

# Brain Tumors

*for USMLE Step One*



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UMass Class of 2021

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# CNS Tumors for USMLE Step One



Tumors identified by *histopathology*

Tumors identified by *history*/imaging

Kids

Adults

Inside the brain

Outside the brain

1. Pilocytic Astrocytoma
2. Medulloblastoma
3. Craniopharyngioma

1. Oligodendroglioma
2. Glioblastoma Multiforme

Meningioma

1. Schwannoma
2. Pinealoma
3. Metastases
4. Pituitary Adenoma

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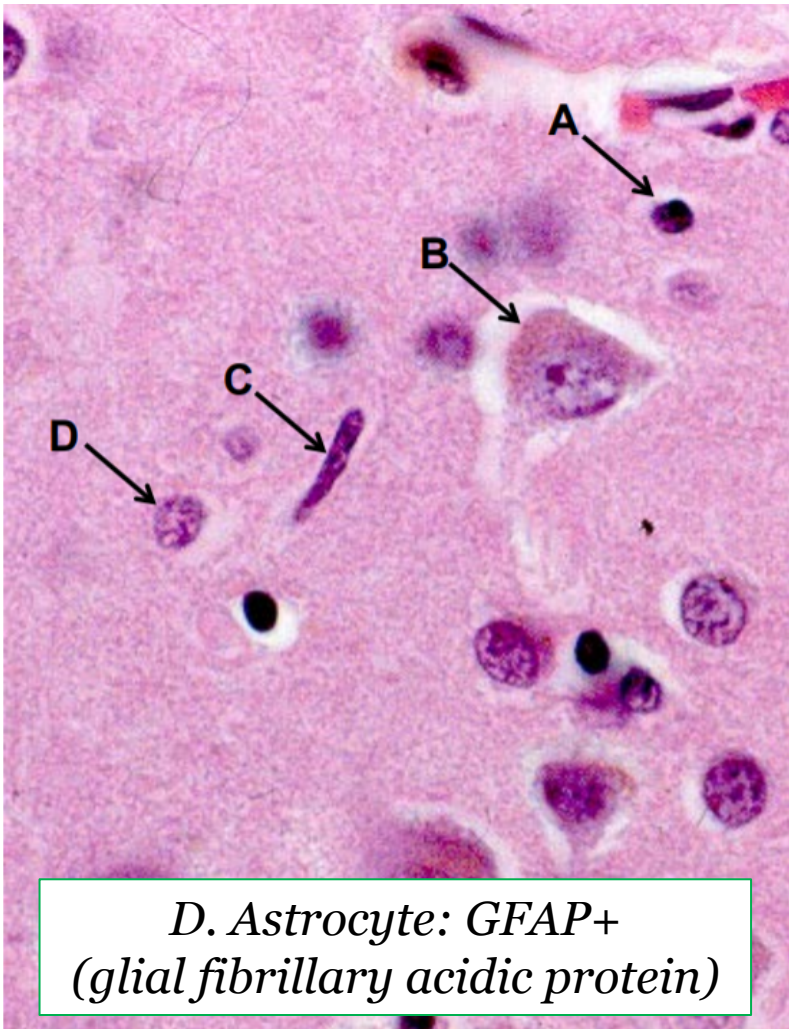
1. Pilocytic Astrocytoma  
*Eosinophilic R. fibers*
2. Medulloblastoma  
*Granular cells*
3. Craniopharyngioma  
*Machine oil*

1. Oligodendroglioma  
*Fried Egg*
2. Glioblastoma Multiforme  
*Palisading Necrosis*

Meningioma  
*Whorled*

1. Schwannoma
2. Pinealoma
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# Brief (*seriously*) Histo Review



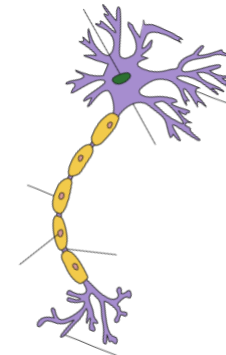
A = Oligodendrocyte

Tomato



Function:  
**Myelinating** CNS axons  
(PNS = Schwann Cells)

B = Neuron



Function:  
Confusing  
Medical  
Students

C = Microglia

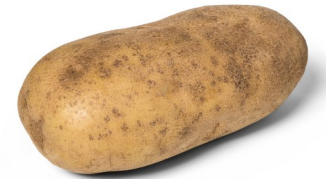
Hot Pepper



Function:  
**Immune**  
defense in  
CNS

D = Astrocyte

**GFAP+**  
Potato



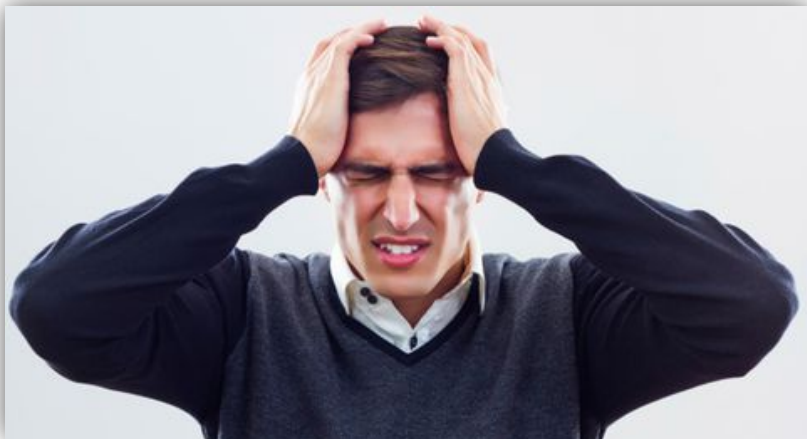
Function:  
**Structural**  
support; helps  
form blood-brain  
barrier; regulates  
**extracellular**  
environment

*D. Astrocyte: GFAP+*  
*(glial fibrillary acidic protein)*



# Brain Tumor Presentation

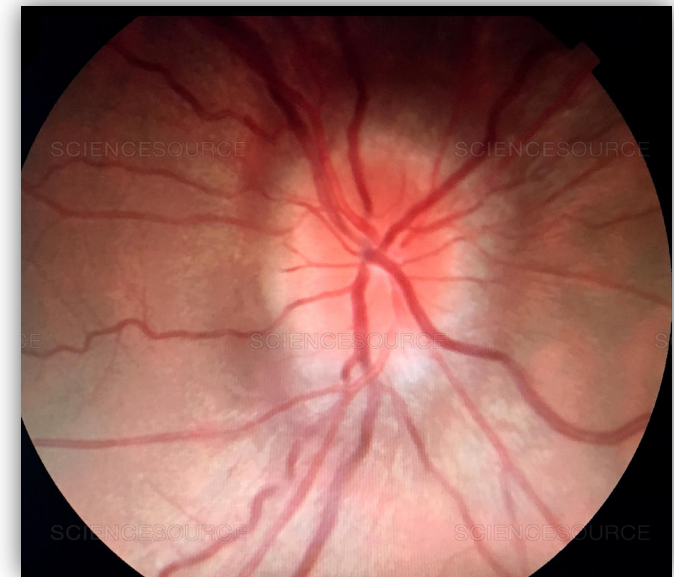
**Dull headache, worst  
in the morning**



**New seizures in  
an old-ish guy**



**Increased ICP  
(*papilledema*)**

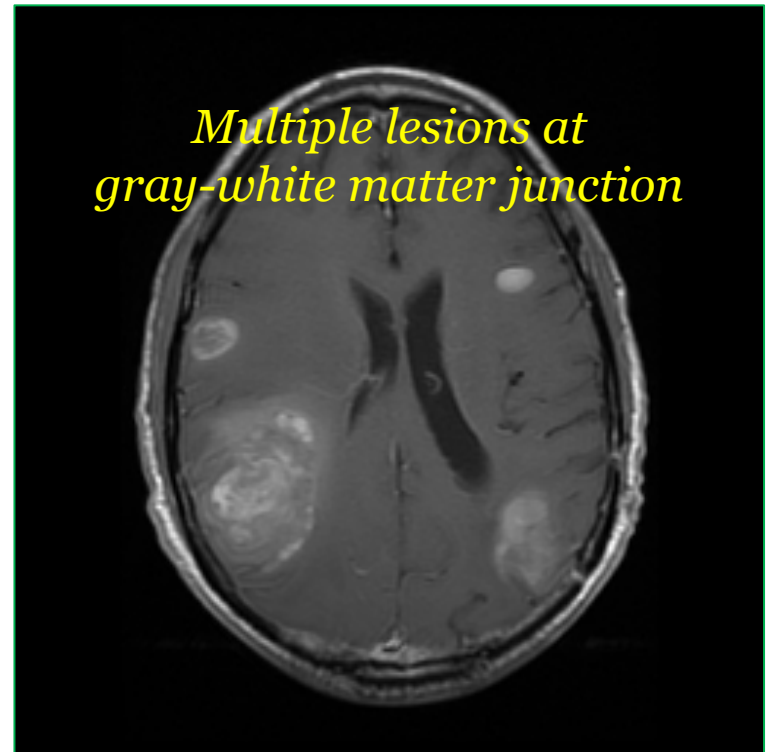


# Brain Metastases

**Lung** > Breast, Melanoma, Colon



*Primary tumor outside CNS*



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Tumors identified by *history*/imaging

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Adults

Inside the brain

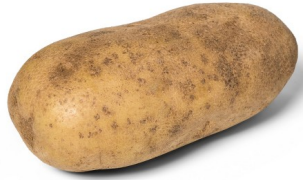
Outside the brain

1. **Pilocytic Astrocytoma**
2. **Medulloblastoma**
3. **Craniopharyngioma**

1. Oligodendroglioma
2. Glioblastoma Multiforme

Meningioma

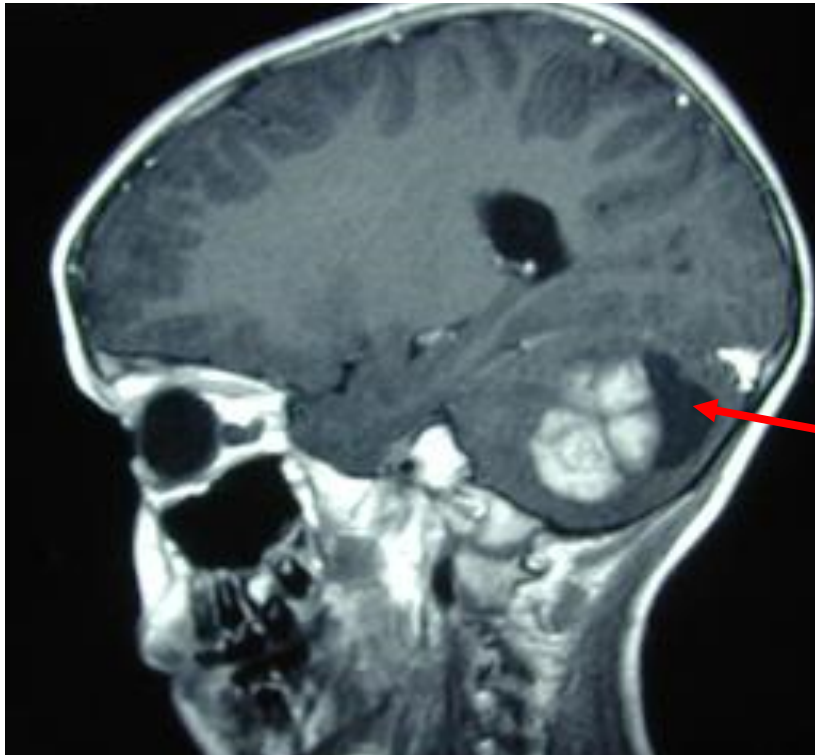
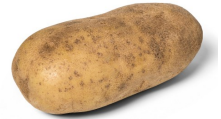
1. Schwannoma
2. Pinealoma
3. Metastases
4. Pituitary Adenoma



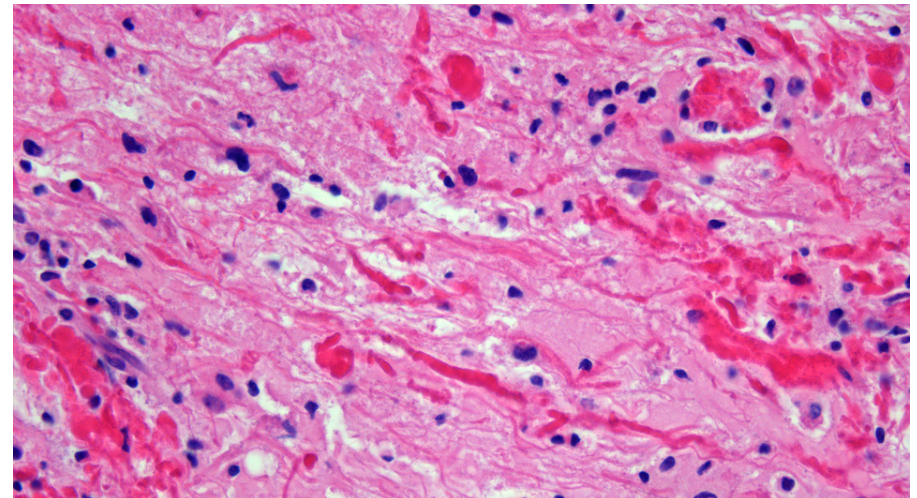
# “Pilo-cystic” Astrocytoma

Most common brain tumor in kids!!!

Benign tumor of Astrocyte  
origin = **GFAP+**

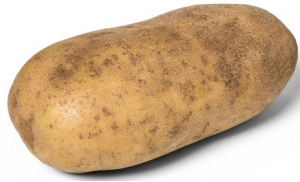


**CYST!!**



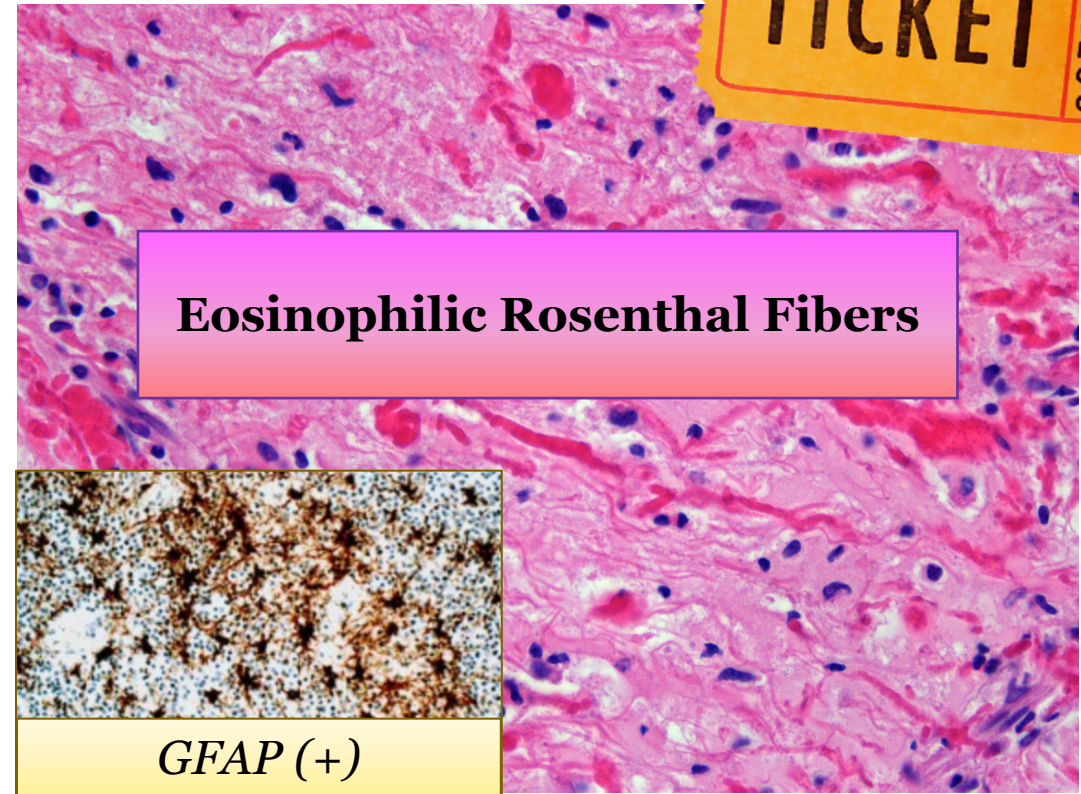
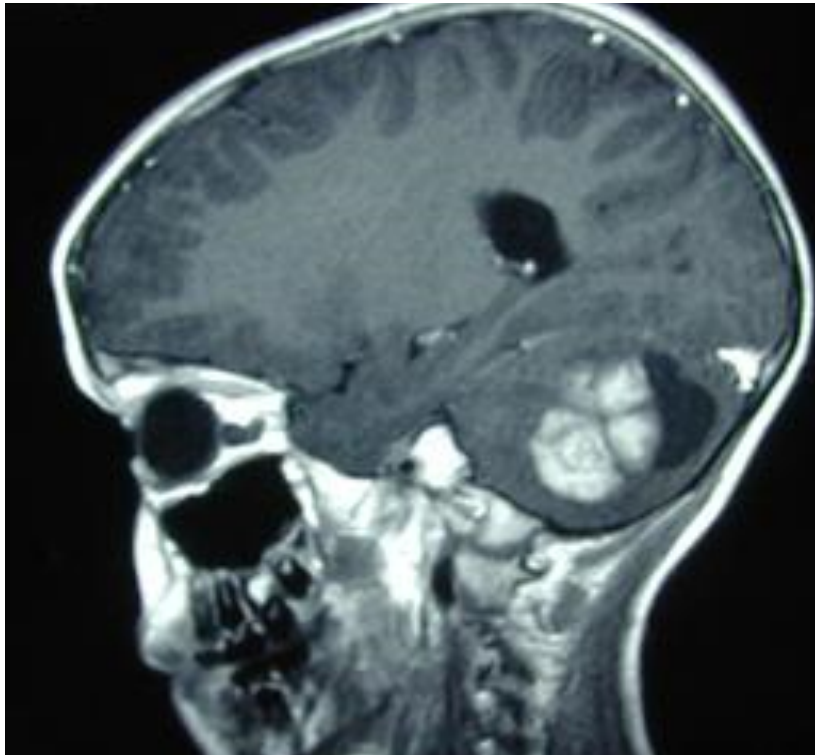
*Eosinophilic Rosenthal Fibers*





# “Pilo-cystic” Astrocytoma

**Most common** brain tumor in kids!!!



**Eosinophilic Rosenthal Fibers**

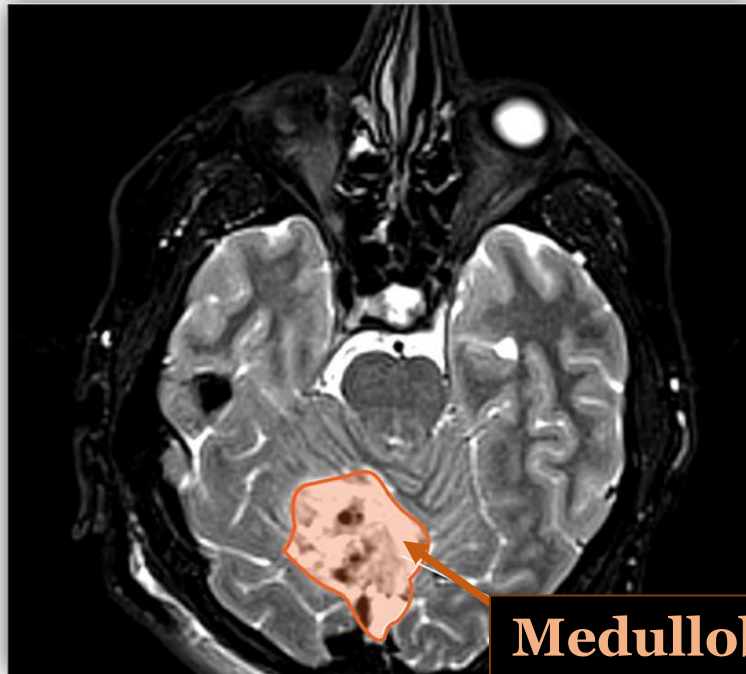
*GFAP* (+)



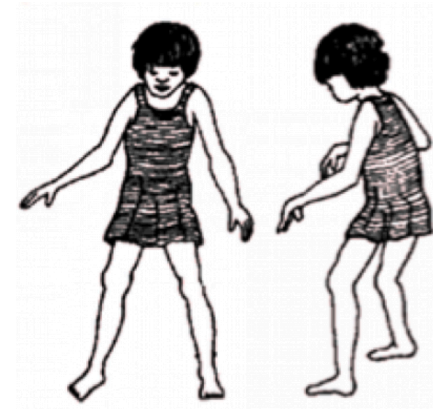
# Medulloblastoma → 'Granular Cerebellar Cell-oma'

Medulloblastoma=  
Cerebellar tumor

Origin  
**Granular Cells of Cerebellum**  
(*neural ectodermal*)



**Medulloblastoma**

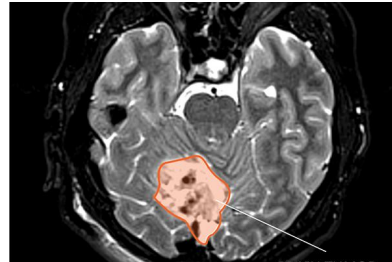


*Cerebellar vermis affected= Ataxia*



# Medulloblastoma → ‘Granular Cerebellar Cell-oma’

Medulloblastoma



**Origin**  
**Granular Cells of Cerebellum**  
(*neural ectodermal*)

“Drop Metastases”  
to Spinal Cord



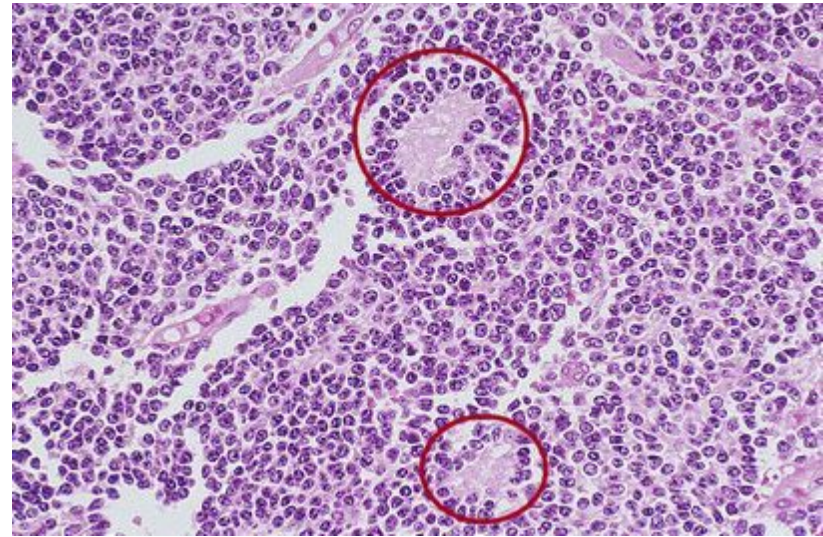
# Medulloblastoma → 'Granular Cerebellar Cell-oma'

## Origin

**Granular Cells of Cerebellum**  
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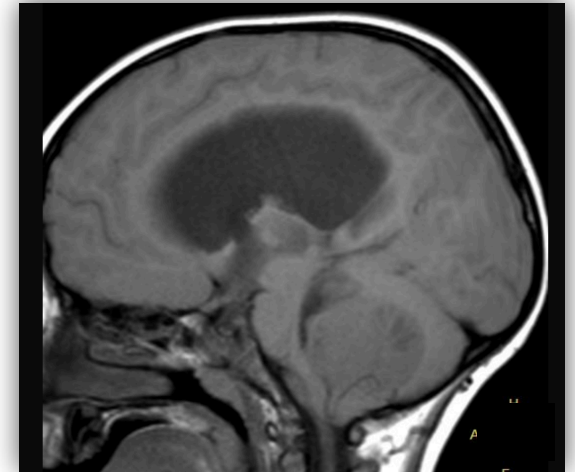
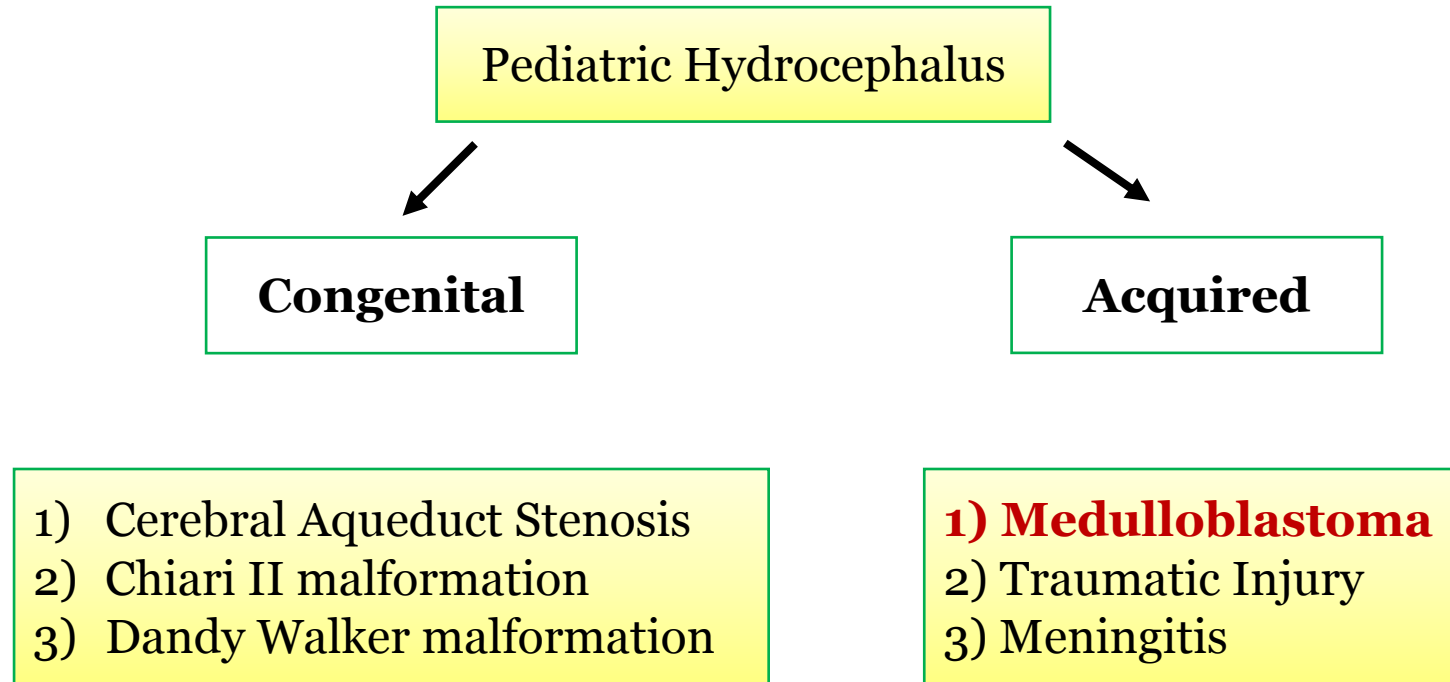


Small round blue cells

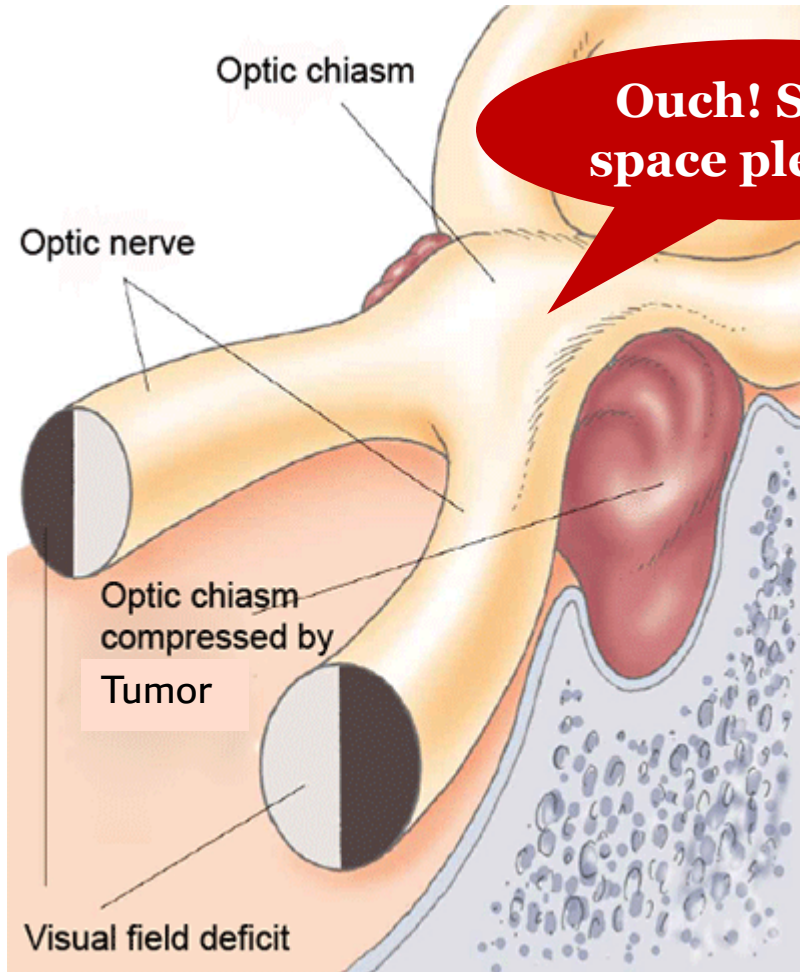


**Homer-Wright Rosettes**

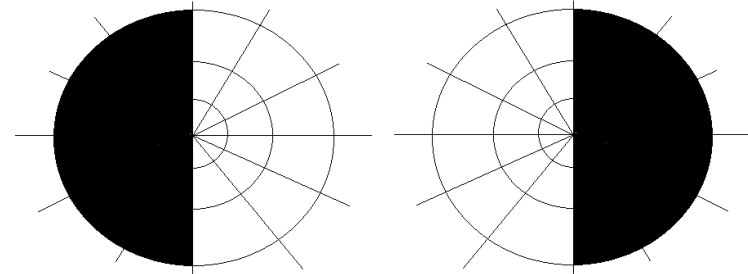
# Medulloblastoma Causing Obstructive Hydrocephalus



# Craniopharyngioma



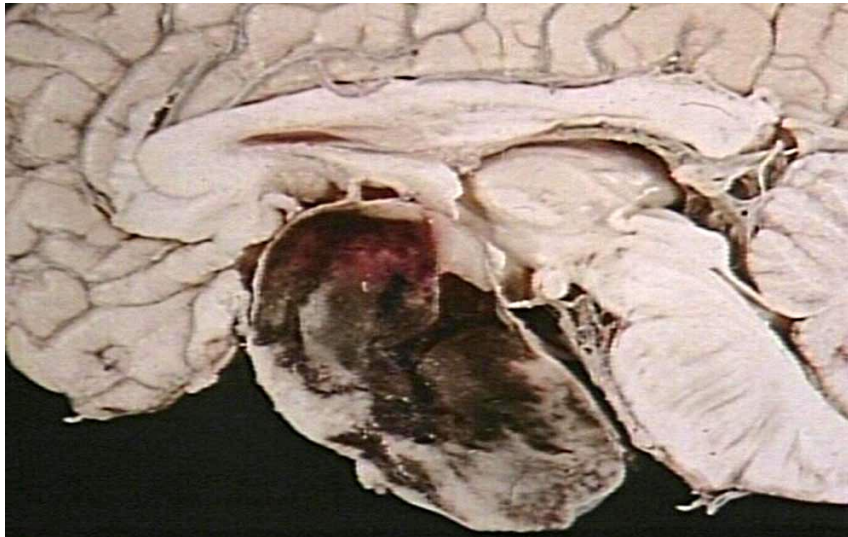
## Bitemporal Hemianopsia





# Cranio-pharyn-gioma

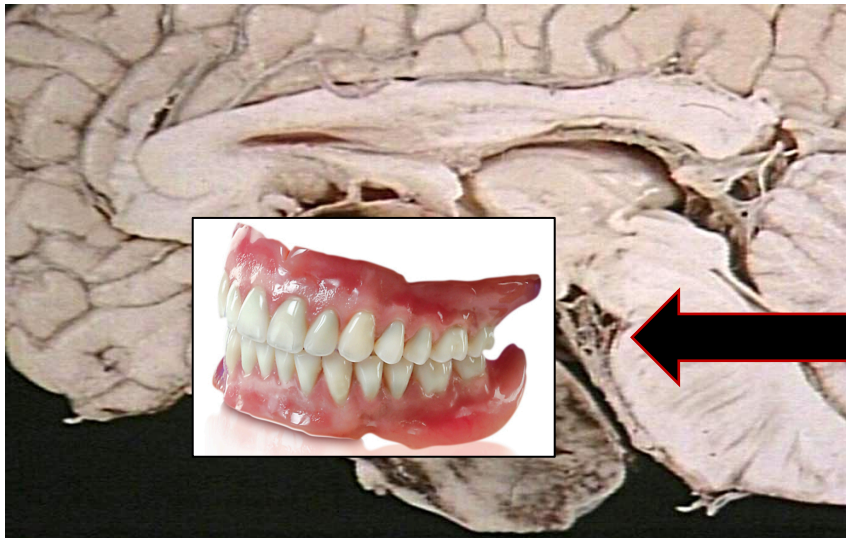
Calcified cysts containing  
cholesterol crystals resembling  
**motor oil**



Origin=Rathke's  
pouch remnants,  
**ORAL (surface)**  
**ectoderm**

# Cranio-pharyn-gioma

Calcified cysts containing  
cholesterol crystals resembling  
**motor oil**



Origin=Rathke's  
pouch remnants,  
**ORAL (surface)**  
ectoderm



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*Whorled*

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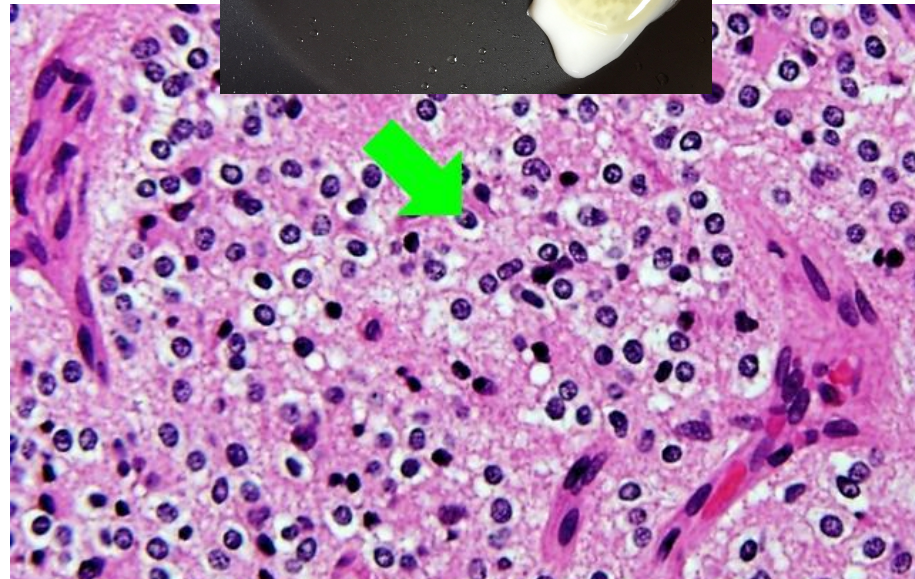


# Ol-egg-odendrogloma



**New seizures  
in someone  
old-ish**

**+**



**=**

**Oligodendro-glioma**

# Review: Fried-egg cell tumors

**Ol-egg-odendroglioma**



**Testicular  
Seminoma**



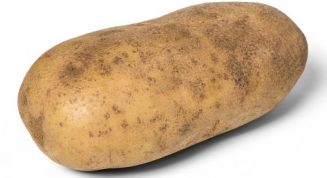
**Ovarian  
Dysgerminoma**



# Glioblastoma Multiforme

**Poor prognosis + rapid growth=  
scary as hell!**

**Malignant, high-grade tumor  
of astrocyte origin=GFAP+**



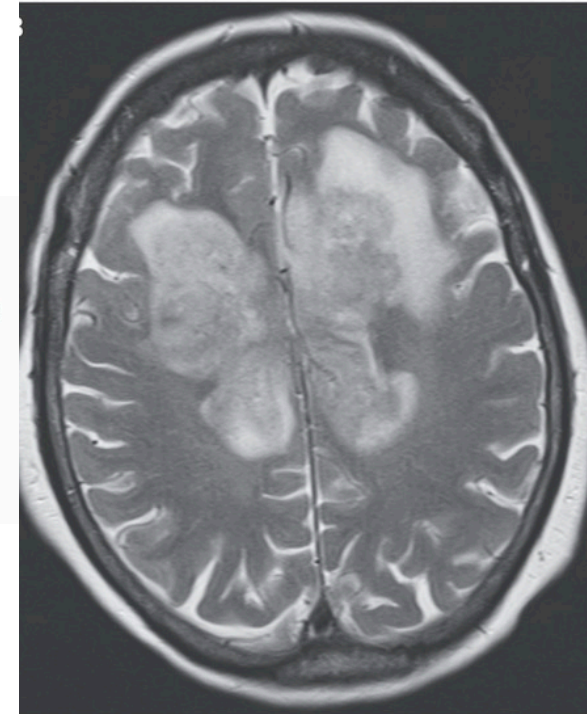
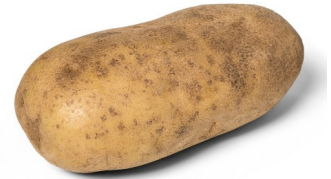


# Glioblastoma Multiforme

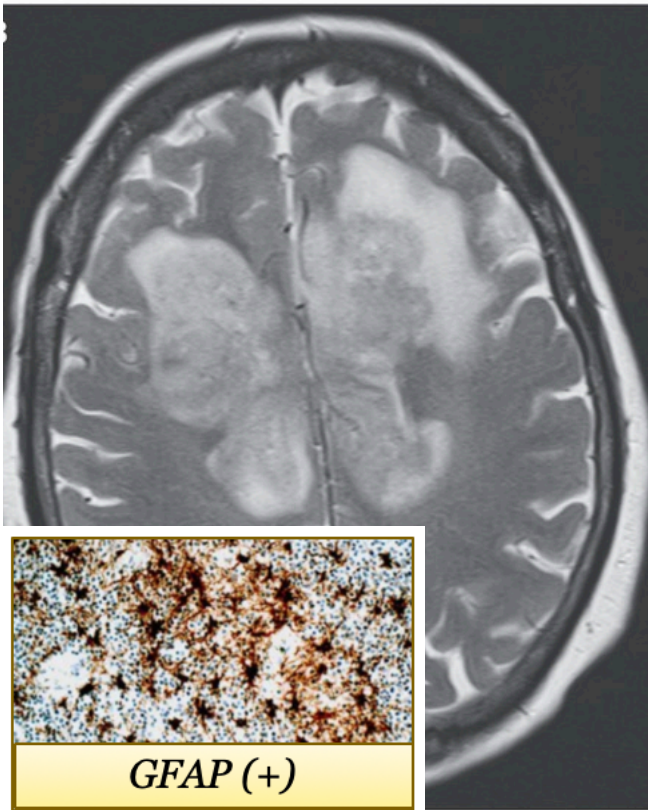
Astrocyte  
origin=**GFAP+**

**Poor prognosis + rapid growth=  
scary as hell!**

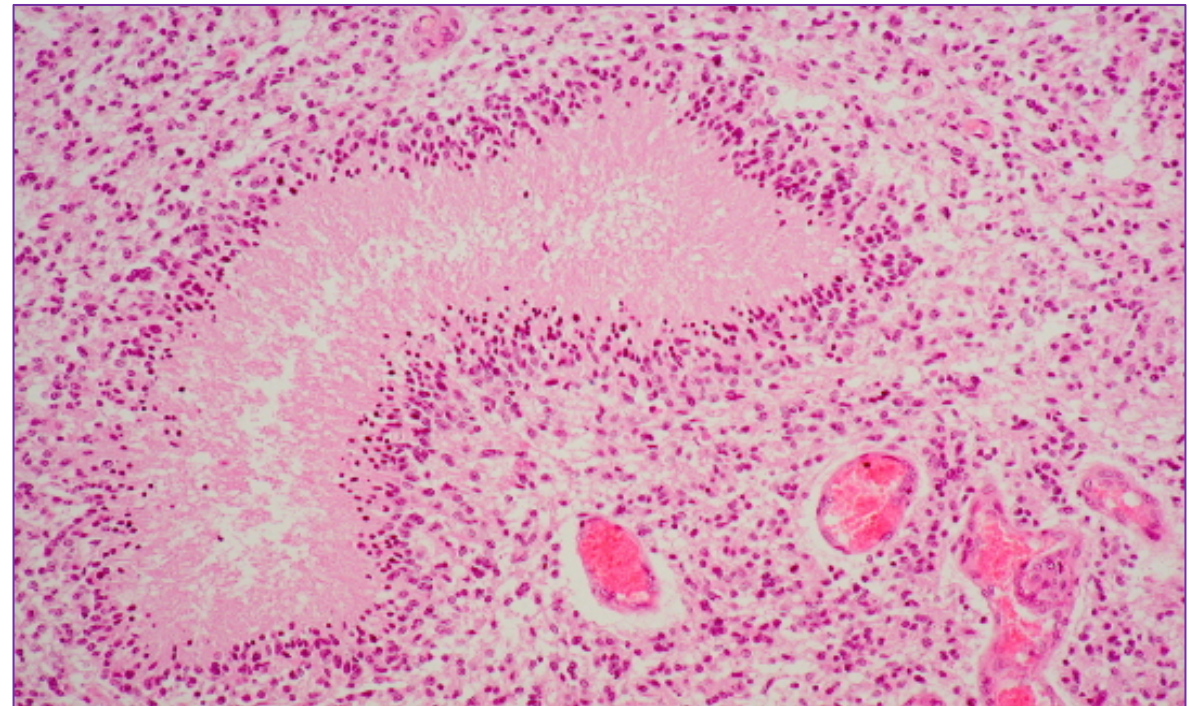
Crosses midline="Butterfly glioma"



# Glioblastoma Multiforme



*Poorly differentiated astrocytes*

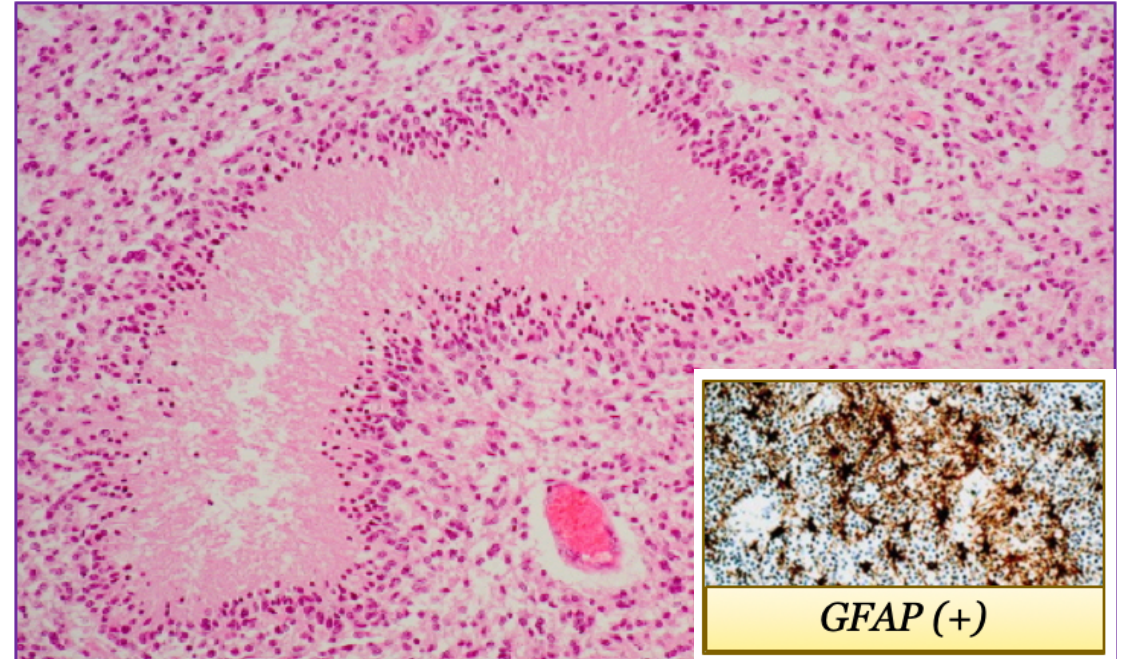
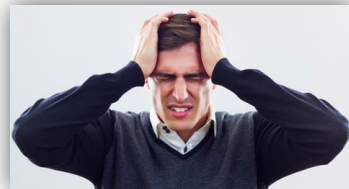
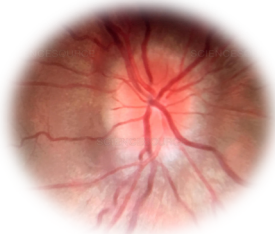
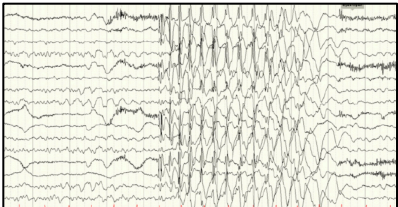


***Pseudo-palisading necrosis* on biopsy**



# Glioblastoma Multiforme

**Setup for GBM questions:**  
**50s-60s adult with months**  
**of headache or seizures,**  
**increased ICP and contrast-**  
**enhancing mass on MRI.**

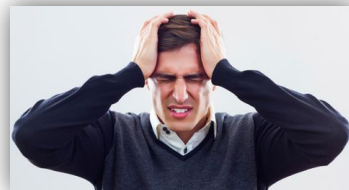
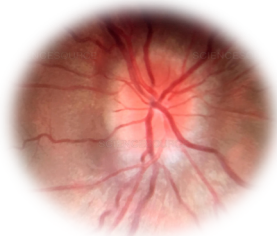
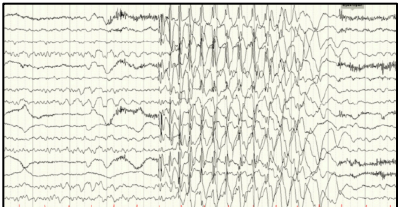


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# Glioblastoma Multiforme

**Setup for GBM questions:**  
**50s-60s adult with months**  
**of headache or seizures,**  
**increased ICP and contrast-**  
**enhancing mass on MRI.**

**First-line treatment:**  
**Temozolomide\***  
***(NOT SURGERY)***



*\*alkylating agent*

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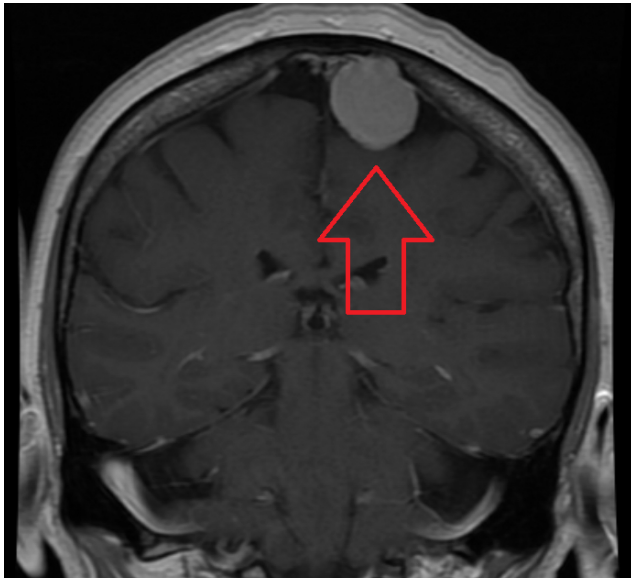
Meningioma  
*Whorled*

1. Schwannoma
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# Mening-ioma

**Benign extra-axial mass  
compressing the brain**

Expresses Estrogen Receptor:  
**Females > Males**

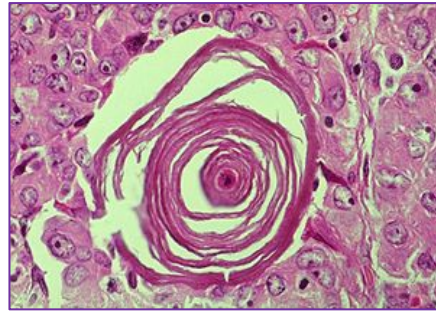
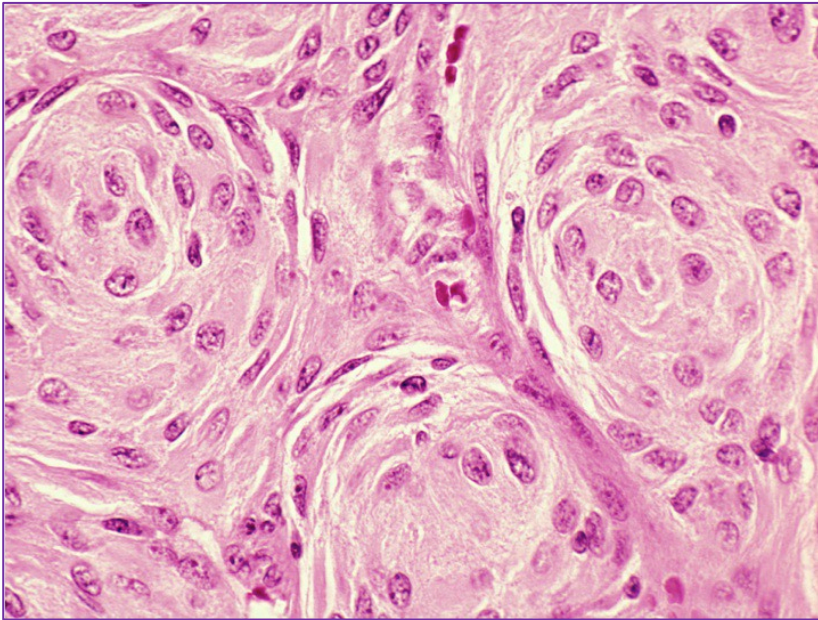


**Presentation:**  
**Seizures, Headache, or Focal  
neurologic deficit + Papilledema**



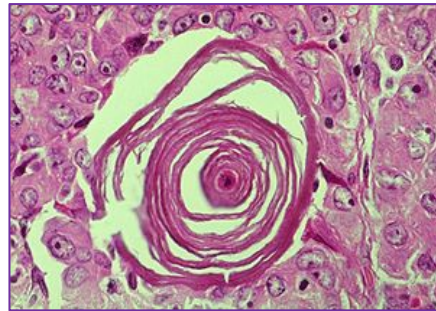
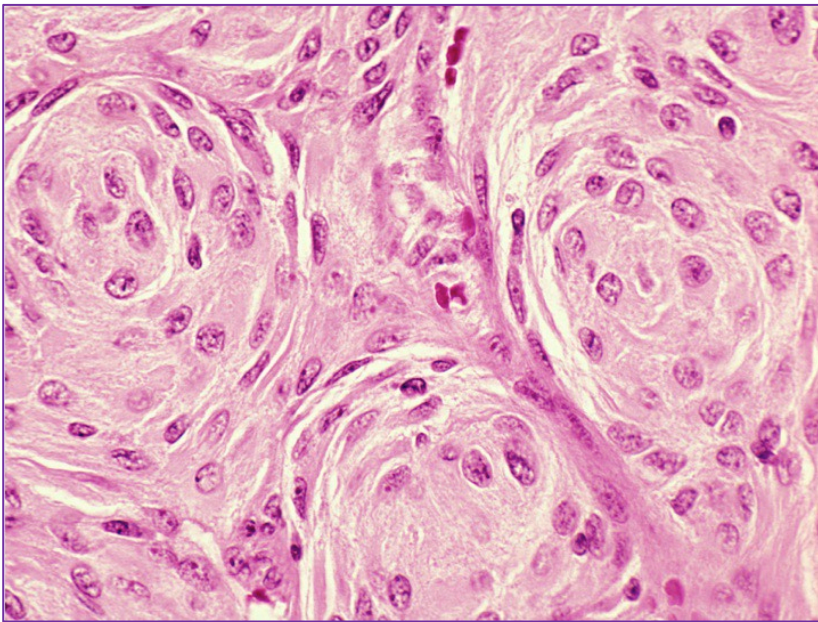
# Mening-ioma

**Biopsy:**  
**Whorled spindle cells and psammoma bodies**

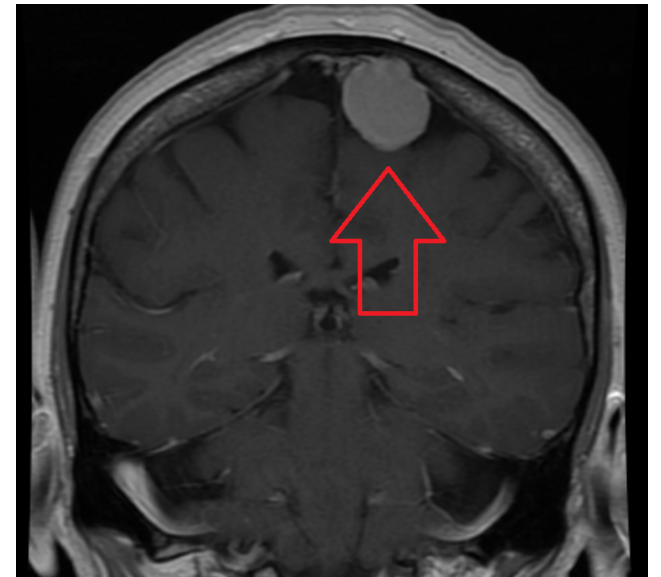


# Mening-ioma

**Biopsy:**  
**Whorled spindle cells and psammoma bodies**



**Treatment:**  
**Surgery +/- radiation**





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Tumors identified by *history/imaging*

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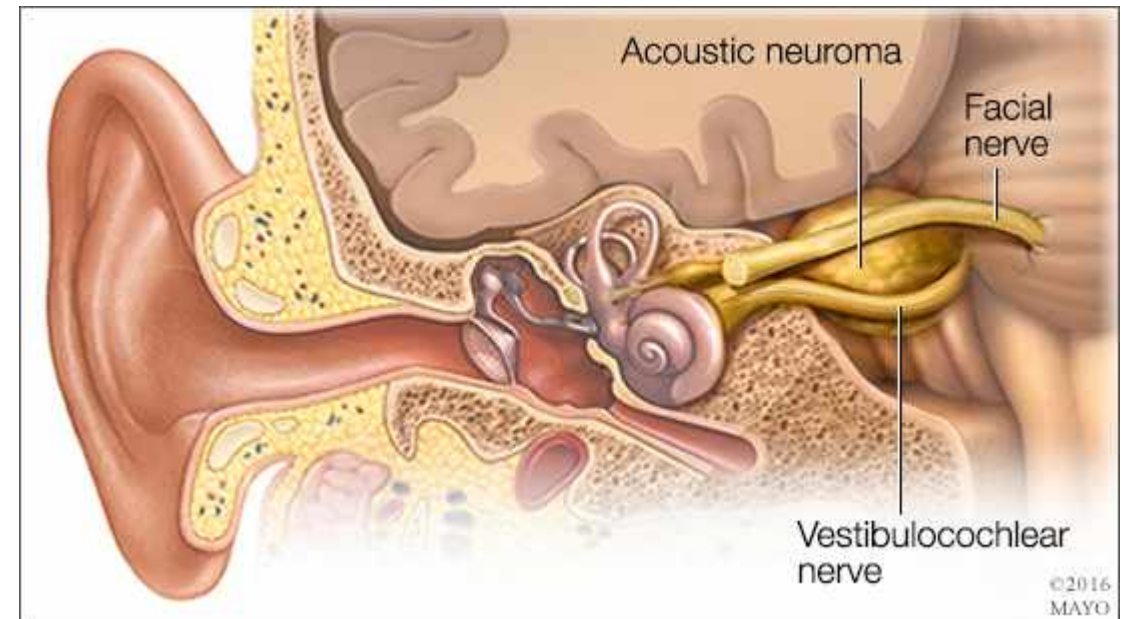
# Schwannoma

## **Presentation** (*unilateral*):

- Facial numbness/paralysis
- Vertigo
- Hearing loss with tinnitus

All on the same side!

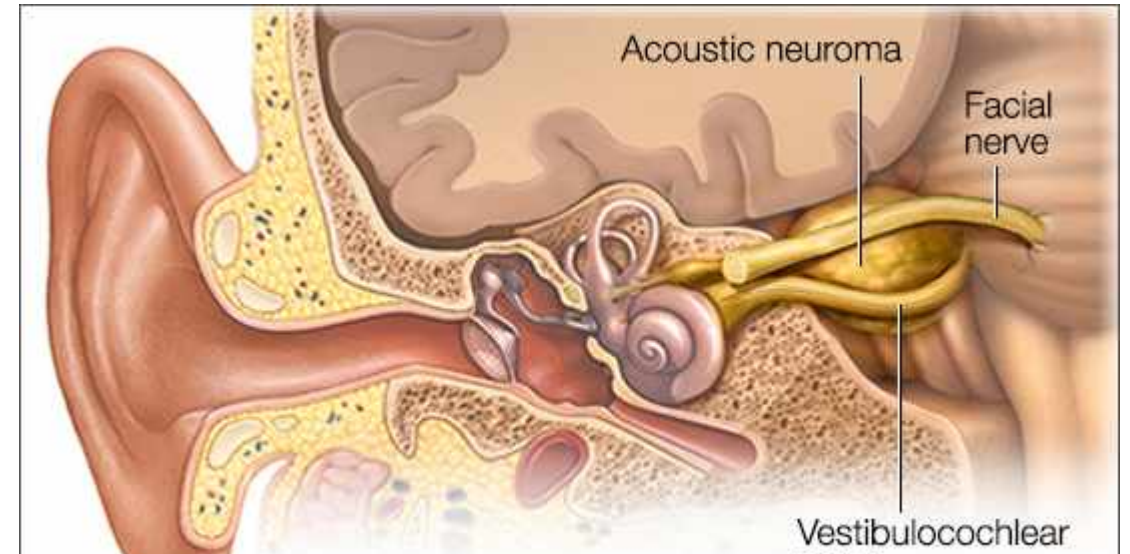
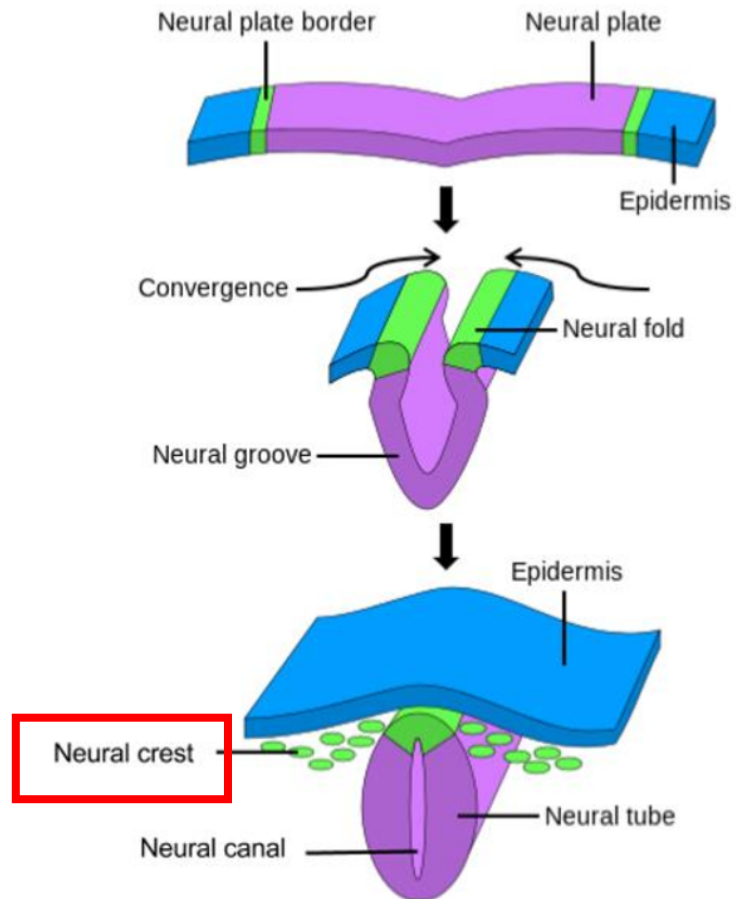
Classic = acoustic neuroma of 8<sup>th</sup> cranial nerve at cerebellopontine angle



# Schwannoma

**Schwannomas = Neural Crest Tumors, S100+**

Classic = acoustic neuroma of 8<sup>th</sup> cranial nerve at cerebellopontine angle



Neural Crest, S100 (+)

# Bilateral Acoustic Schwannomas

## **Presentation** (*bilateral*):

- Facial numbness/paralysis
- Vertigo
- Hearing loss with tinnitus

*All on the same side!*

## **Neurofibromatosis type 2 (NF2 gene mutation)**

## **Presentation** (*bilateral*):

- Facial numbness/paralysis
- Vertigo
- Hearing loss with tinnitus

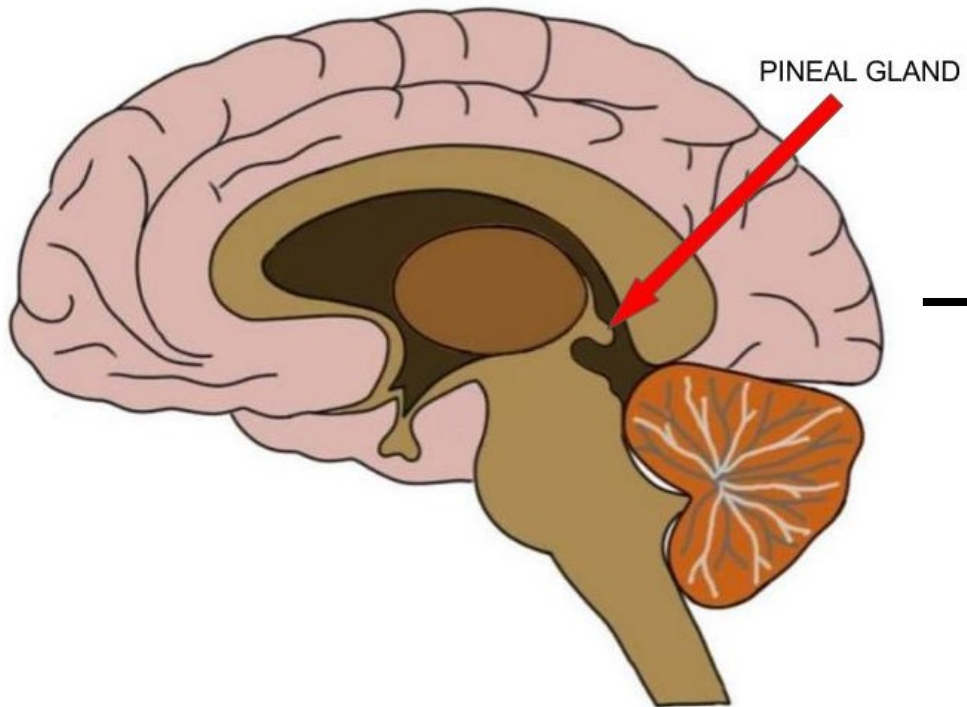
*All on the same side!*



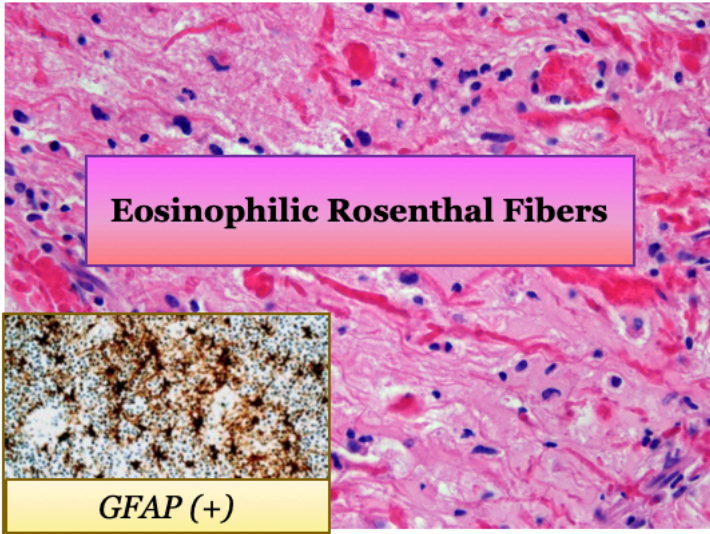
# Pinealoma

Dorsal Midbrain Compression

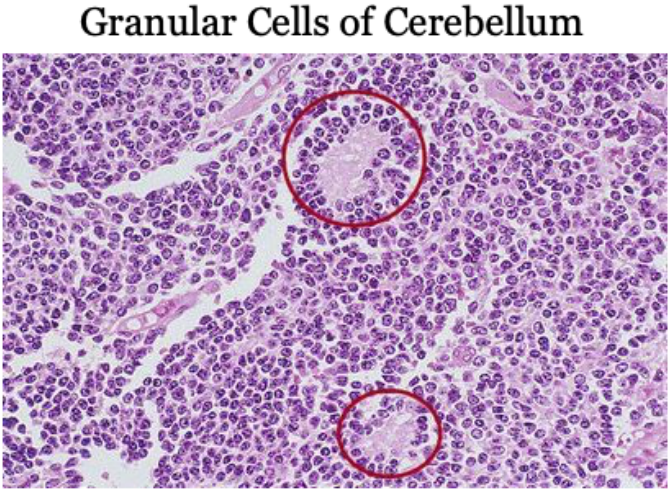
Impaired Upward Gaze



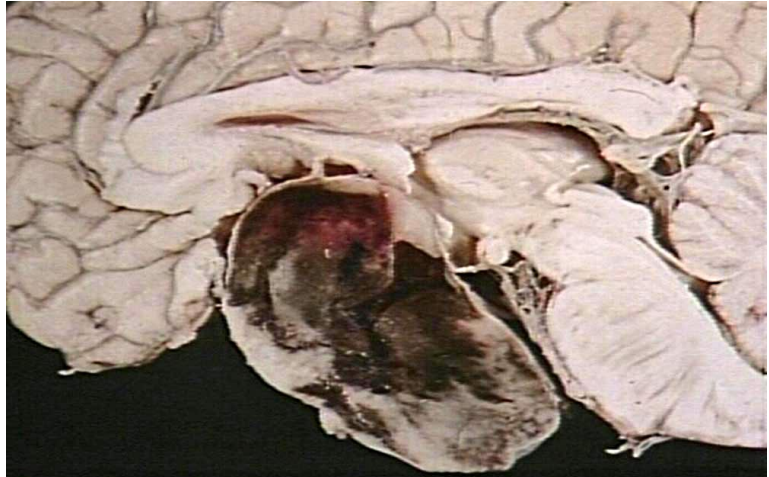
# Pediatric CNS Tumors



Pilocytic Astrocytoma  
Cystic lesion (neuroimaging)  
**Eosinophilic Rosenthal Fibers**



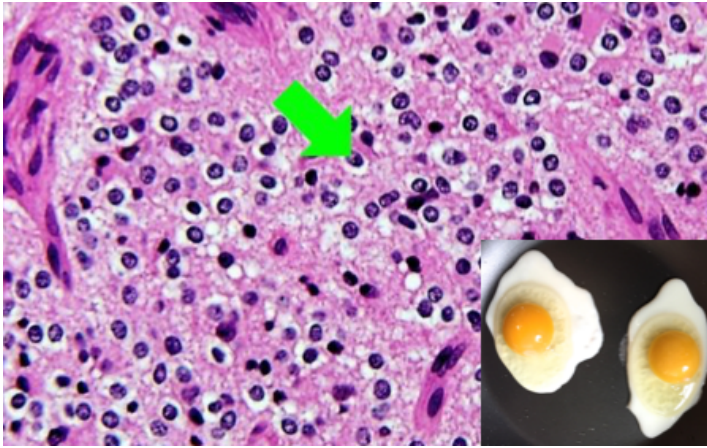
Medulloblastoma  
**Granular cells** of cerebellum  
**Spinal Metastases**  
Obstructive hydrocephalus



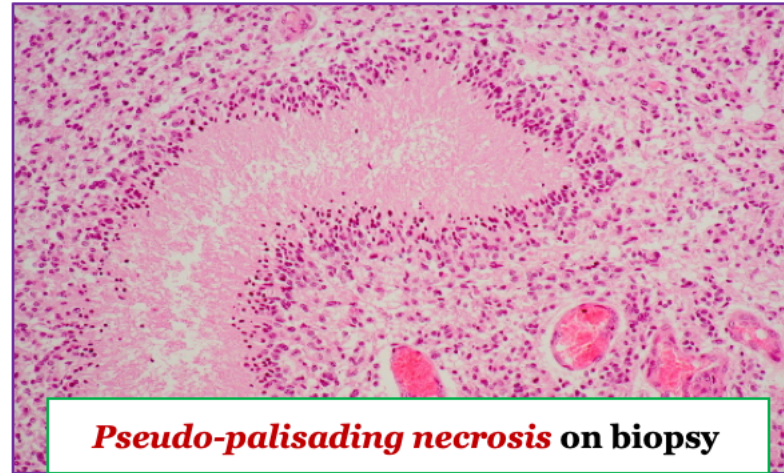
Craniopharyngioma  
**Oral ectoderm** (teeth/ $\text{Ca}^{+2}$ )  
**Cystic** (loculated) **Motor Oil**



## Adult CNS Tumors

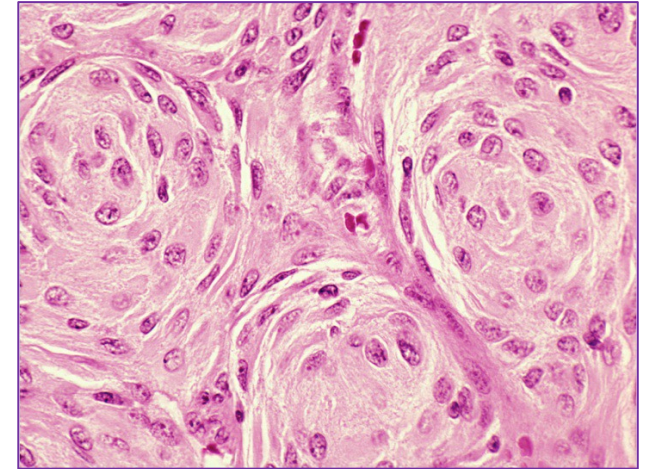


Oligodendroglioma  
Fried egg appearance  
New onset seizures



***Pseudo-palisading necrosis*** on biopsy

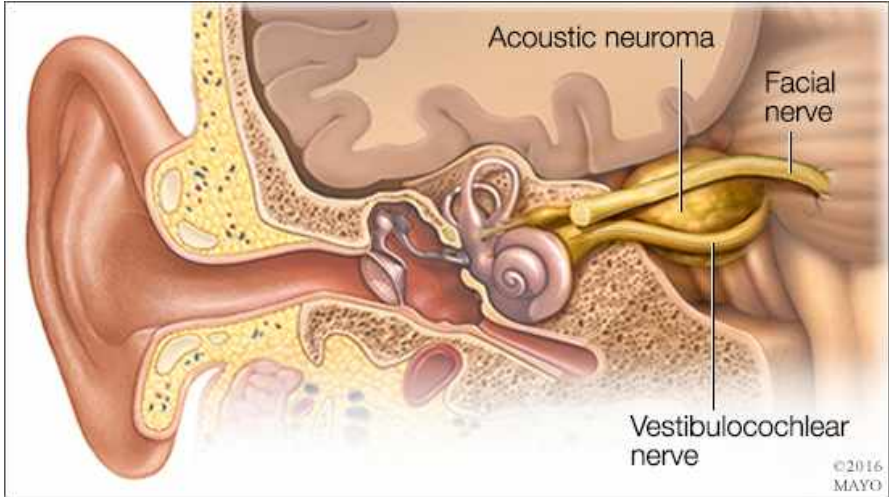
Glioblastoma  
Butterfly appearance  
**Pseudo-Palisading necrosis**



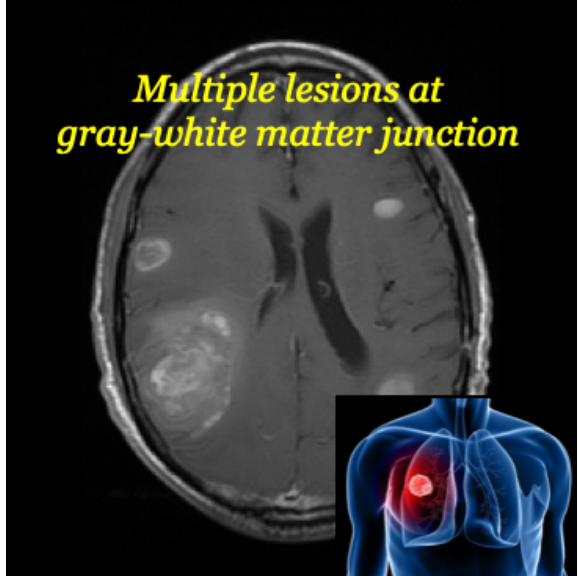
Meningioma  
**Whorled appearance**  
Psammoma bodies

Tumors by Clinical Presentation/Neuroimaging

Pinealoma  
Upward gaze palsy



Schwannoma  
Schwann cells - myelin producing  
Characteristic triad  
(hearing loss, vertigo, facial numbness)



Metastases  
Multiple lesions (gray-white junction)  
Lung most common



# CNS Tumors for USMLE Step One

Tumors identified by *histopathology*

*This was too easy!* Identified by *radiology/imaging*

Kids

In the

side  
rain

oma

- 1. Pilocytic Astrocytoma
- 2. Medulloblastoma
- 3. Craniopharyngioma

- 1. Oligodend
- 2. Glioblastoma multiforme

- 1. Schwannoma
- 2. Pinealoma
- 3. Metastases
- 4. Pituitary Adenoma

*Sample questions*

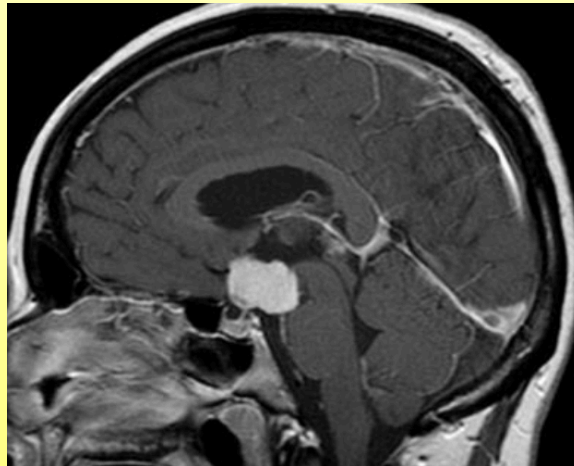


**Q1. A 13 year old boy with no PMH presents with bitemporal hemianopsia. A small mass is found near his pituitary gland, which grossly appears calcified with “motor oil” inside. This tumor is derived from which of the following germ cell layers?**

- A) Neural Crest
- B) Mesoderm
- C) Endoderm
- D) Oral ectoderm
- E) Phalloderm

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- C) Endoderm
- D) Oral ectoderm**
- E) Phalloderm

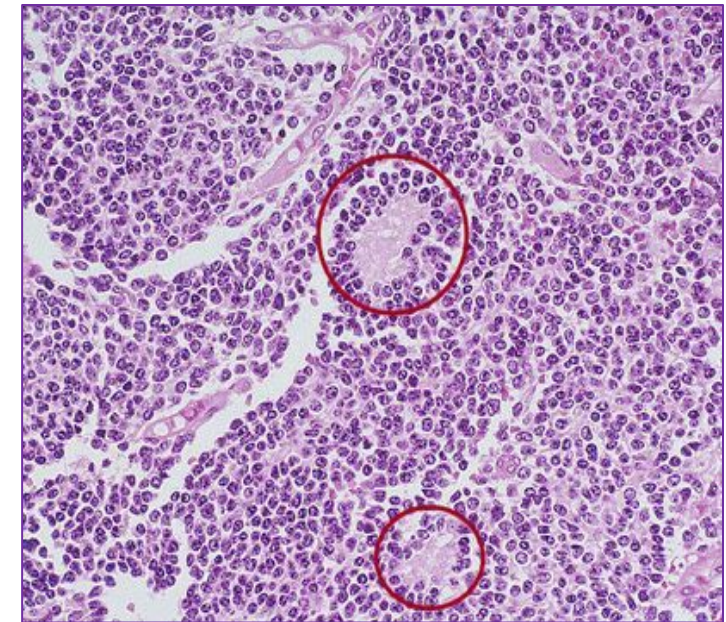


*Calcified suprasellar mass*

**Q2. A 4 year old boy with no PMH presents with two months of poor coordination with several recent falls and right leg weakness for the last week. MRI reveals a mass in his cerebellum. Biopsy is shown (right). Which of the following is true about this tumor?**

- A) It is benign
- B) It is derived from Rathke's pouch
- C) It is derived from granular cells
- D) It cannot metastasize
- E) It is derived from neural crest

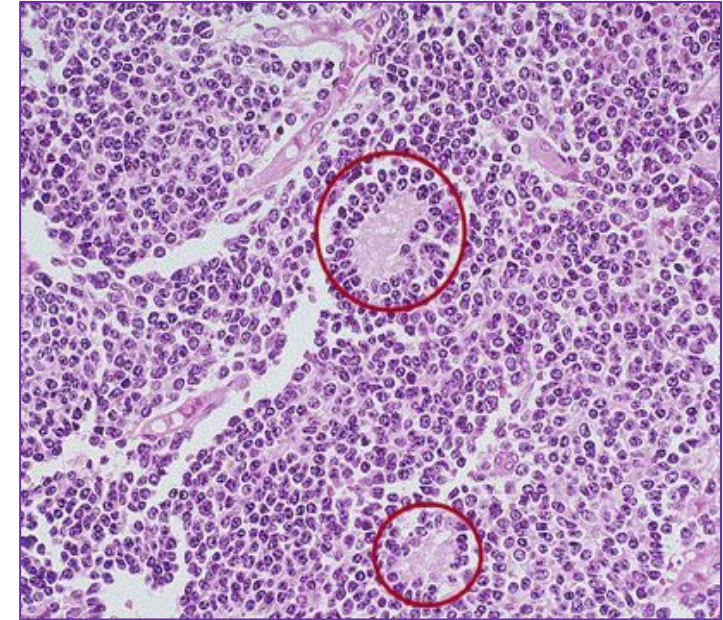
**Pathology**





**Q2. A 4 year old boy with no PMH presents with two months of poor coordination with several recent falls and right leg weakness for the last week. MRI reveals a mass in his cerebellum. Biopsy is shown (right). Which of the following is true about this tumor?**

- A) *It is benign*
- B) *It is derived from Rathke's pouch*
- C) It is derived from granular cells**
- D) It **cannot** metastasize
- E) It is derived from neural crest **ectoderm**



Medulloblastoma

**“Drop Metastases”  
to Spinal Cord**

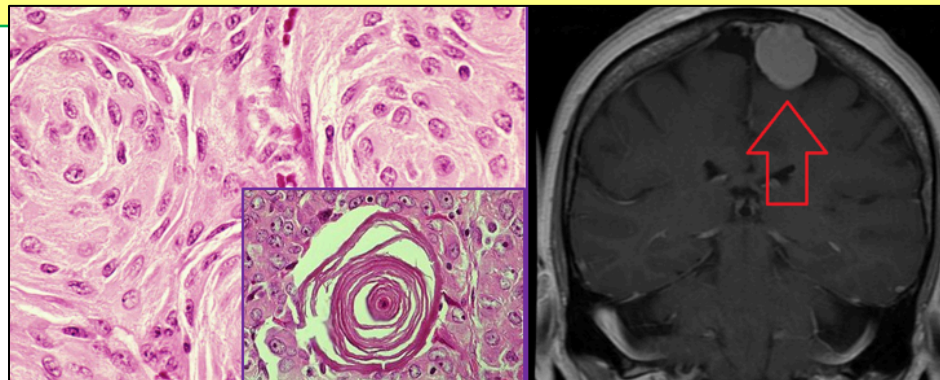


**Q3. A 56 year old woman presents with seizures. An MRI of the brain reveals a well-circumscribed mass originating from the falx cerebri. Which of the following is expected of this mass?**

- A) High growth rate and poor prognosis
- B) Pseudopalisading necrosis and increased vascular permeability on biopsy
- C) Fried egg cells on biopsy
- D) Metastatic potential
- E) Whorled spindle cells and psammoma bodies on biopsy

**Q3. A 56 year old woman presents with seizures. An MRI of the brain reveals a well-circumscribed mass originating from the falx cerebri. Which of the following is expected of this mass?**

- A) *High growth rate and poor prognosis*
- B) Pseudopalisading necrosis and increased vascular permeability on biopsy (*glioblastoma*)
- C) Fried egg cells on biopsy (*oligodendroglioma*)
- D) ~~Metastatic potential~~ (*medulloblastoma*)
- E) Whorled spindle cells and psammoma bodies on biopsy**



# Brain Tumors

*for USMLE Step One*



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UMass Class of 2021

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