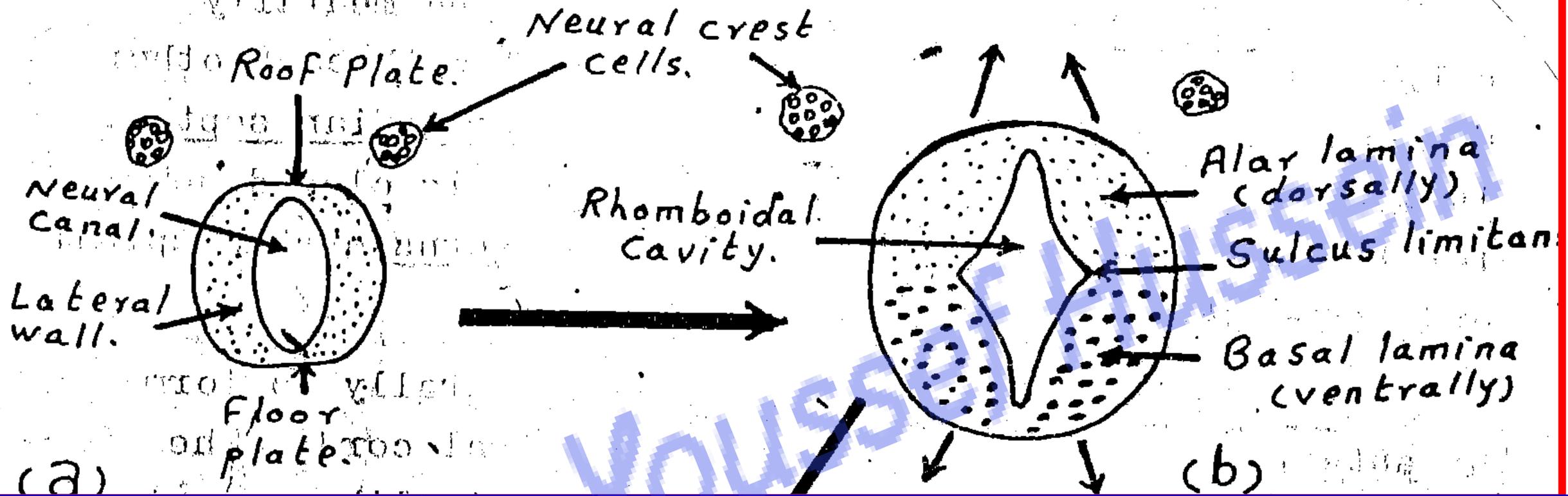
- The **anterior horns** are found in all segments.
- The **lateral horns** are found in;
  - 1) All the thoracic and upper 2-3 lumbar segments (sympathetic).
  - 2) In the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> sacral segments (parasympathetic).

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**B- Dorsal parts:** contain the sensory cells, form the posterior horns of the spinal cord

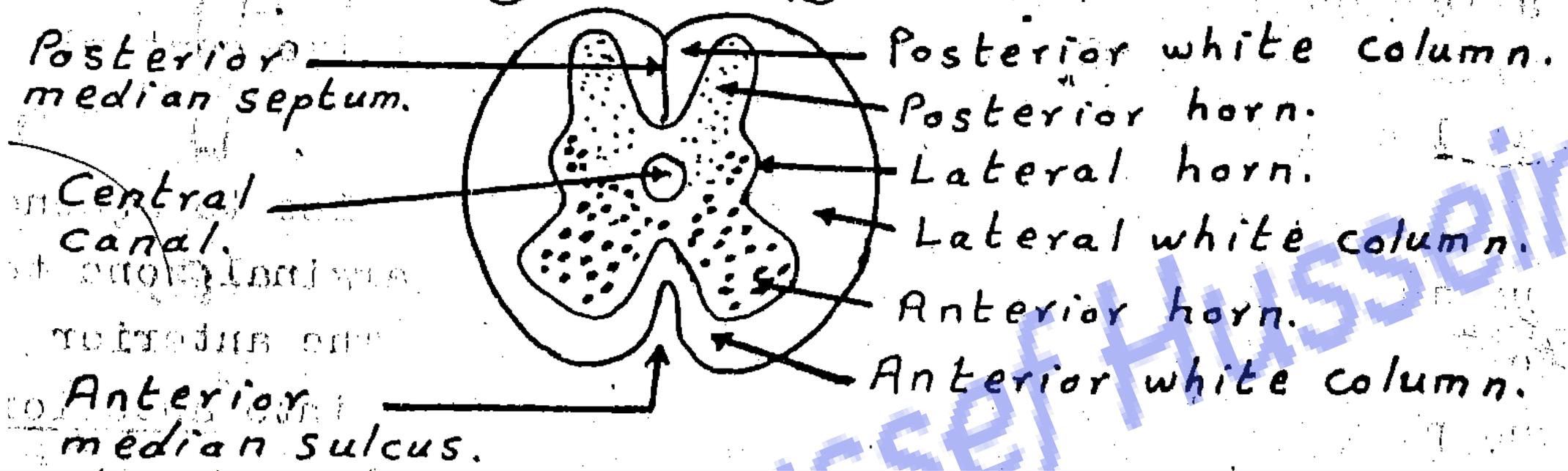
**C- The cavity** becomes reduced in size (narrow) to form the central canal.

**D- Marginal layer:** the outer layer containing ascending and descending tracts (**white matter** of the spinal cord, anterior, lateral and posterior columns).



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**B- Dorsal parts:** contain the sensory cells, form the posterior horns of the spinal cord

**C- The cavity** becomes reduced in size (narrow) to form the central canal.

**D- Marginal layer:** the outer layer containing ascending and descending tracts (**white matter** of the spinal cord, anterior, lateral and posterior columns).

- **Congenital anomalies of the spinal cord**

**Spina bifida:** failure of fusion of neural arch of vertebra around the spinal cord.

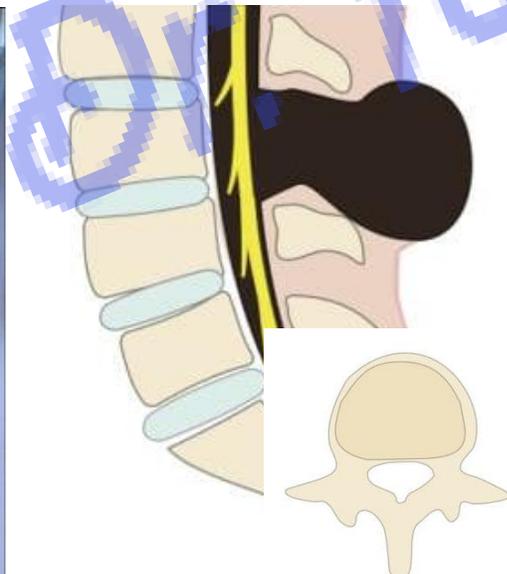
**\*\* Types of spina bifida:**

- a- Spina bifida occulta:** bifid spines of the vertebra but no herniation. Dura is intact. Usually seen at lower vertebral levels. Associated with tuft of hair or skin dimple at level of bony defect. No increase AFP.
- b- Meningocele;** bulge of the meninges through the spina bifida (increase AFP).
- c- Meningomyelocele;** bulge of the meninges and spinal cord through the spina bifida. (increase AFP).
- d- Myelocele;** the spinal cord is exposed directly to the spina bifida. (increase AFP).

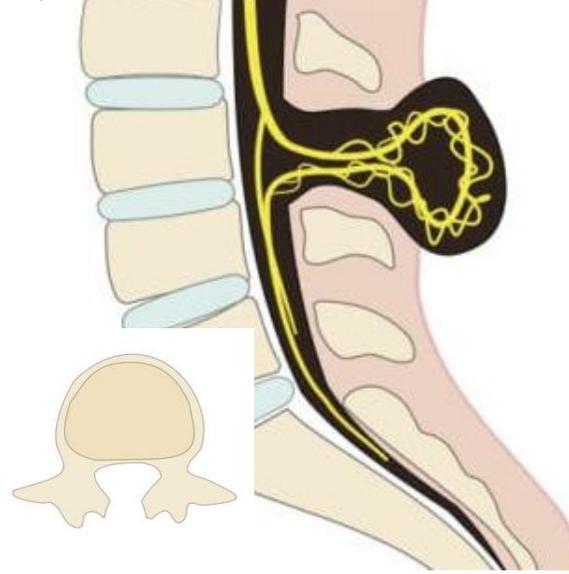
**Spina bifida occulta**



**Meningocele**

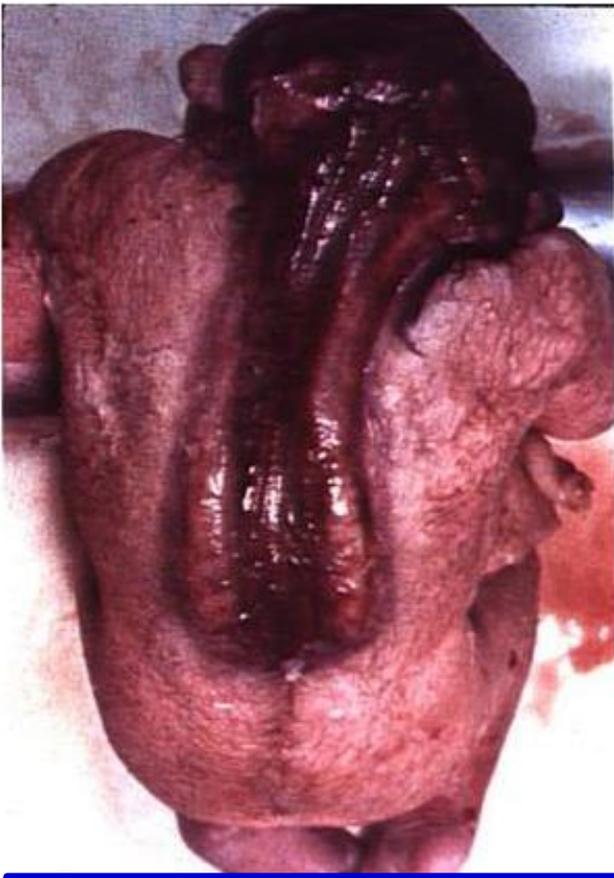


**Meningomyelocele**



**Myelocele**





Rachischisis: spinal cord

Cranioschisis: brain

Craniorachischisis: brain & cord

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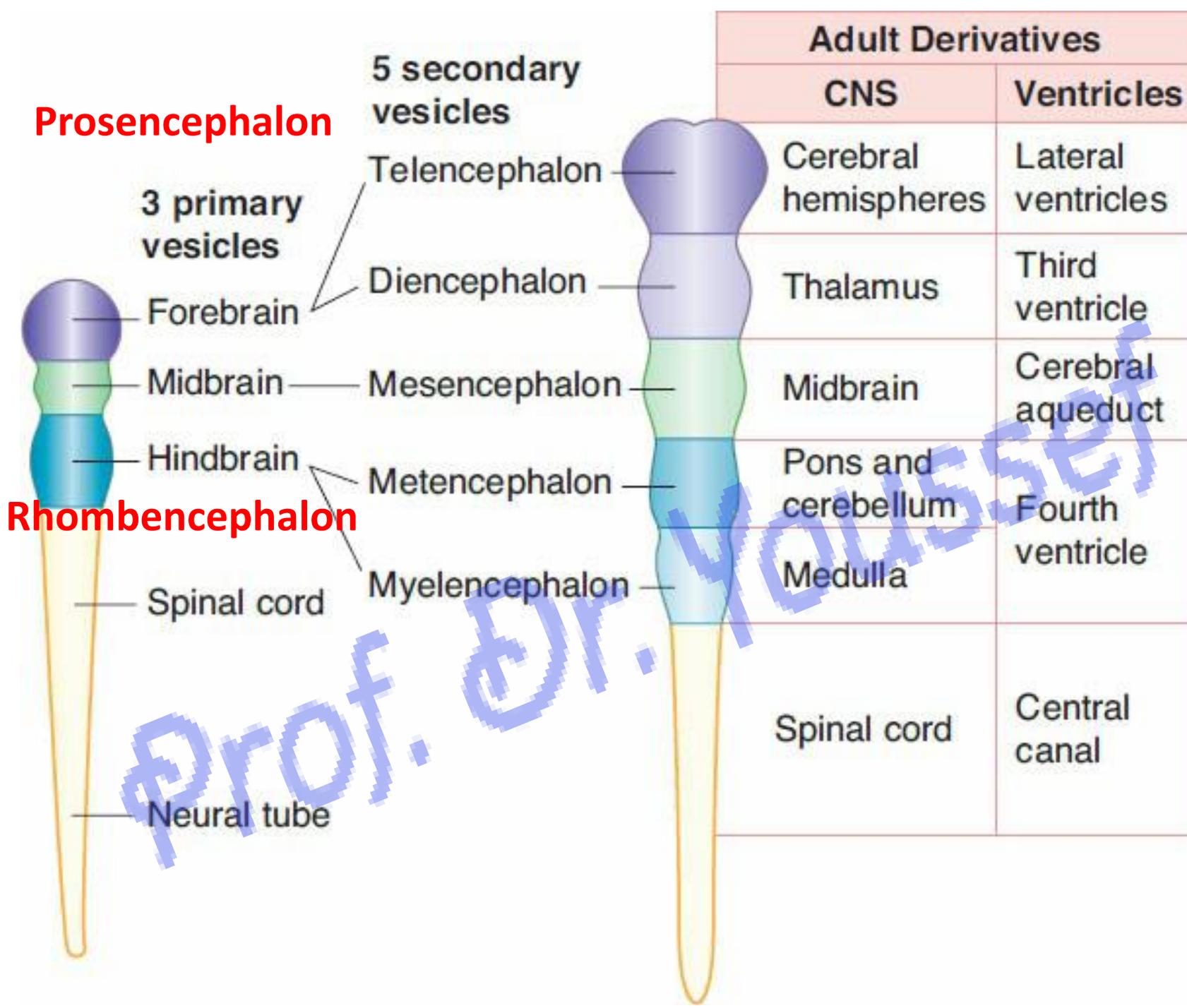
- **Neural tube defects (NTD)**

- **Failure of neural tube to close completely by week 4 of development. Associated with maternal folate deficiency during pregnancy. Diagnosis: ultrasound, maternal serum AFP (increase during pregnancy).**

**Craniorachischisis:** Failure of closure of the neural tube, Exposed, unfused neural tissue without skin/meningeal covering, leading to longitudinal cleft in the back of the head and vertebral column

# Development of Brain

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**Prosencephalon**

**Rhombencephalon**

**Cerebral hemispheres,  
most of basal ganglia**

**Thalamus,  
hypothalamus,  
subthalamus,  
epithalamus (pineal  
gland), retina and optic  
nerve**

## **Meningocele**

herniation of a part of  
the meninges

For Information,  
Visit: [www.epainassist.com](http://www.epainassist.com)



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## Meningoencephalocele



- **Meningoencephalocele**

herniation of a part of the brain and its covering meninges.

- **Meningoencephalocele**

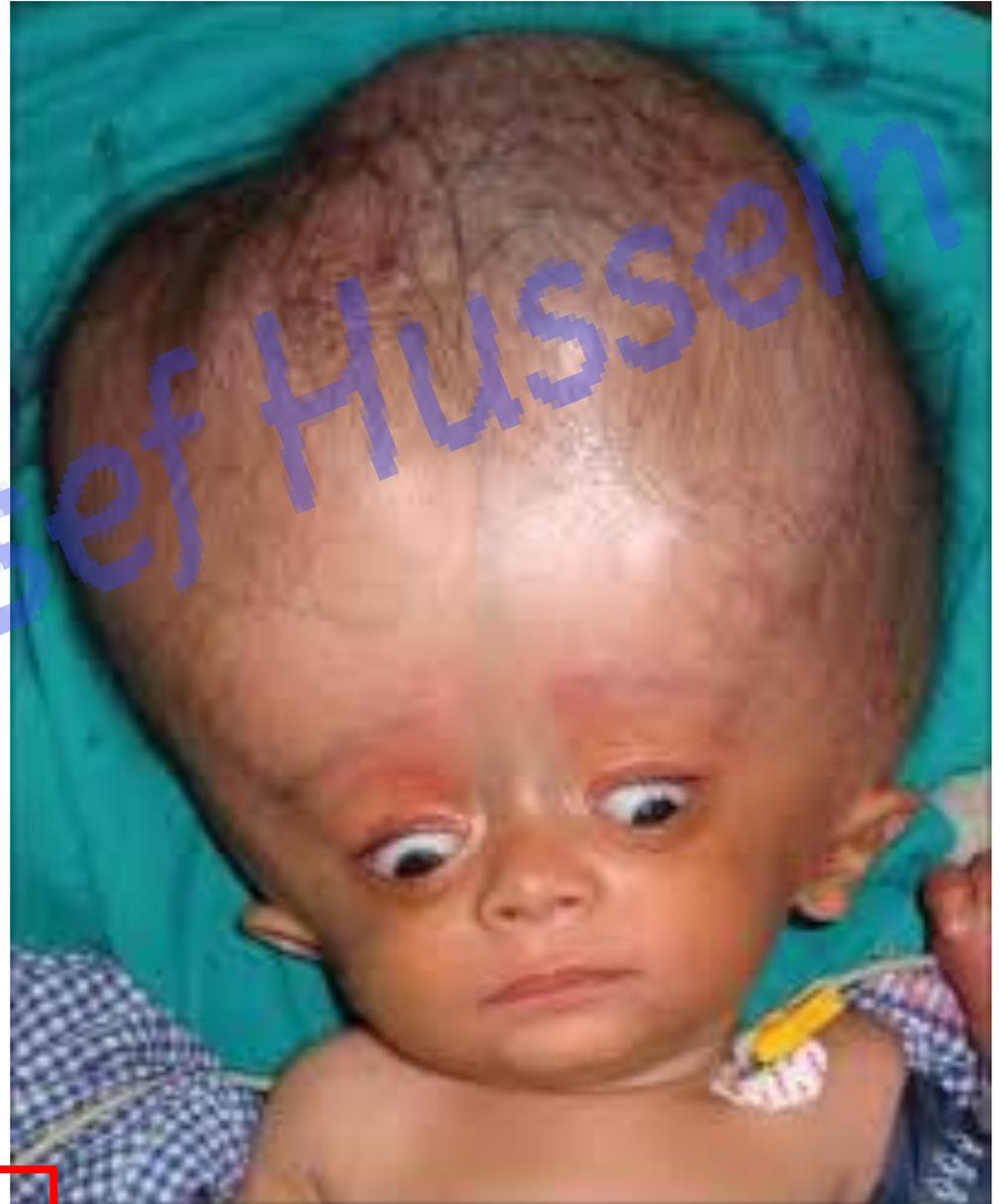
**cele**: herniation of the meninges and part of the brain and its ventricle containing CSF

## Anencephaly

- Failure of development of greater part of the brain and vault of the skull due to failure of cephalic part of the neural tube to close
- Incompatible with life
- Increase AFP during pregnancy
- **Often presents with polyhydramnios (decrease fetal swallowing due to lack of neural control).**



- **Hydrocephalus**  
excessive  
accumulation of  
C.S.F in the  
ventricular system  
due to closure in the  
CSF circulation



- **Microcephaly**

small skull and

cerebral

hemisphere



- **Cyclopia** one cerebral hemisphere, one ventricle and one median eye



- **Brain malformations**

- Often incompatible with postnatal life.
- Survivors may be profoundly disabled.

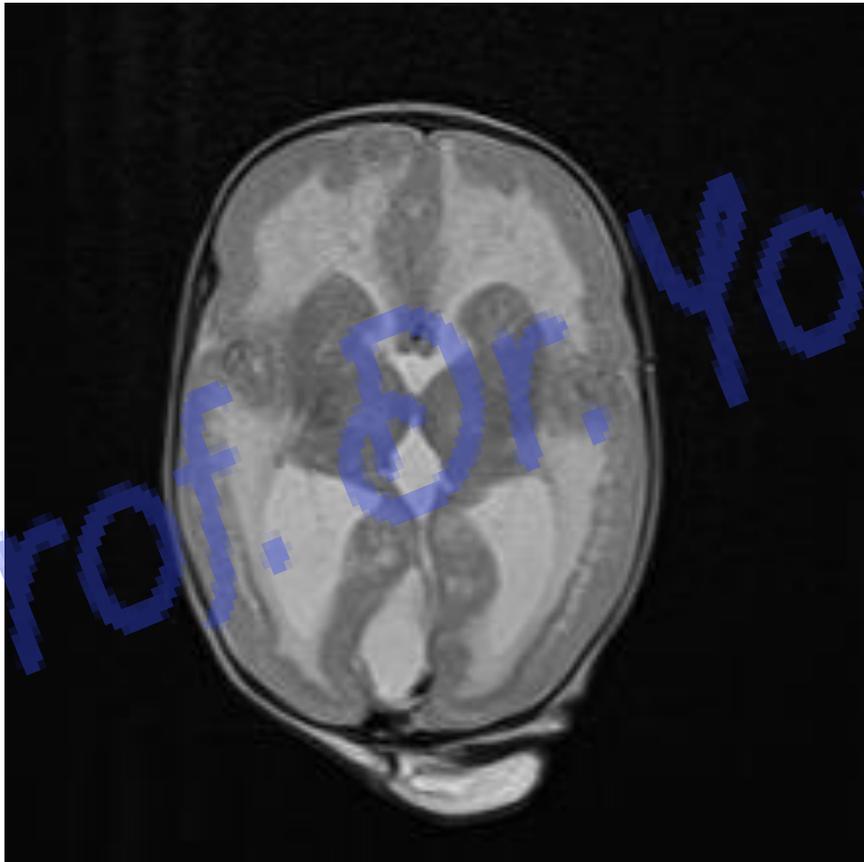
- **Holoprosencephaly**

- Failure of forebrain to divide into 2 cerebral hemispheres;
- developmental field defect usually occurring at weeks 3–4 of development.
- Associated with *SHH* mutations.
- May be seen in Patau syndrome (trisomy 13), fetal alcohol syndrome.
- Presents with **midline defects**: monoventricle, fused basal ganglia, cleft lip/palate, hypotelorism, cyclopia, proboscis (long, bendable nose). nose-like appendage
- Increase risk for pituitary dysfunction (eg, diabetes insipidus).



## Lissencephaly

- Failure of neuronal migration--smooth brain surface that lacks sulci and gyri
- Presents with dysphagia, seizures, microcephaly, facial anomalies.



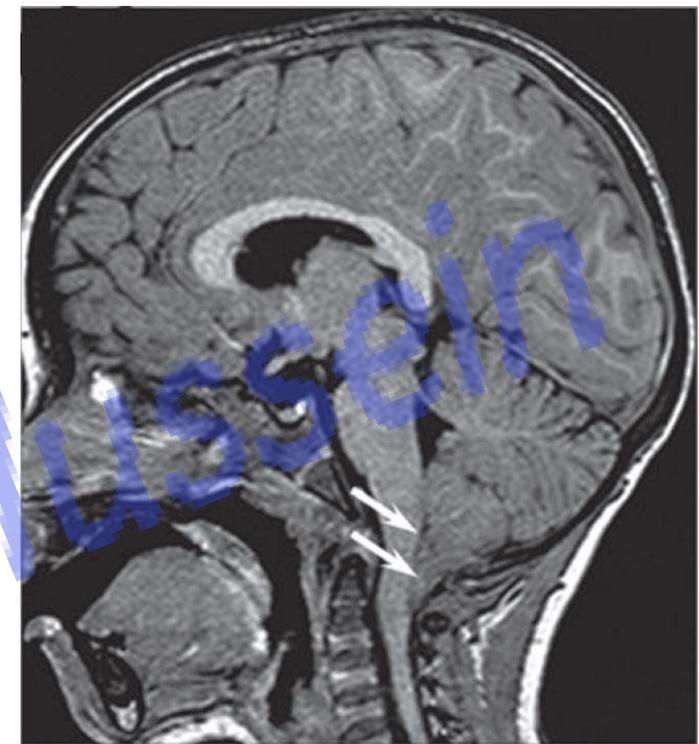
- **Posterior fossa malformations**

- **Chiari I malformation**

- Downward displacement of cerebellar tonsils through foramen magnum (**1** structure).
- Usually asymptomatic in childhood, manifests in adulthood with headaches and cerebellar symptoms.
- Associated with spinal cord cavitations (eg, syringomyelia).

- **Chiari II malformation**

- Downward displacement of cerebellum (vermis and tonsils) and medulla (**2** structures) through foramen magnum -- noncommunicating hydrocephalus.
- More severe than Chiari I, usually presents early in life with dysphagia, stridor, apnea, limb weakness.
- Associated with Meningocele (usually lumbosacral).



**Tonsil in the  
Foramen magnum**

- **Posterior fossa malformations**

- **Dandy-Walker malformation**

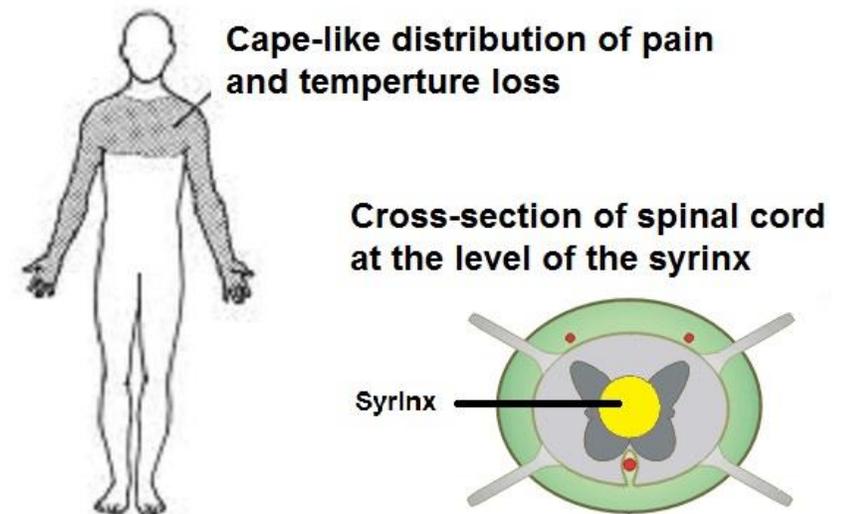
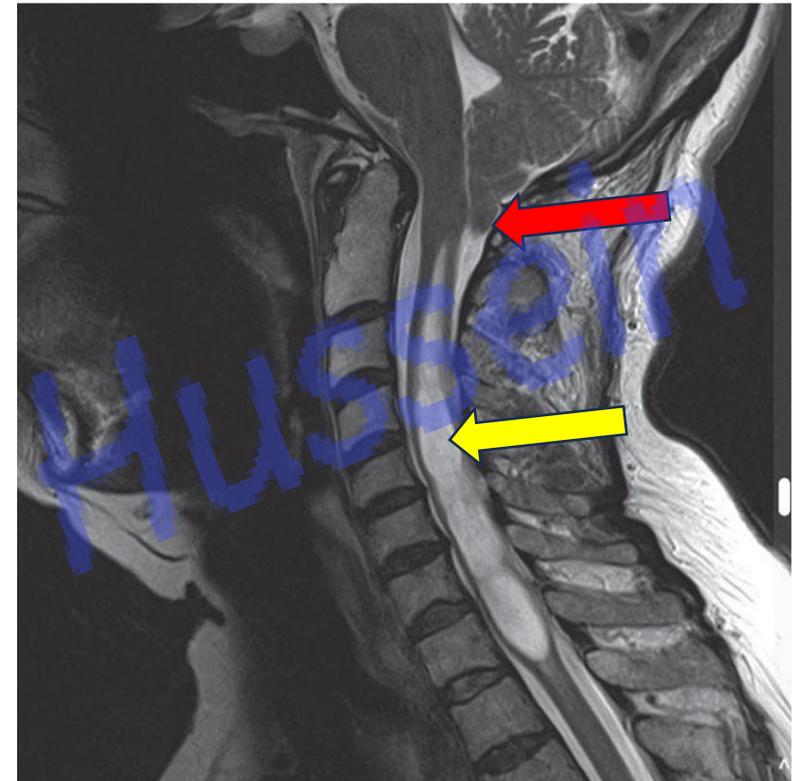
- **Agensis of cerebellar vermis -- cystic enlargement of 4th ventricle that fills the enlarged posterior fossa.**
- **Associated with noncommunicating hydrocephalus, spina bifida.**



**Enlargement of the 4<sup>th</sup> ventricle**

## Syringomyelia

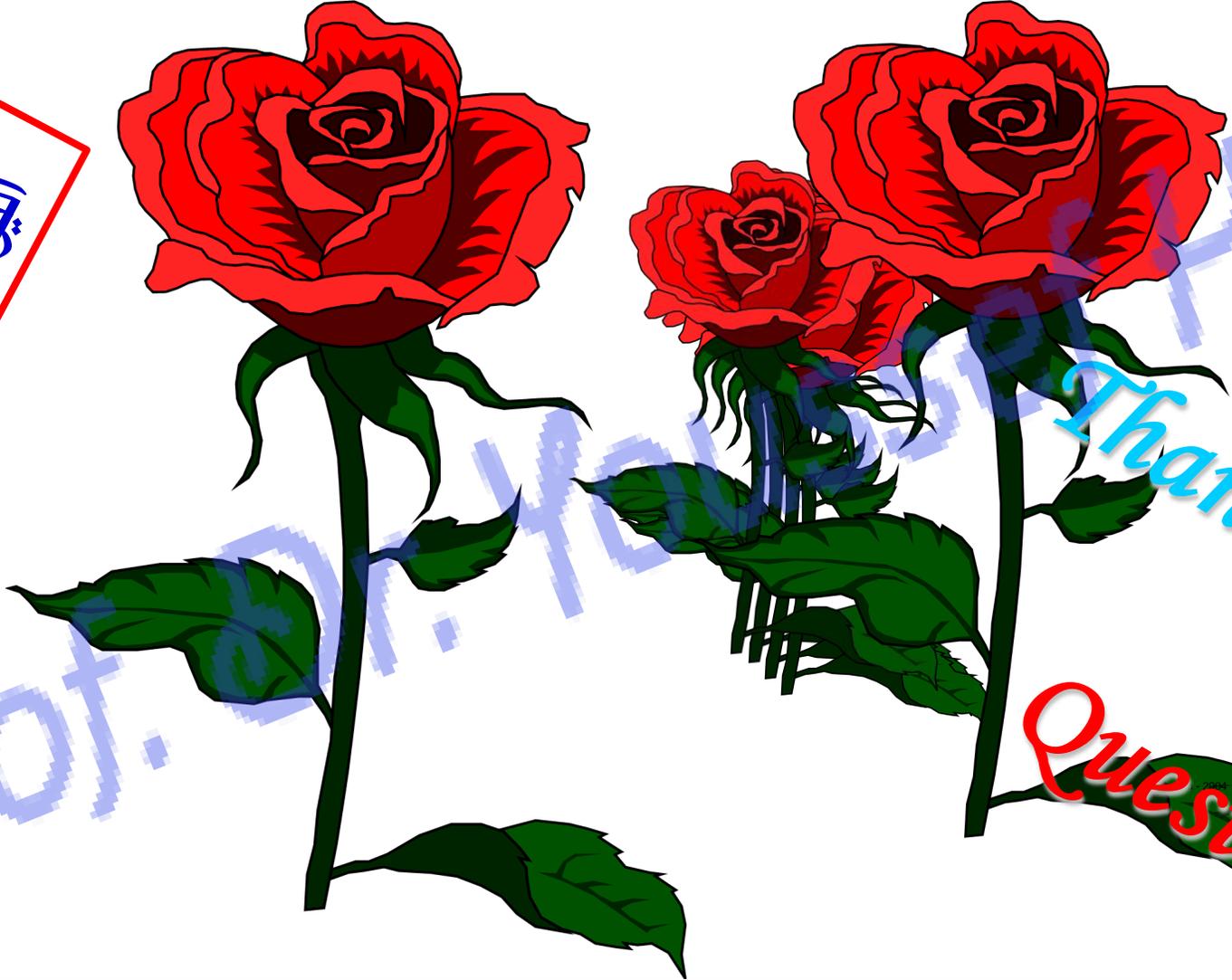
- Fluid-filled, gliosis-lined cavity within spinal cord (yellow arrow)
- Fibers crossing in anterior white commissure (spinothalamic tract) are typically damaged first → “cape-like” loss of pain and temperature sensation in bilateral upper extremities.
- As lesion expands it may damage anterior horns → LMN deficits.
- **Syrinx** (Greek) = tube, as in “syringe.”
- Most lesions occur between C2 and T9.
- Usually associated with Chiari I malformation (red arrow)
- Less commonly associated with other malformations, infections, tumors, trauma.



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Thank You

Questions

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