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Brain Tumors: An Overview

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Goodman Campbell Brain & Spine

Disclosures:

- None

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Objectives:

- Basic information
- How do brain tumors present?
- Common types of primary brain tumors
- Metastatic brain tumors

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What is the most common benign brain tumor?

- Meningioma
- Pituitary adenoma
- Schwannoma

What is the most common malignant brain tumor?

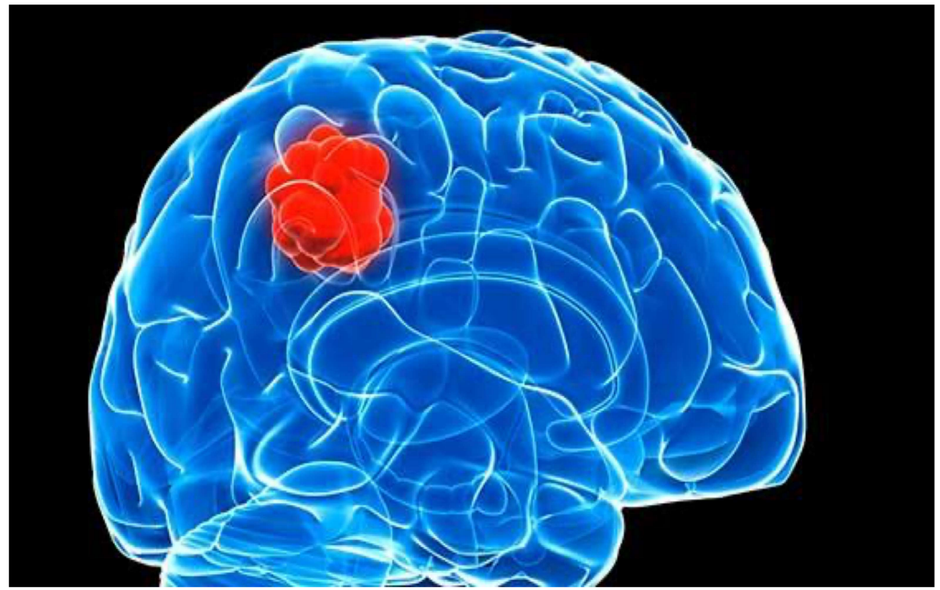
- Glioblastoma
- Brain metastasis
- Anaplastic Astrocytoma
- Pituitary carcinoma

What is the most common primary malignant brain tumor in adults?

- Glioblastoma
- Anaplastic astrocytoma
- Oligodendroglioma
- Ependymoma

Basic Incidences of Brain Tumors

- In 2010, **62,930** new cases were recorded in United states for adult brain tumors, while for children **4,030** new cases for were recorded for the same period, of which 2,880 children were under 15 year of age.
- White Americans > Black Americans
- In US, brain tumors typically occur in 2 distinct categories
  - Children aged 0-15years
  - Adults in their 5th to 7th decade



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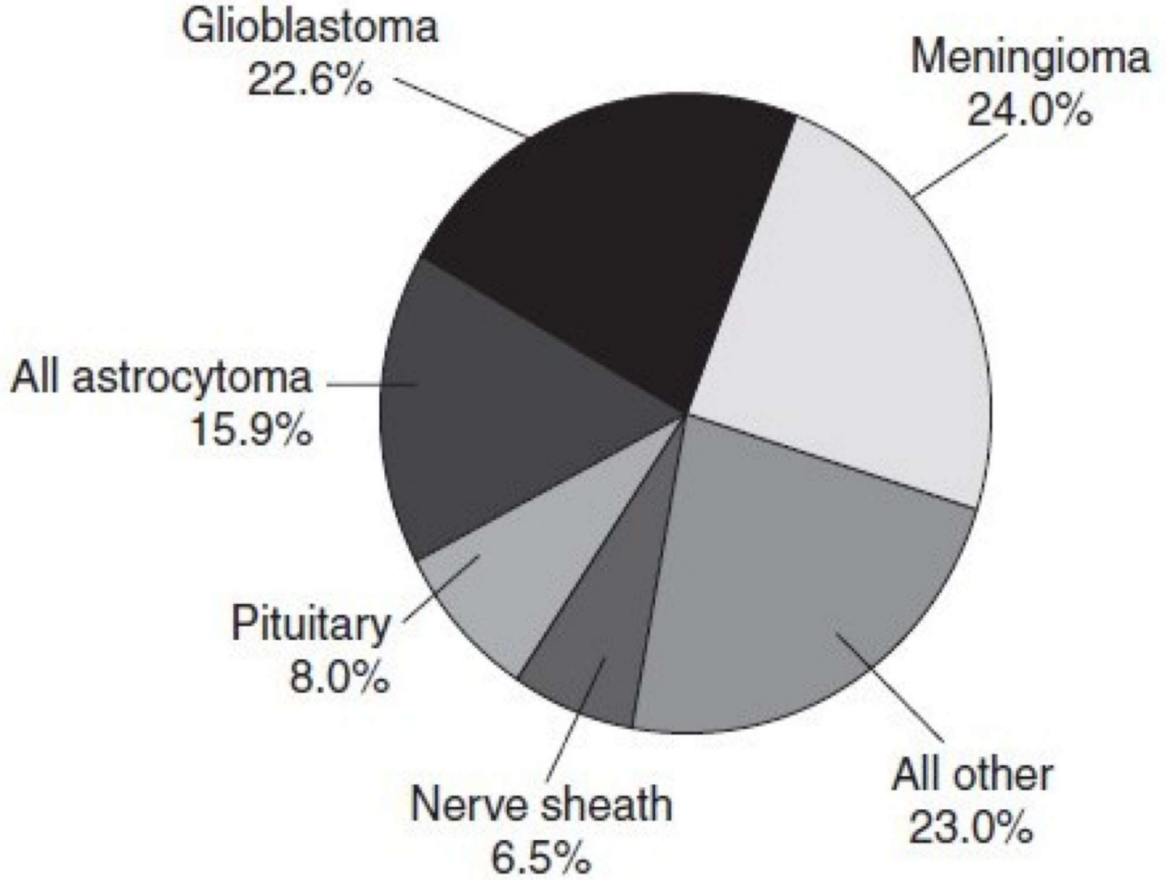

Figure : Distribution of all primary brain and CNS tumors by histology (From CBTRUS, 2010)

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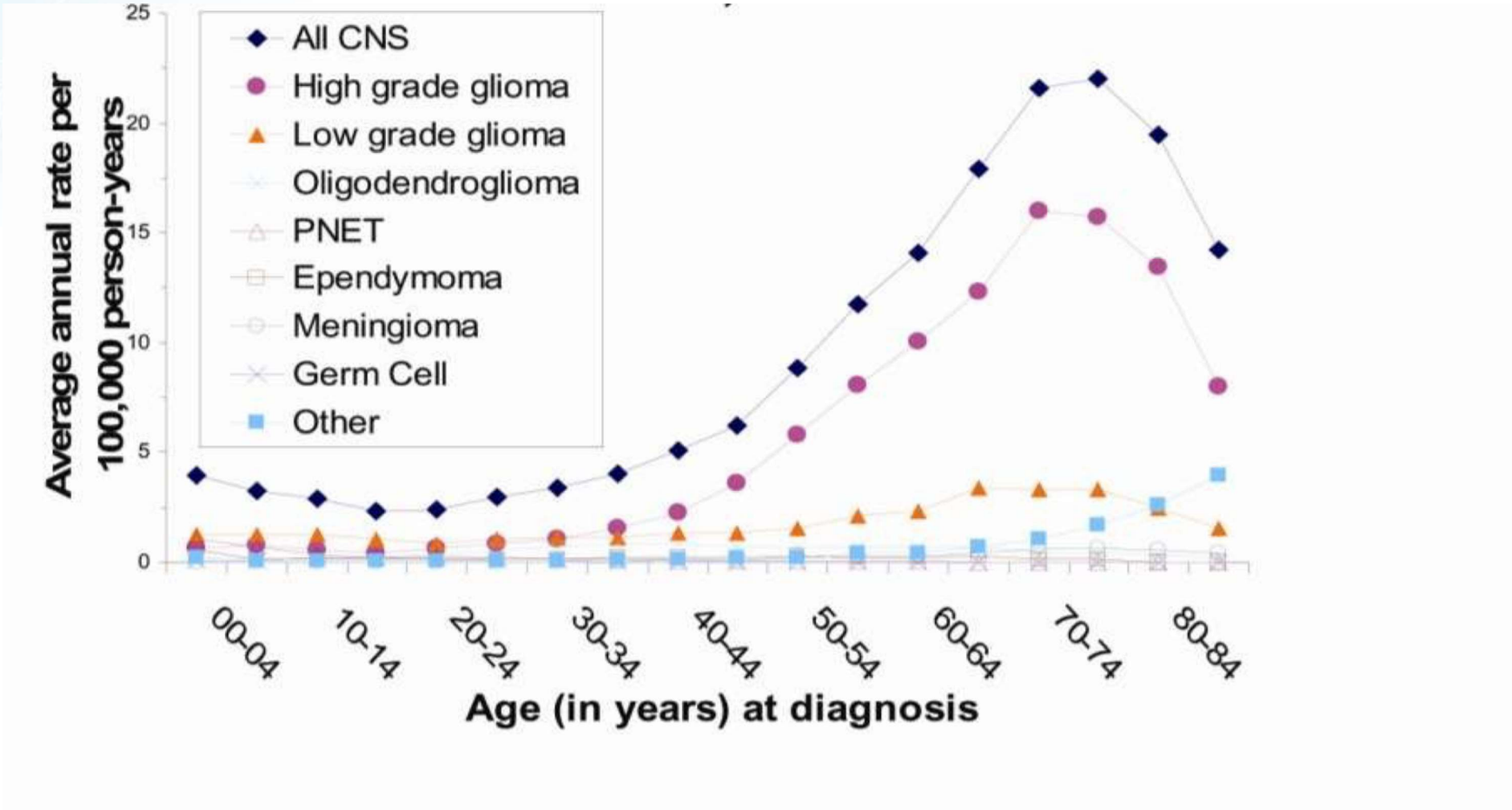
Incidence of malignant primary CNS tumors by age and histology



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What is a Brain Tumor?

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Primary vs. Secondary

Primary — originates in the brain

Secondary — made up of cells that have spread (metastasized) to the brain from somewhere else in the body.

- May lodge into the certain structures:
  - Brain parenchyma – most common area of metastases
  - Leptomeninges – pia mater & arachnoid
  - Dural space

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Benign

- slow-growing
- noncancerous
- do not spread to surrounding tissue

Malignant

- cancerous
- fast-growing and aggressive
- can invade nearby tissue and also are more likely to recur after treatment

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They can also be:

- **Extramedullary (Extraaxial)**
  - Meningioma
  - Pituitary adenoma
  - Vestibular schwanomma
- **Intramedullary (Intraaxial)**
  - mostly manifesting as seizures
  - Glioma
  - Primary CNS Lymphoma
  - Metastatic
- **Intraventricular**
  - Meningioma
  - Neurocytoma
  - Ependymoma

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I have been diagnosed with a brain tumor, what do we do?

- Making a diagnosis
  - Biopsy
  - Imaging
- Treatment (includes, but doesn't always include all)
  - Surgery
  - Radiation
  - Chemotherapy
  - Observation

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How do Brain Tumors Present?

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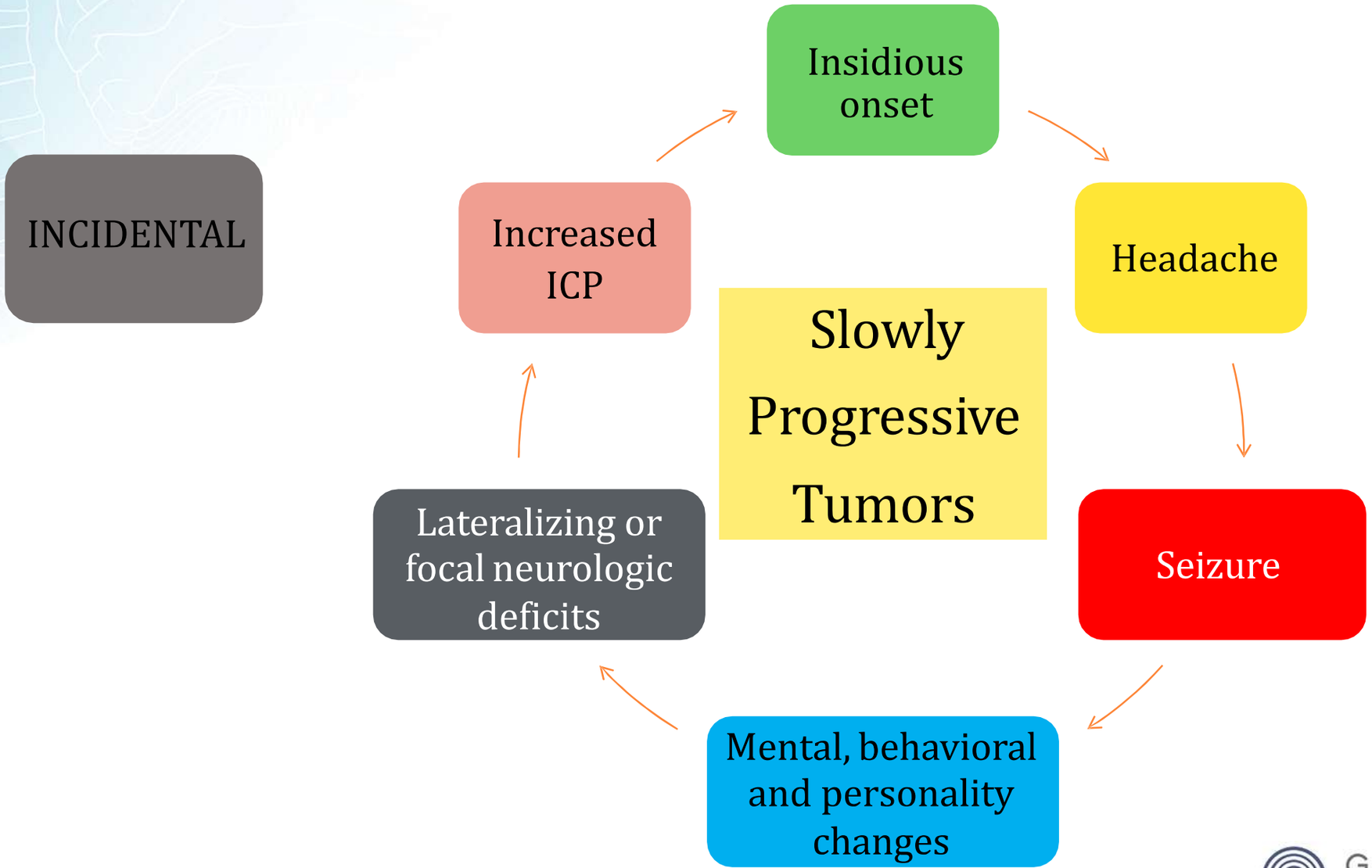
Clinical Presentation



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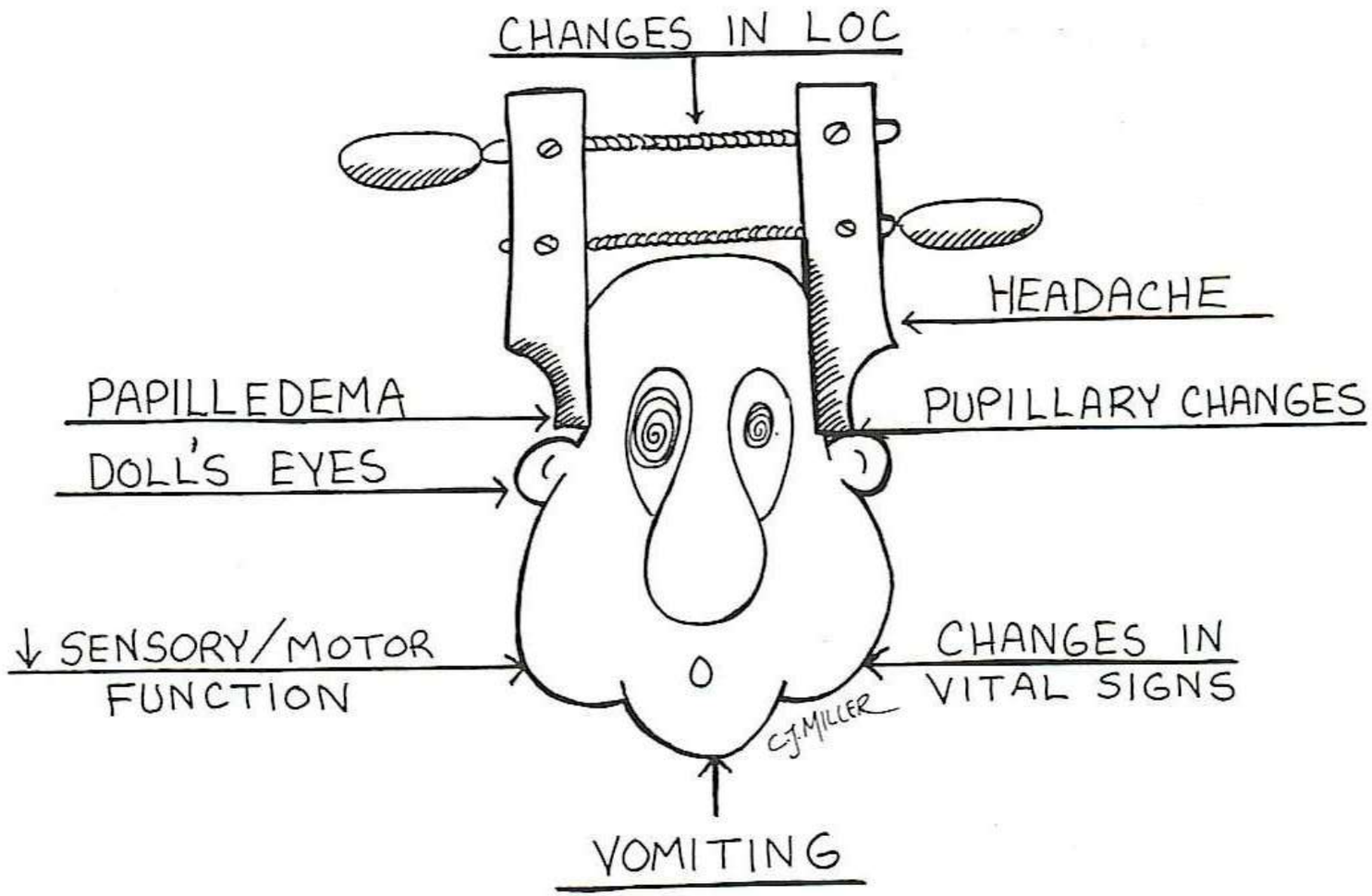
Increased ICP



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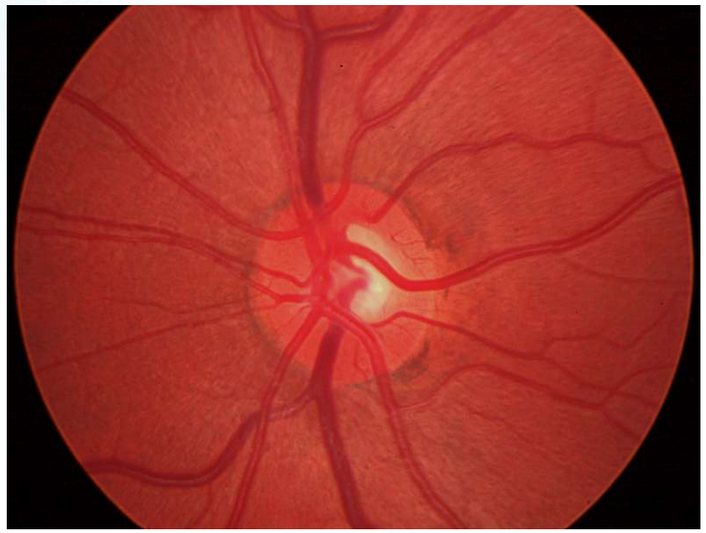
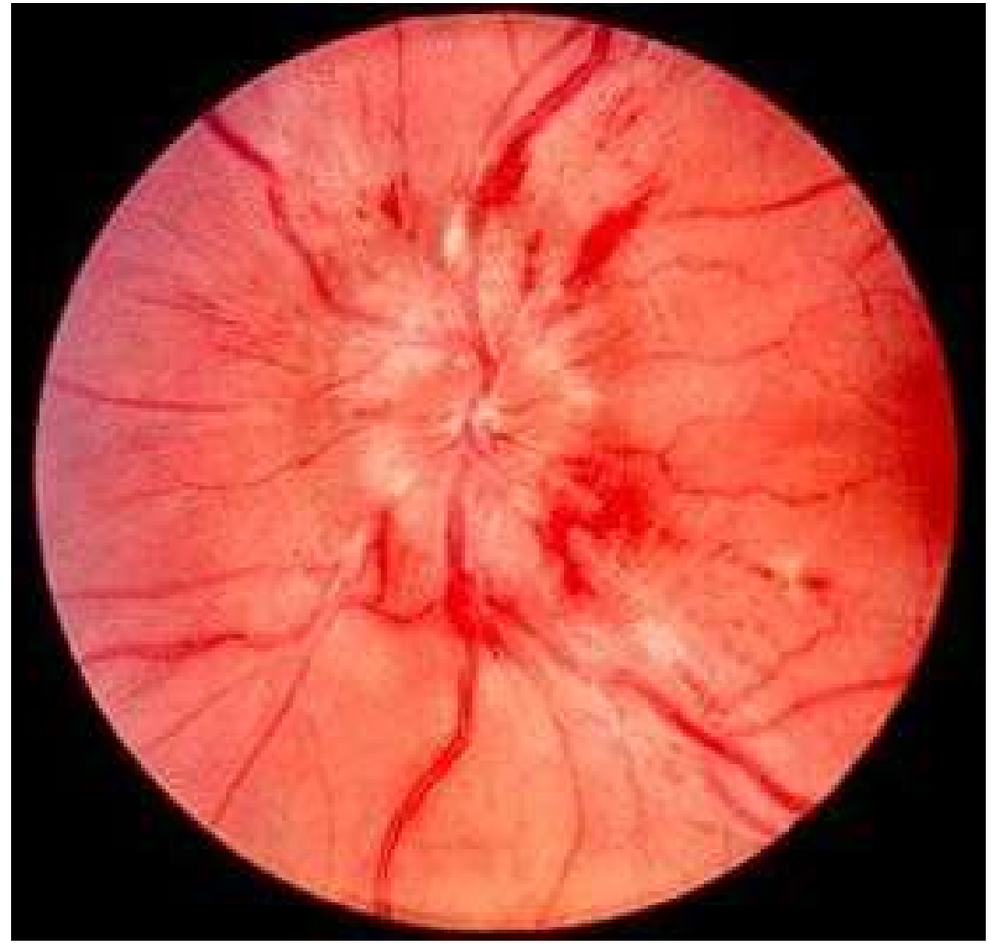
Papilledema



Normal

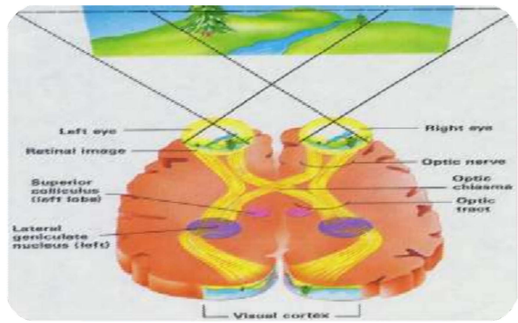


Cerebral Dysfunction

Seizure

Contralateral lesion:

- Hemiparesis with Babinski reflex & cranial nerve deficits
- Hemisensory deficits
- Homonymous hemianopsia/quadrantanopsia



Organic mental, behavioral personality changes

Language disorder

aphasia

(motor area lesion: Broca's aphasia; sensory lesion: Wernicke's aphasia)

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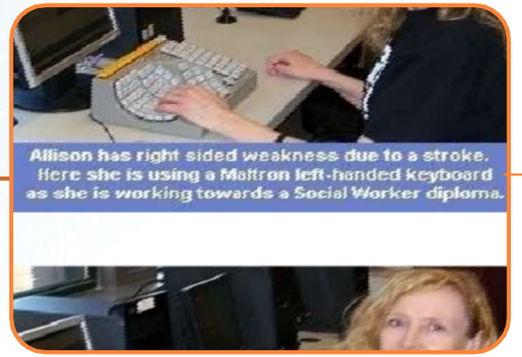
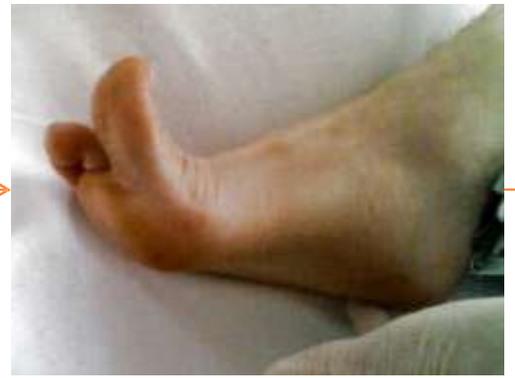
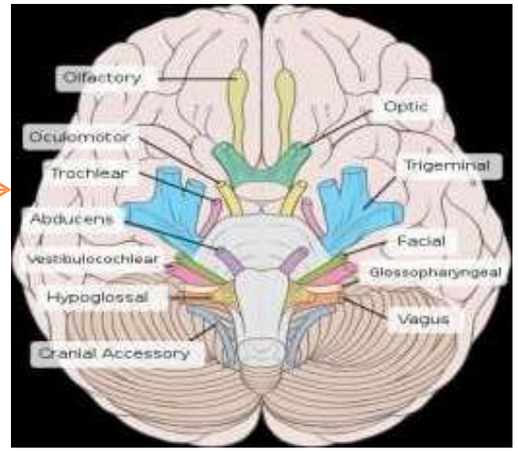
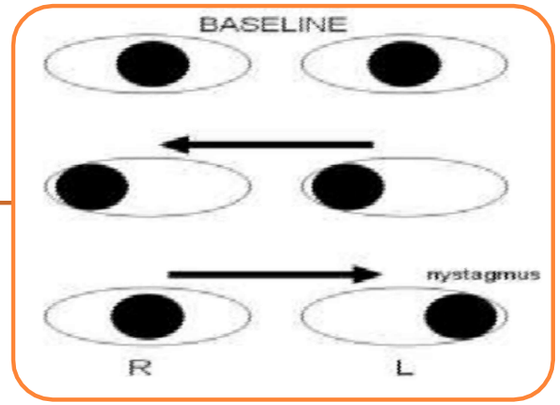
Brainstem Dysfunction









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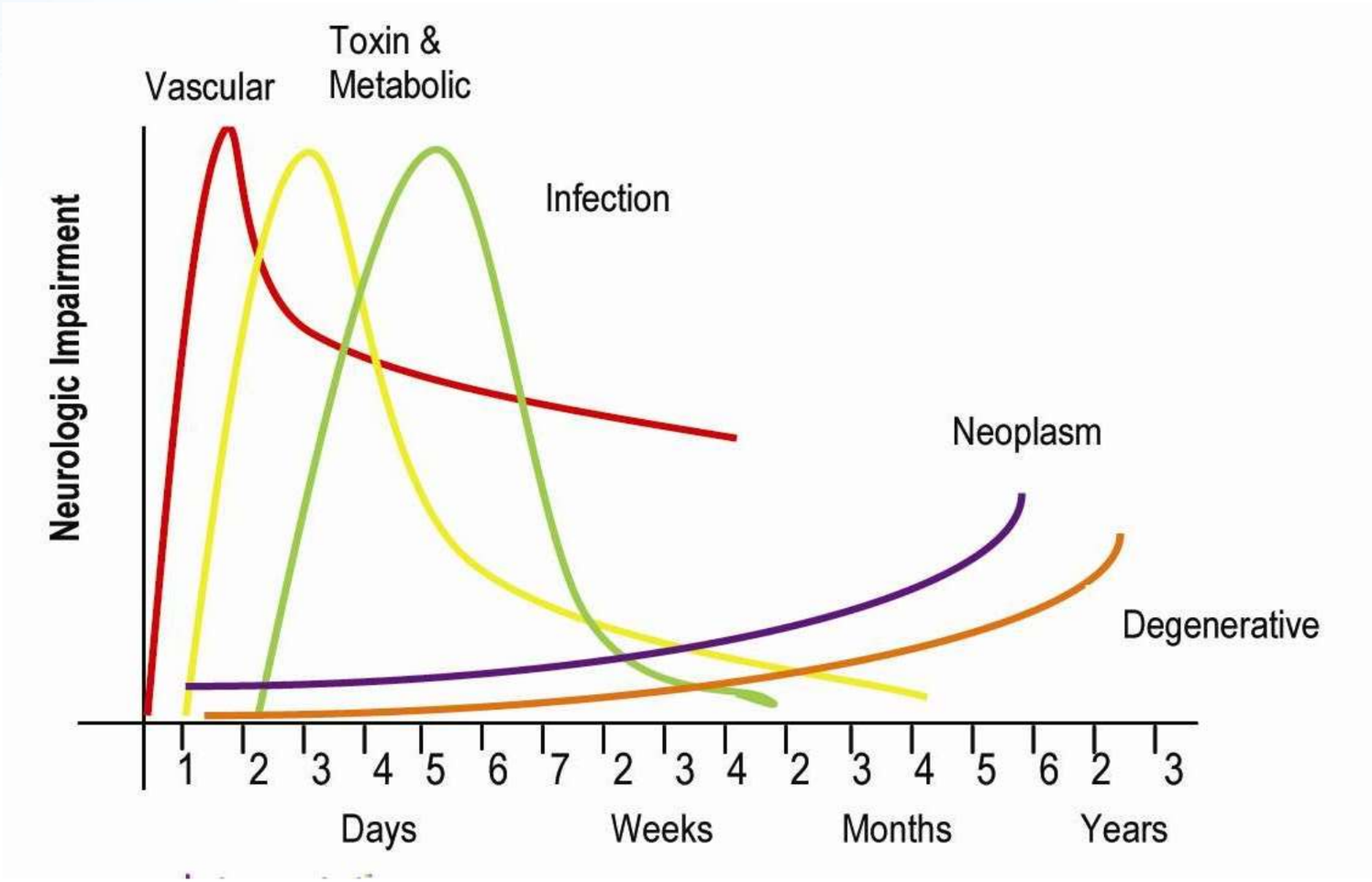
Course of Illness



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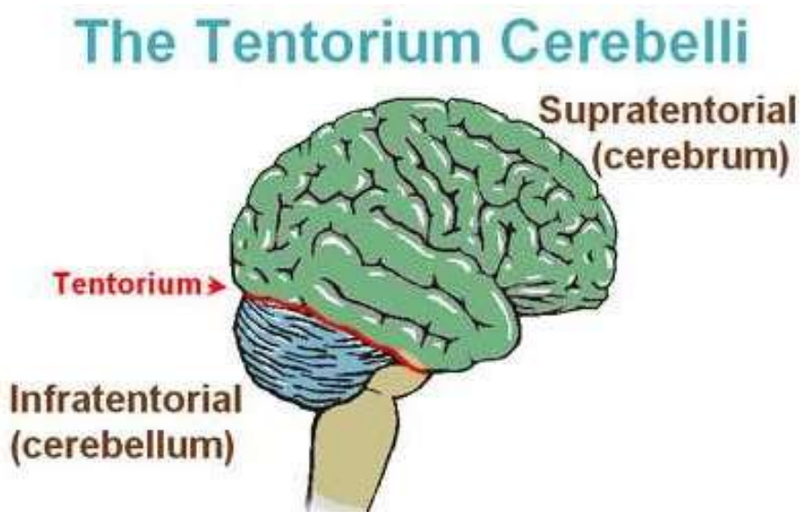
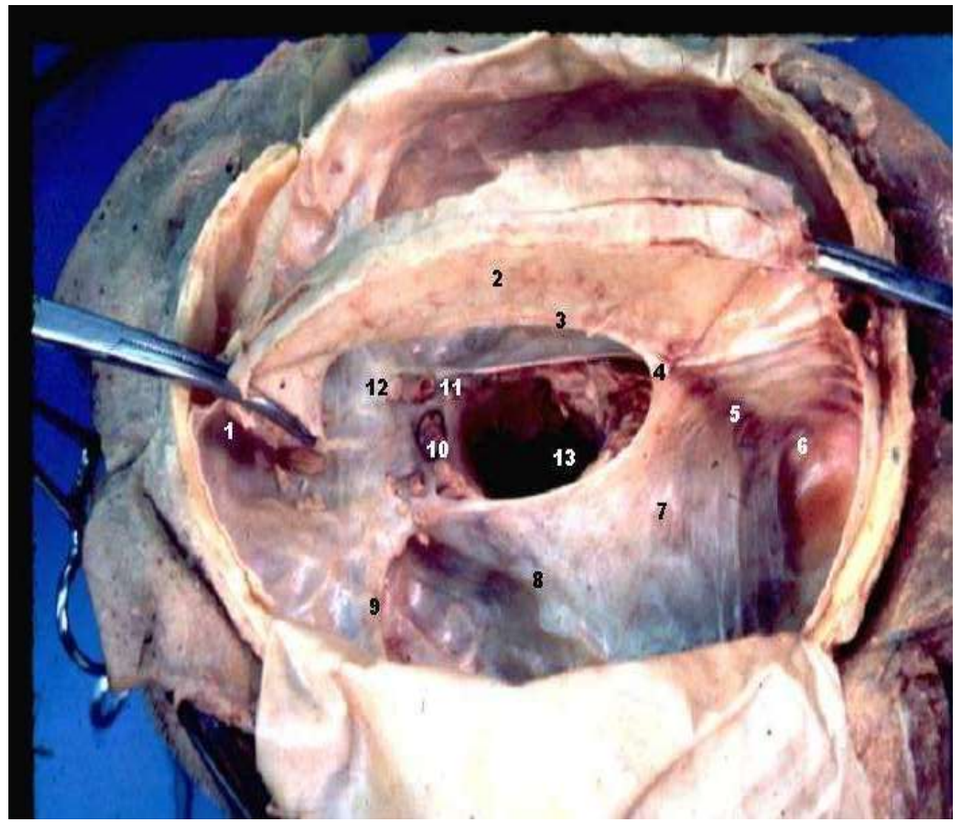
WHO Grading System

Grade I-Pilocytic astrocytoma	•Benign cytological features- see below
Grade II-Low- grade astrocytoma	•Moderate cellularity-no anaplasia or mitotic activity
Grade III- Anaplastic astrocytoma	•Cellularity, anaplasia, mitoses
Grade IV- Glioblastoma	• Same as Grade III plus microvascular proliferation and necrosis

Age Incidence

- Adults
  - Supratentorial: 80-85%
  - Intratentorial: 15-20%
- Children
  - Infratentorial: 60%
  - Supratentorial: 40%





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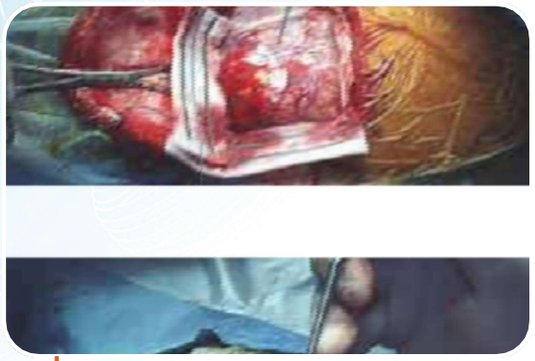
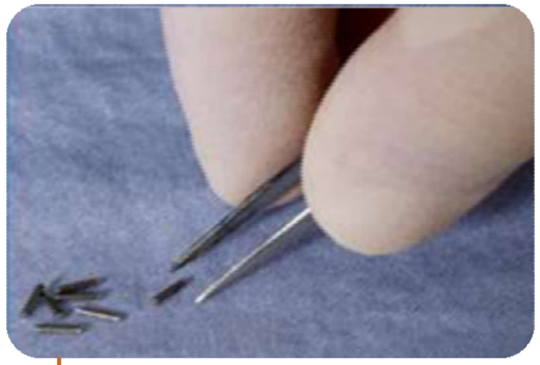
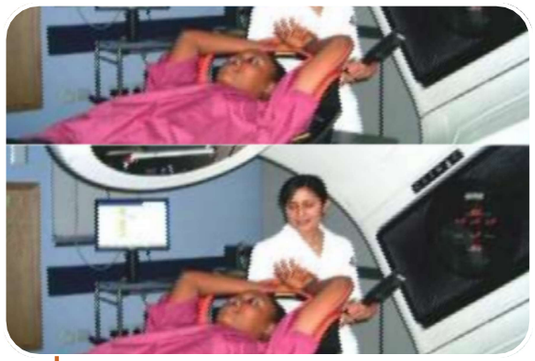
Treatment of Brain Tumors



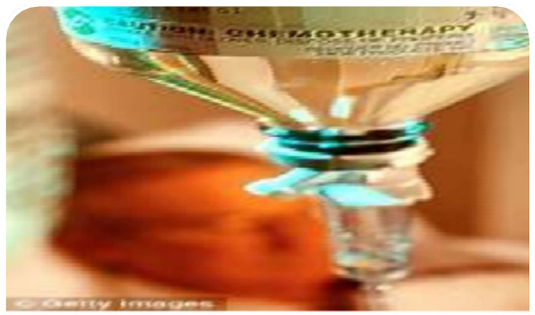
Surgery



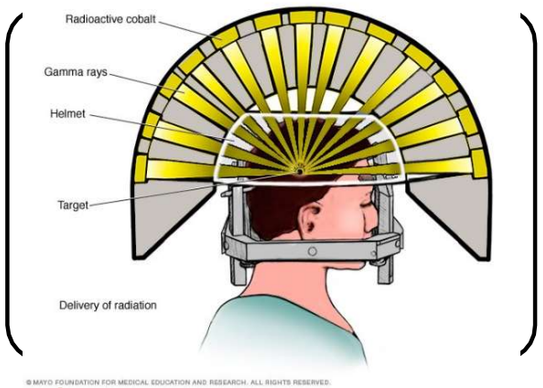
Brachytherapy



Radiotherapy



Chemotherapy



Gamma knife

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Common Types of Brain Tumors

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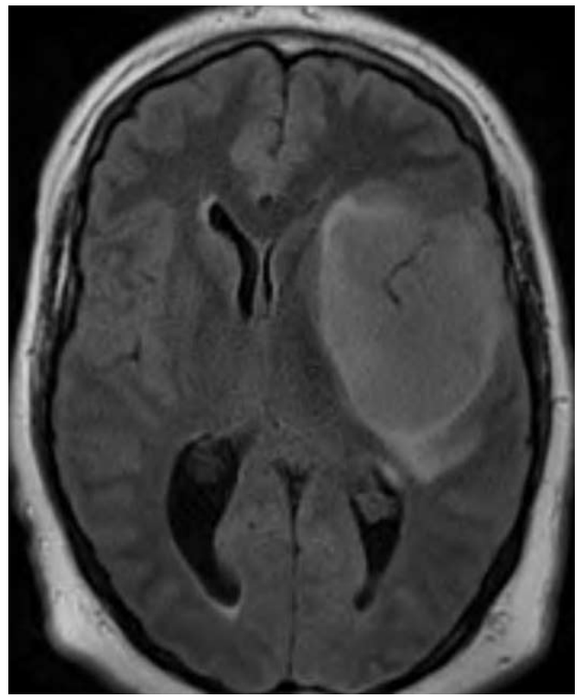
I. Gliomas

- Most common primary brain tumor
- 50% of all symptomatic brain tumors
- Incidence increases with advancing age
- No known environmental factors
- No behavioral lifestyle choices
- Ionizing radiation: the only clear risk factor
- Originate from glial cells or their stem cell precursors



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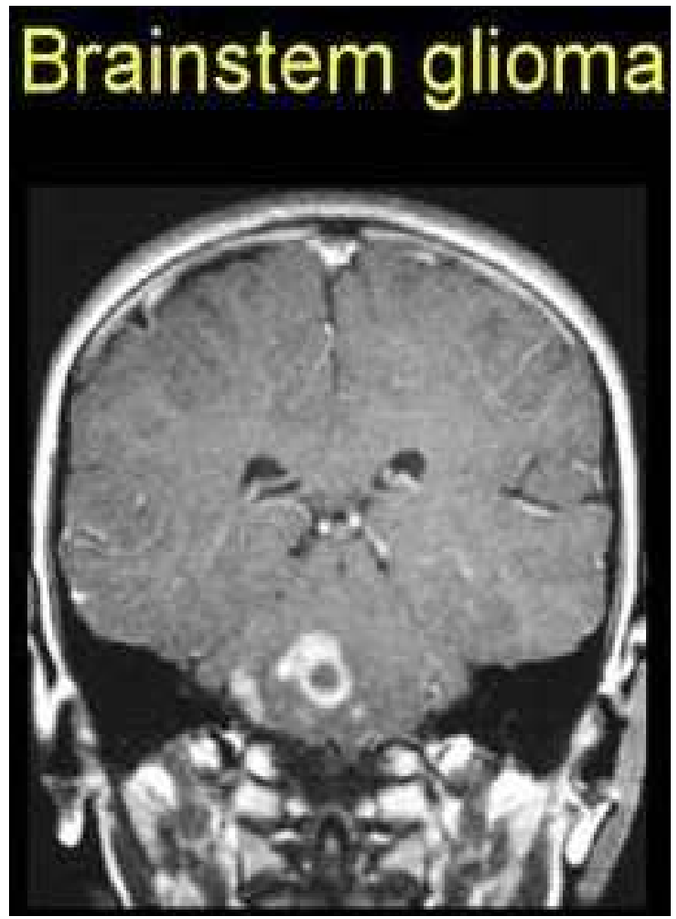
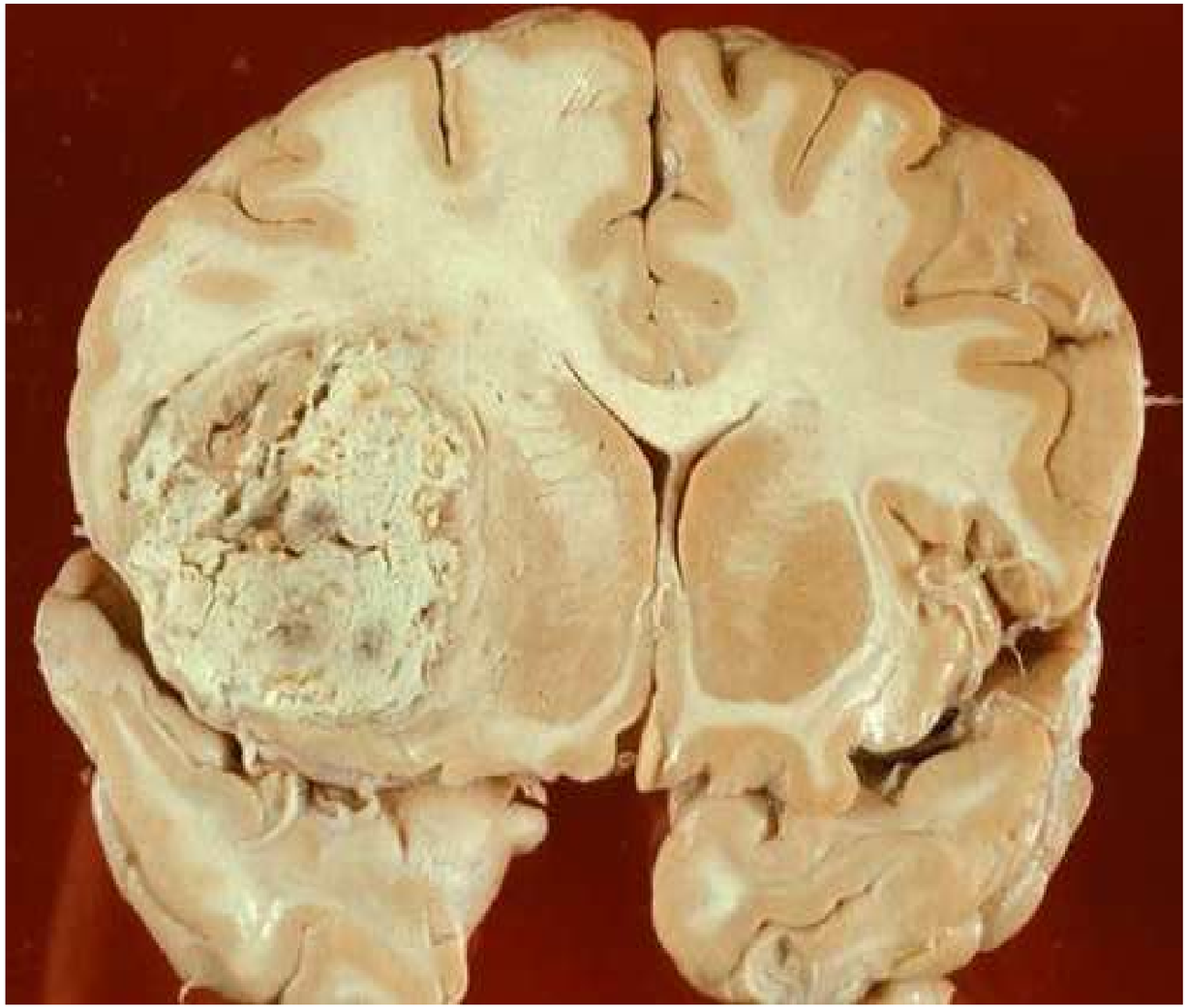
Gliomas

- Include:
  - Astrocytoma
  - Oligodendroglioma
  - Ependymoma
- WHO Classification Basis
  - Increased cellularity
  - Nuclear atypia
  - Endothelial proliferation
  - Necrosis



Glioblastoma Multiforme (Grade IV Astrocytoma)



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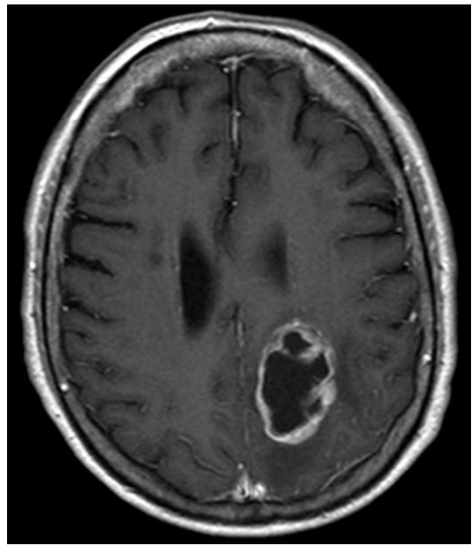
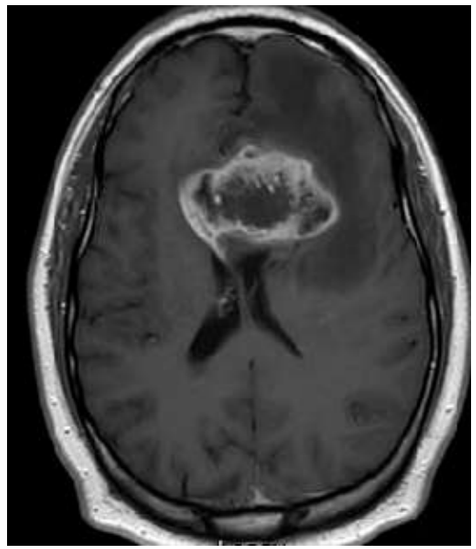
Glioblastoma

- Most common primary *brain* tumor in adults
  - 50s-70s
- Presents with headache, focal neurologic symptoms
  - Destructive, rapid growth
  - Seizure less common
- Prognosis is poor
  - 1-2 years for most new diagnosis
  - Very modest improvements in last 2 years
- Treatment:
  - Maximal safe resection (sometimes just biopsy)
  - Temozolomide and XRT
  - Recurrence: variable treatment options





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Prognosis of Astrocytomas

- Median survival
  - GBM: 1-2 years
  - Anaplastic astrocytoma: 3 years
  - Low-grade astrocytoma: 5 years
  - Others survive a decade or more
  - Most die from transformation of tumor to higher grade

Video of GBM Resection

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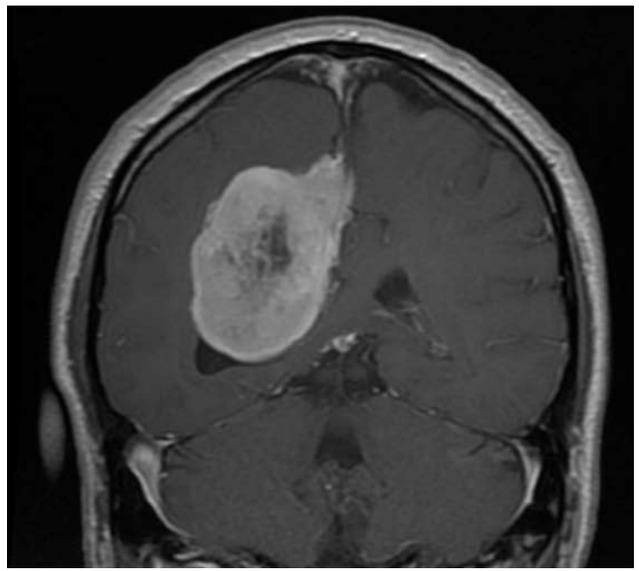
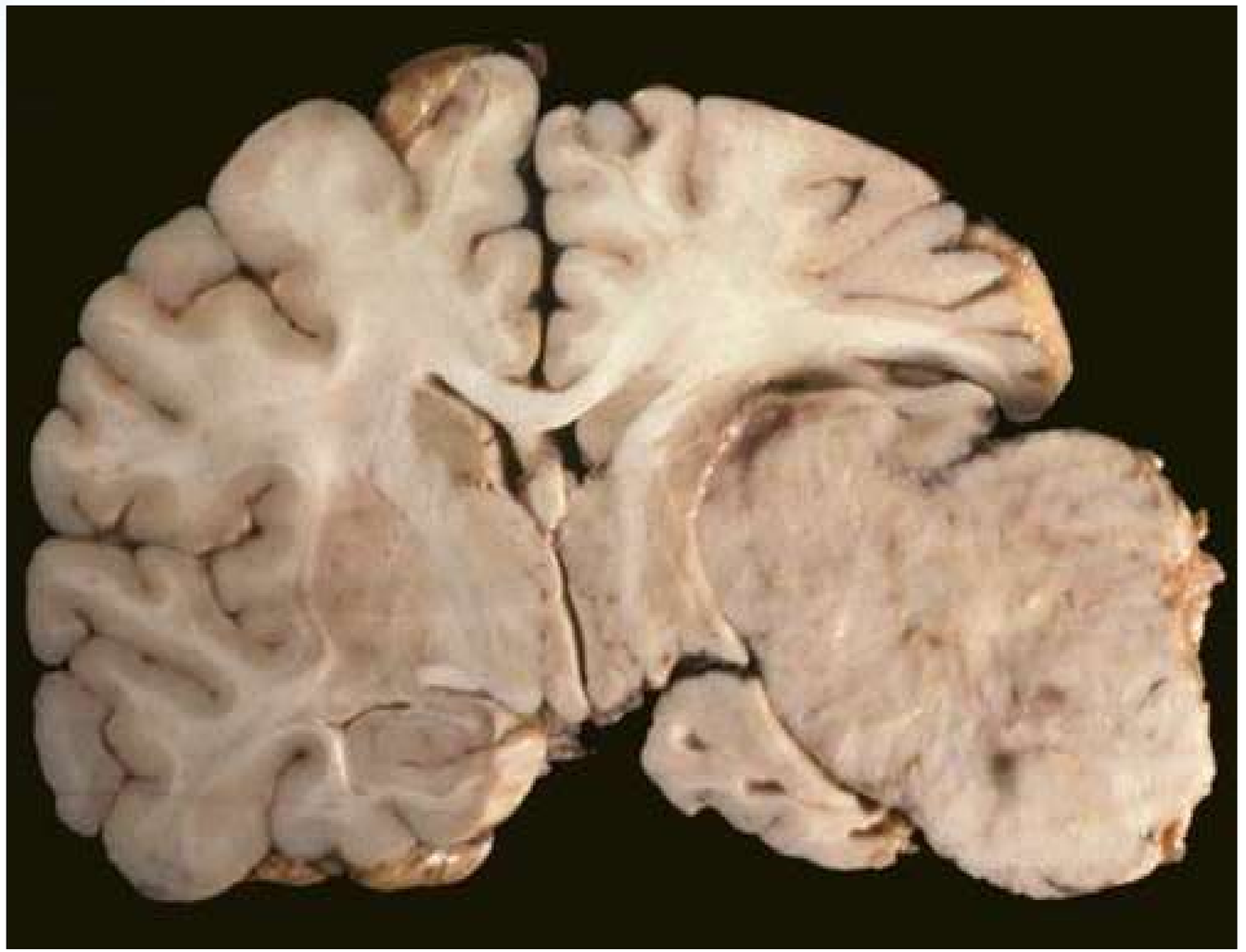
II. Meningioma

- Second most common primary brain tumor
- Originate from arachnoid cells (meningoepithelial cap cells normally seen in arachnoid villi)
- 20% of all intracranial tumors (with asymptomatic cases - 40% or more)
- >90% are grade I tumors



Meningioma



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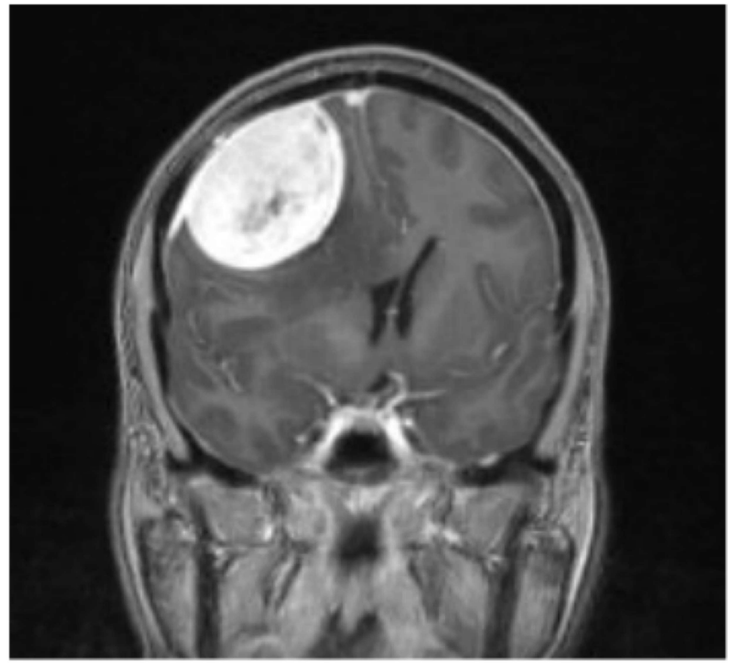
II. Meningioma

- Most diagnosed in 6th - 7th decades
- Female: Male—3:2 to 2:1
- Multiple in 5-15% (NF-2)
- 90% intracranial
- 10% intraspinal
- Spinal meningioma: 10x in women
- All familial meningiomas occur with NF-2
- Rare in children (more in boys)
  - Rare with dural attachments
  - Usually intraventricular or posterior fossa
  - Commonly with sarcomatous changes
  - Frequently with NF-2

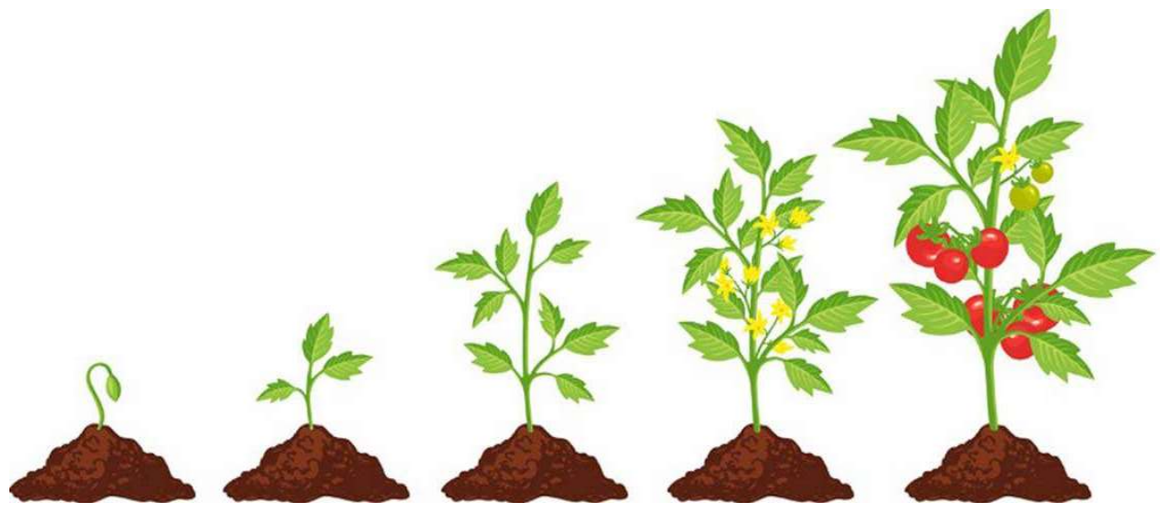


Clinical Manifestations

- Some are asymptomatic - found incidentally by MRI
- But may have symptoms:
  - Tumor location: by compression of underlying neural structures
  - Sites of predilection
    - Cerebral convexity (Sylvian & parasagittal areas)
    - Falx cerebri
    - Skull base
      - Olfactory groove
      - Sphenoid ridge
      - CP angle
      - Tuberculum sellae

Growth Rate of Meningioma

- Less than 1 cm per year (very slow growth but can recur)
- Tumor doubling time: 1.27 to 14.35 years



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Treatment Options

- Surgical resection
- Radiation therapy
- Observation

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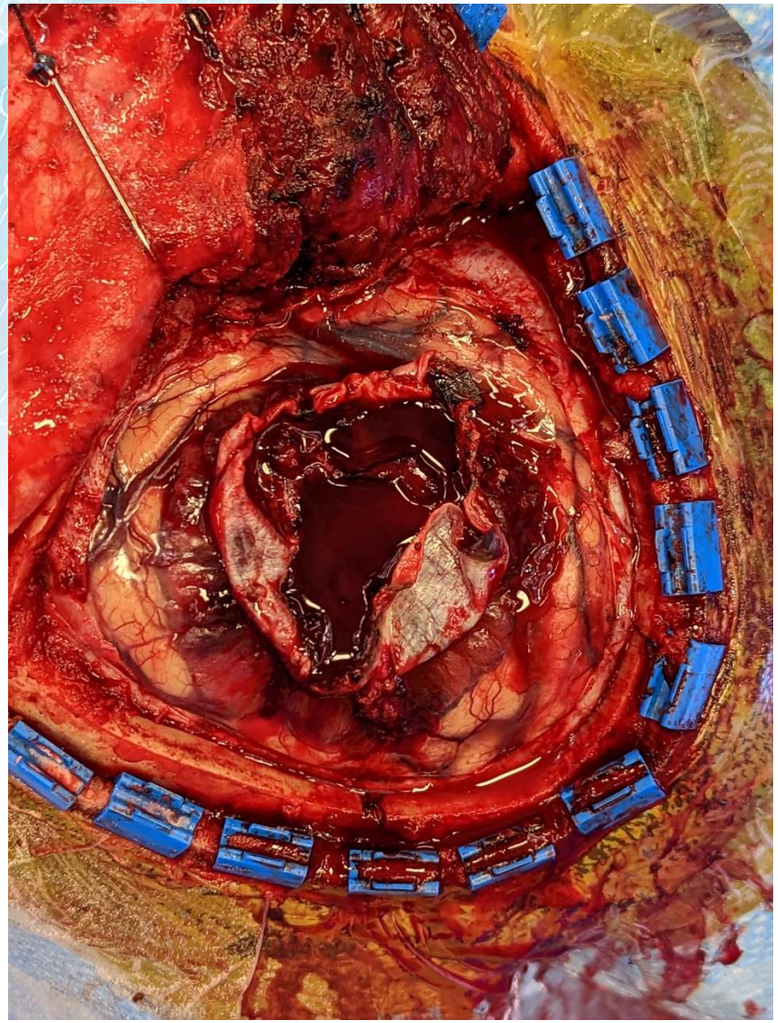
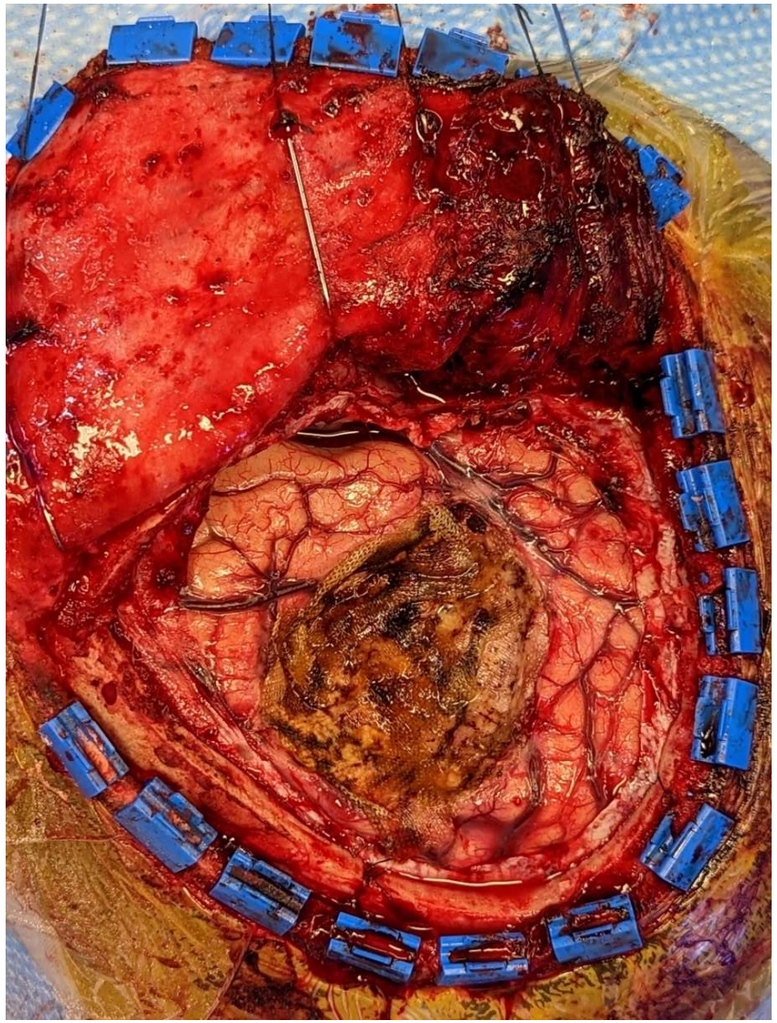
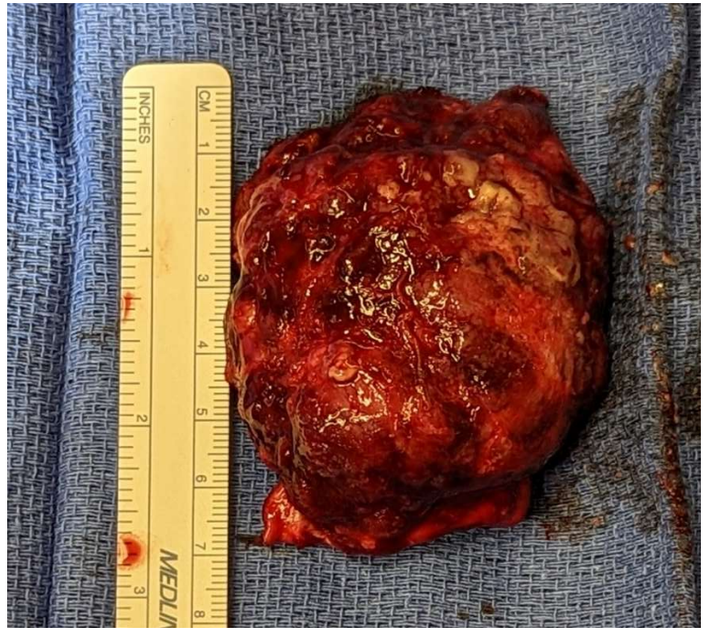
Surgery

- Complete excision may cure many meningiomas
- The extent of resection is the most important in determining recurrence
- For recurrence: reresection considered







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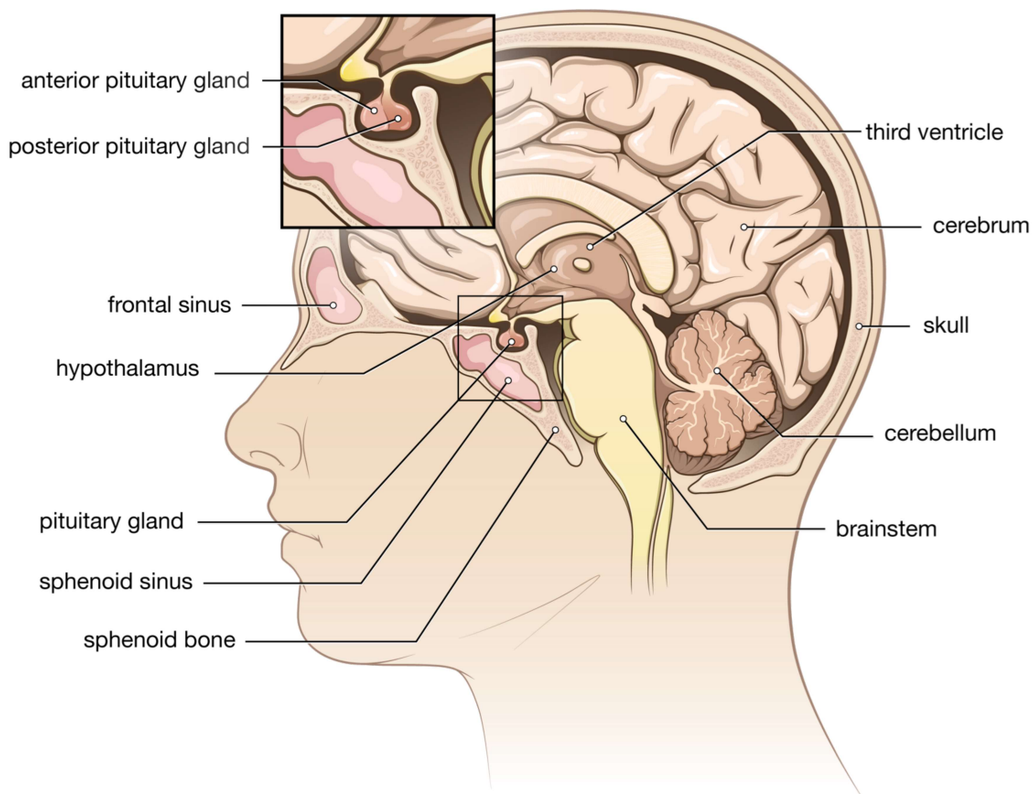
Radiation Therapy

- Residual tumor after surgery
- Recurrent tumor
- Atypical or malignant histology

III. Tumors of the Pituitary Gland

- Third most common primary brain tumor
- Often asymptomatic
- Most common in adults in the 3rd and 4th decade
- 10% incidence in children & adolescents
- Not hereditary except MEN-1 (multiple endocrine neoplasia)



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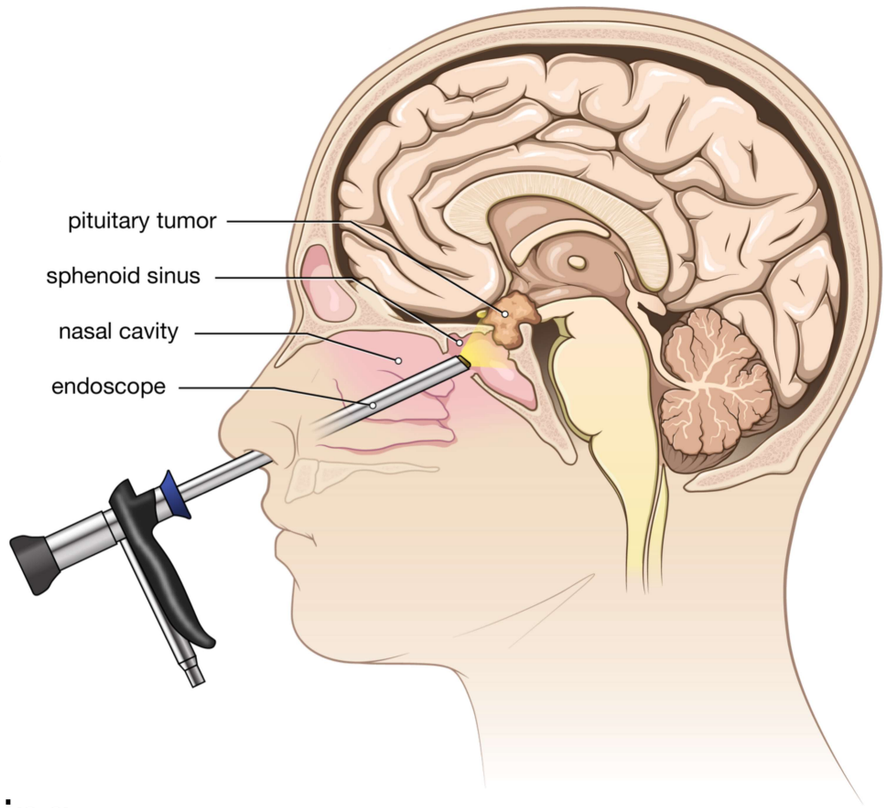
Pathology

- Microadenoma
  - Less than 1cm
  - Symptoms due to excess hormone secretion (or hyperfunctioning)
    - Growth hormone
    - Gonadotropin
    - Thyroid hormone
    - Adrenal hormone
    - Prolactin hormone
- Macroadenoma
  - More than 1cm
  - Symptoms due to compressing normal pituitary gland and neural structure causing hypofunctioning



Pathology

- Endocrine Active (Secretory)
  - Prolactinoma
    - Most common secretory intrasellar endocrine active tumor
    - Secreted either by microadenoma or macroadenoma
  - Growth hormone
    - Before closure of epiphysis -> gigantism
    - After closure of epiphysis -> acromegaly
  - ACTH: Cushing's Syndrome
  - FSH and LH
- Endocrine Inactive (non-secretory or null cell adenoma)
- 10% mixed secretory tumor

When do you operate on Pituitary Adenomas?

- Compression of neural and vascular structures
  - Optic chiasm compression causing bitemporal hemianopsia
- Functionally active tumor (except prolactinoma)
- May enlarge with pregnancy
- 5% of pituitary adenoma present with pituitary apoplexy

Bitemporal Hemianopsia

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Brain Metastases

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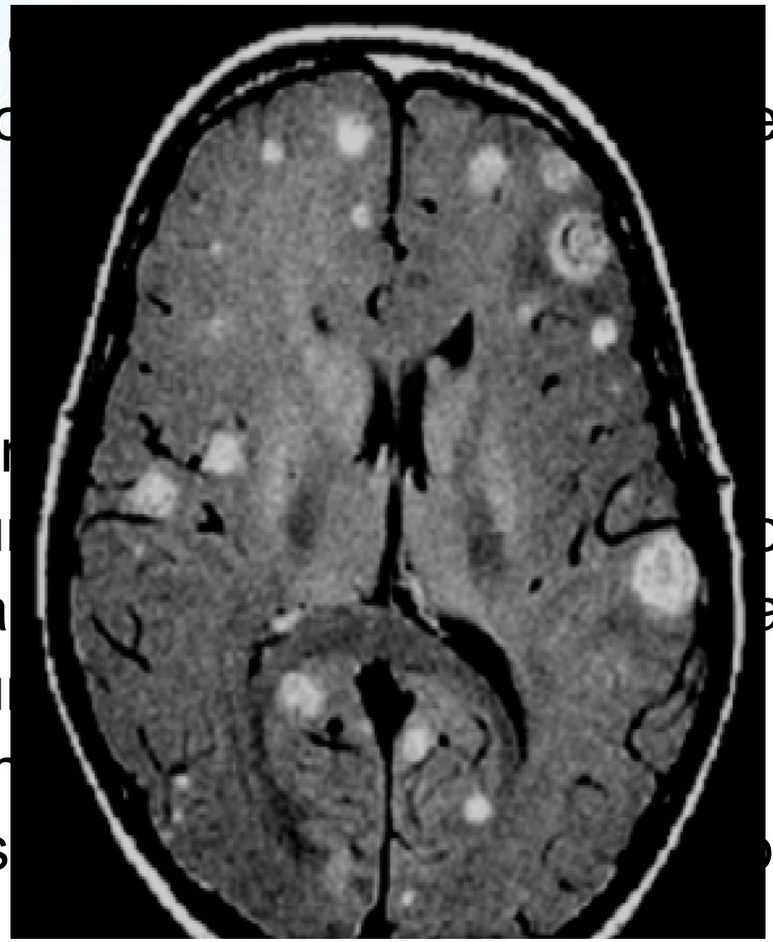

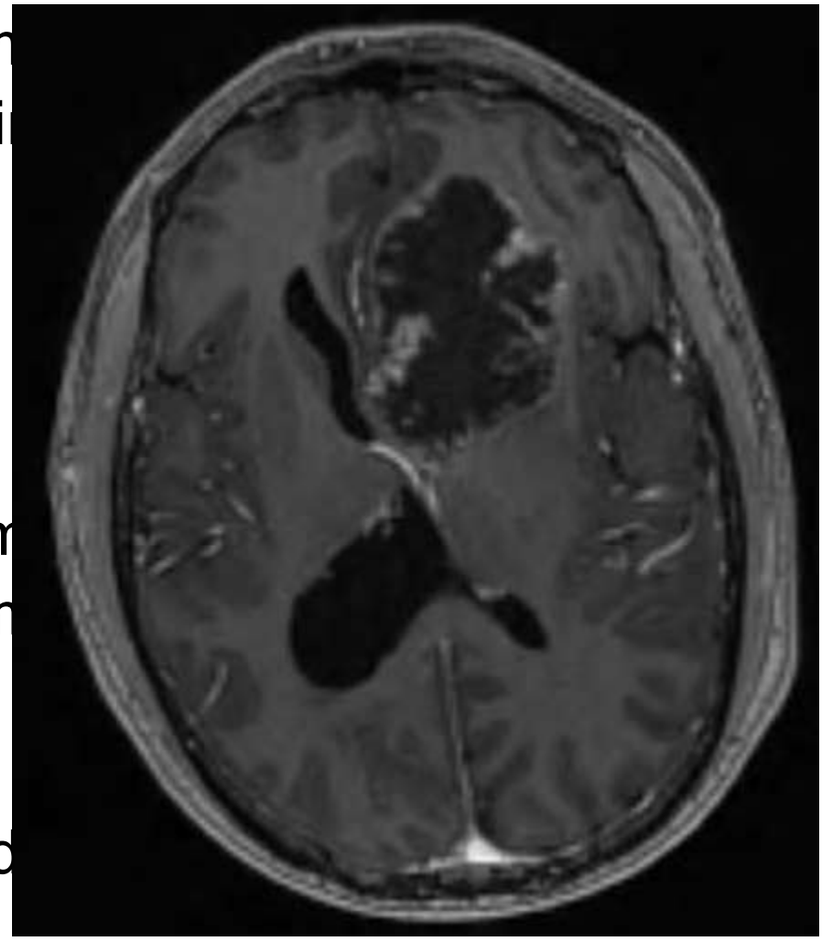

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Video of Metastasis Resection

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Preliminary Patient Management

- Emergency Room?
  - Red flags
- Outpatient Referral?
  - Small tumors, incidental/asymptomatic tumors can be evaluated in an outpatient setting
- Unsure?
  - Call and speak to the on-call neurosurgeon 24/7 to help triage
  - Can save unnecessary ER trips; ensure safe direction for urgent cases
- Who to contact?
  - If known history of malignancy and stable patient – oncologist
  - Otherwise, high-volume center with subspecialty neurosurgical oncology

What is the most common benign brain tumor?

- Meningioma
- Pituitary adenoma
- Schwannoma

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- UpToDate – excellent resource for overview and management
- Braintumor.org – National Brain Tumor Society
- Tumorsection.org – Joint AANS/CNS Section on Tumors
- ClinicalTrials.gov – identify enrolling clinical trials globally

Thank You!!!

- Kushal Shah MD
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