Central Nervous System Pathology lab

BUSHRA AL-TARAWNEH, MD

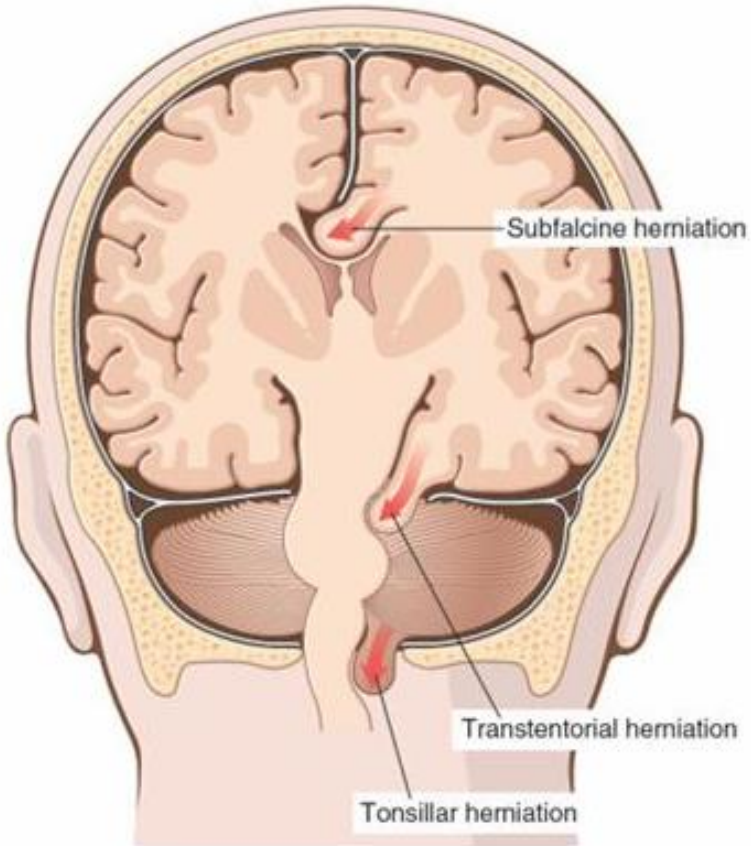
ANATOMICAL PATHOLOGIST

PATHOLOGY, MICROBIOLOGY AND IMMUNLOGY DEPARTMENT

FACULTY OF MEDICINE – MUTAH UNIVERSITY

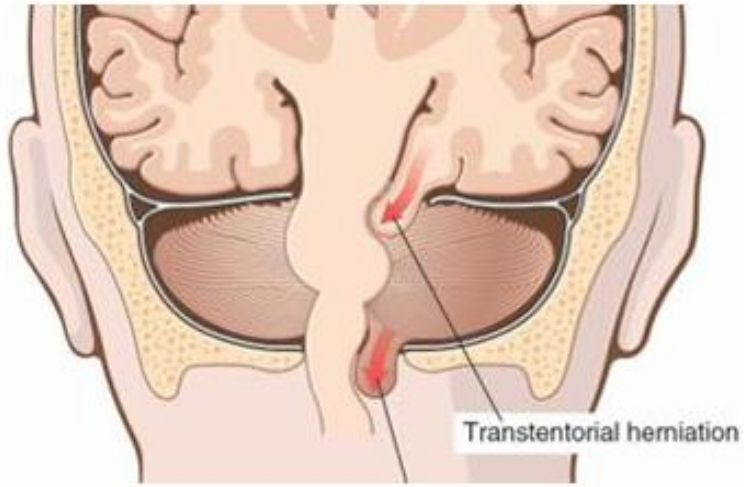
Cerebrovascular Diseases :
Hypertensive Cerebrovascular Disease
Vascular malformations

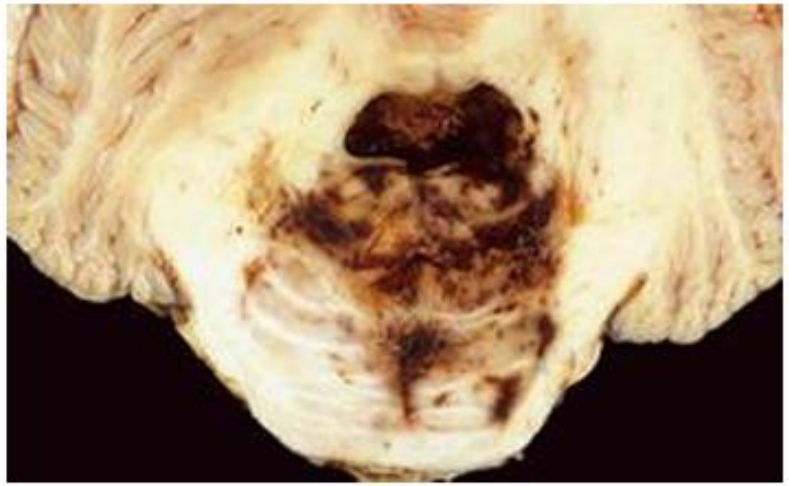
1-Subfalcine (cingulate) herniation



A unilateral or asymmetric expansion of a cerebral hemisphere displaces the cingulate gyrus under the edge of the falx.

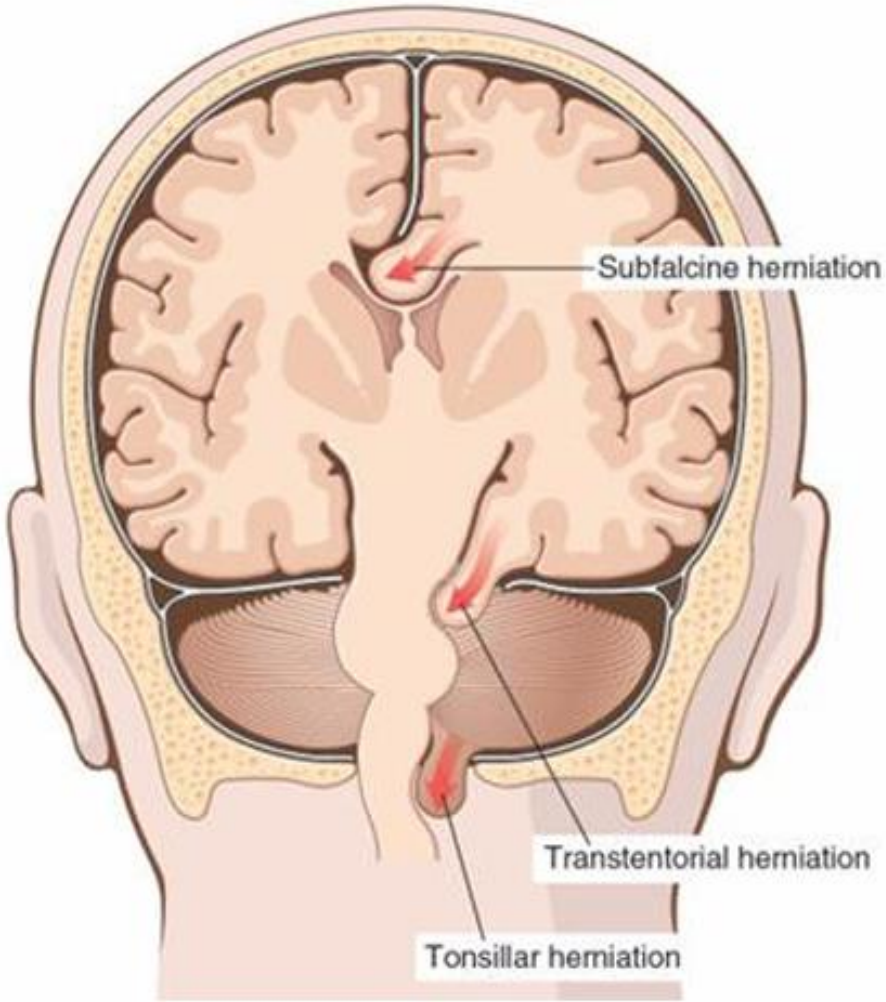
This may compress the anterior cerebral artery.





2-Transtentorial (uncinate) herniation

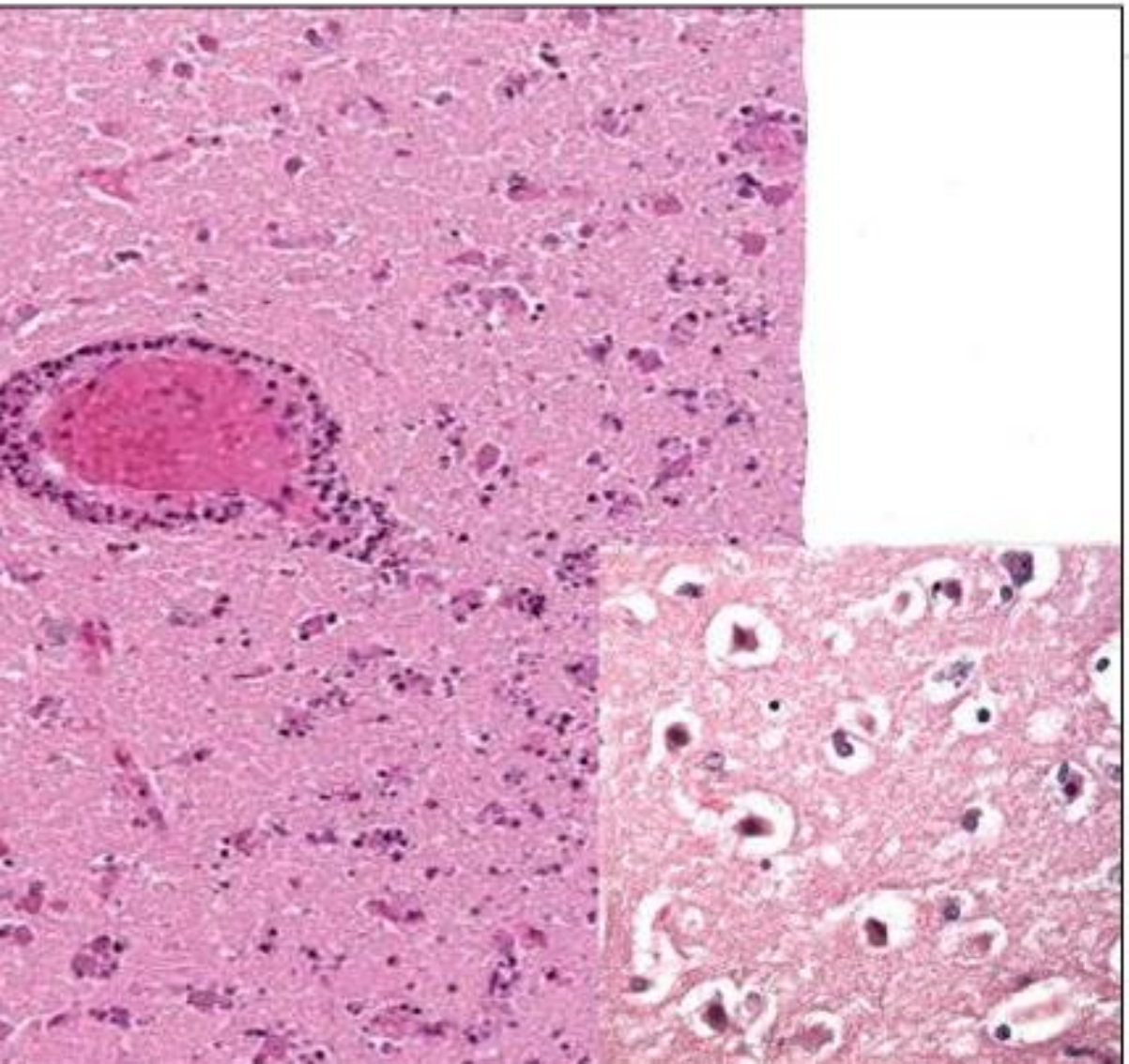
The medial aspect of the temporal lobe is compressed against the free margin of the tentorium. As the temporal lobe is displaced.



3-Tonsillar herniation

Tonsillar herniation refers to displacement of the cerebellar tonsils through the foramen magnum. This type of herniation causes brain stem compression and compromises vital respiratory and cardiac centers in the medulla and is often fatal.

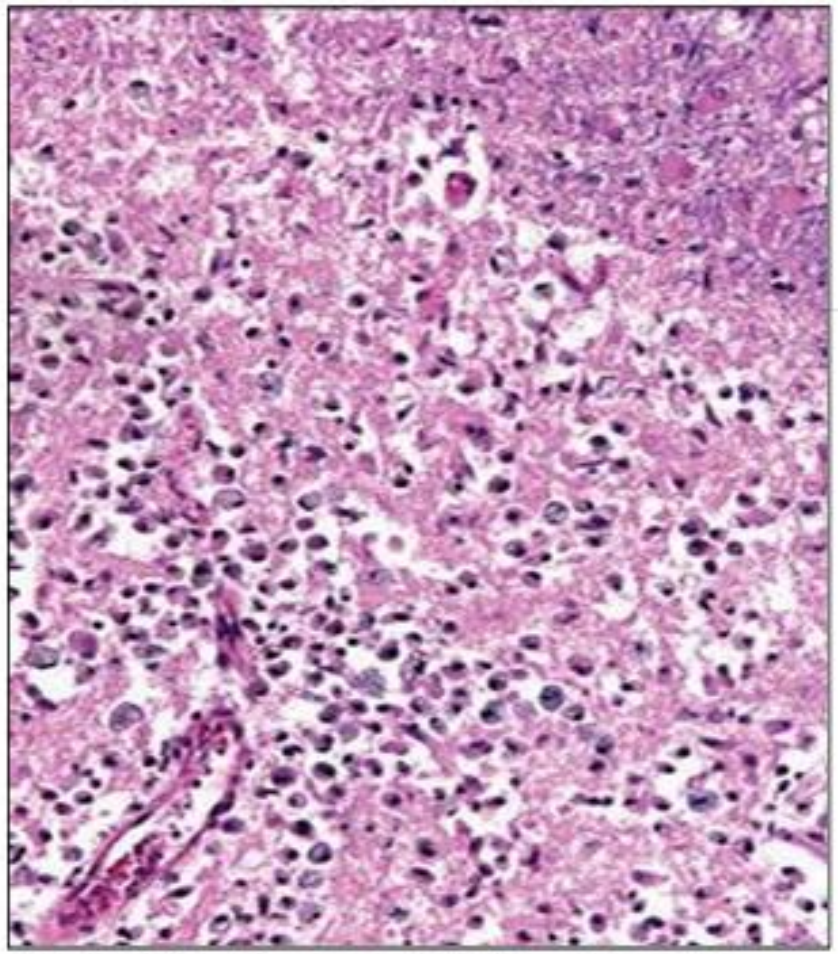
Early changes, 12 to 24 Hrs after insult



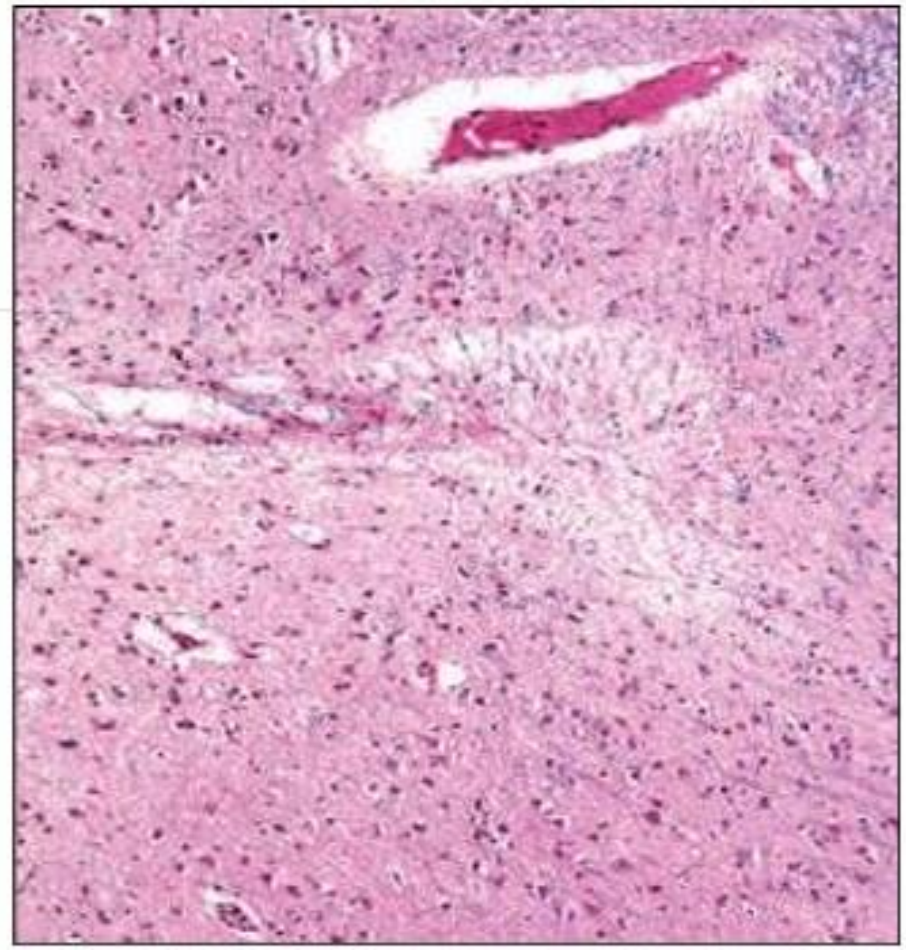
- Acute neuronal cell change (red neurons) characterized initially by microvacuolation → cytoplasmic eosinophilia, and later nuclear pyknosis and karyorrhexis.

- Similar changes occur somewhat later in astrocytes and oligodendroglia.

- After this, reaction to tissue damage begin with infiltration of neutrophils

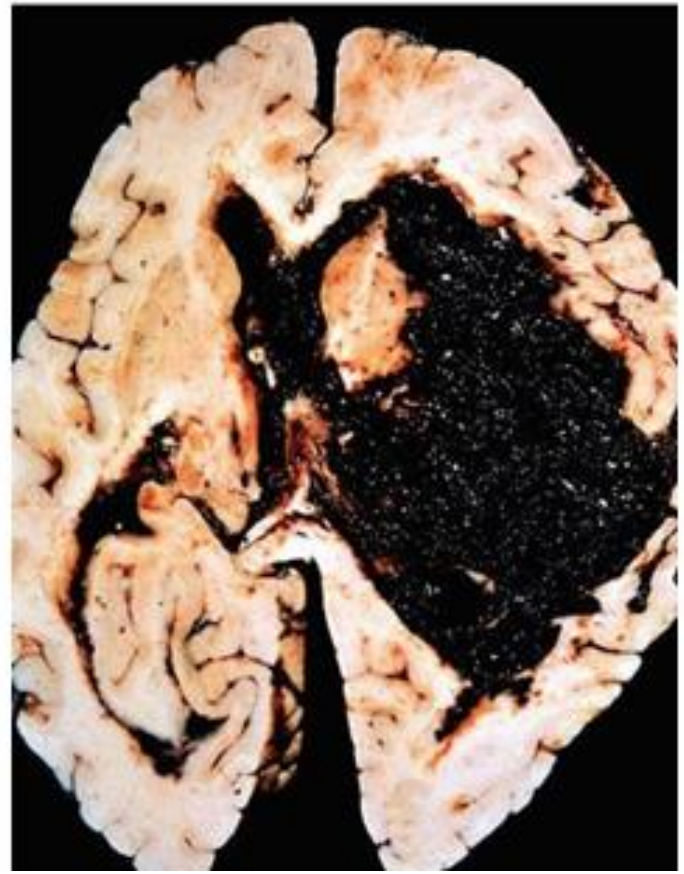


Subacute changes, 24 Hrs - 2 weeks, include necrosis of tissue, influx of macrophages, vascular proliferation, and reactive gliosis.



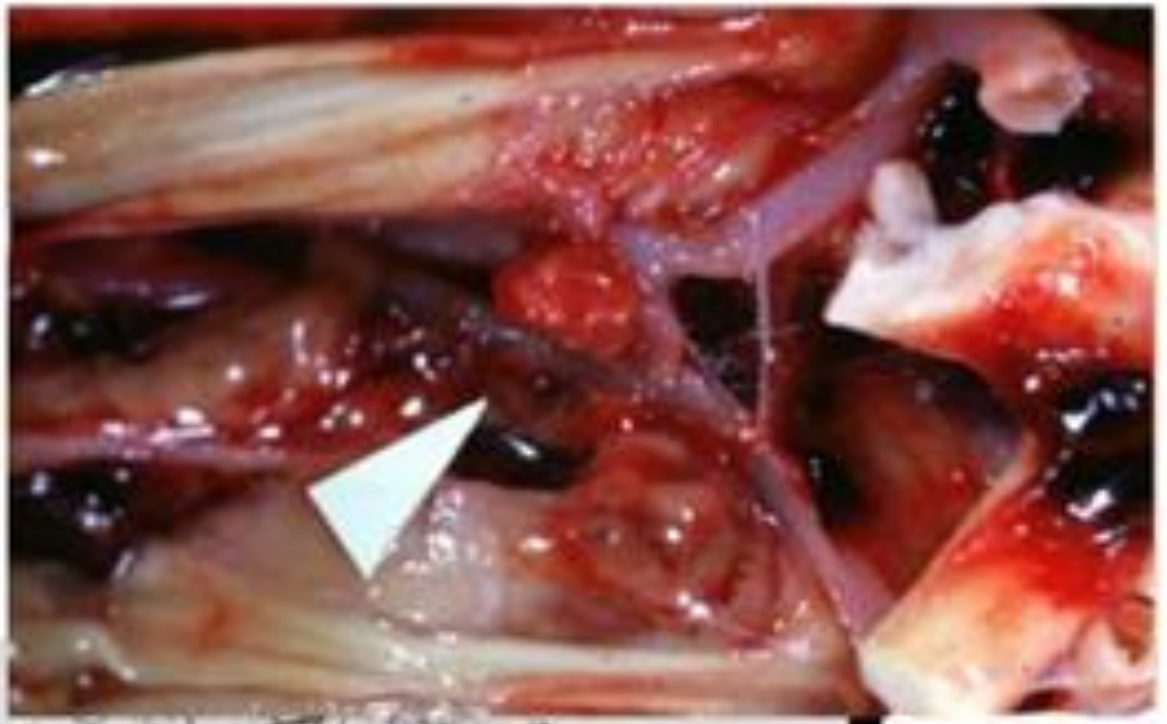
Repair, seen after 2 weeks, a is characterized by removal of necrotic tissue & Gliosis.

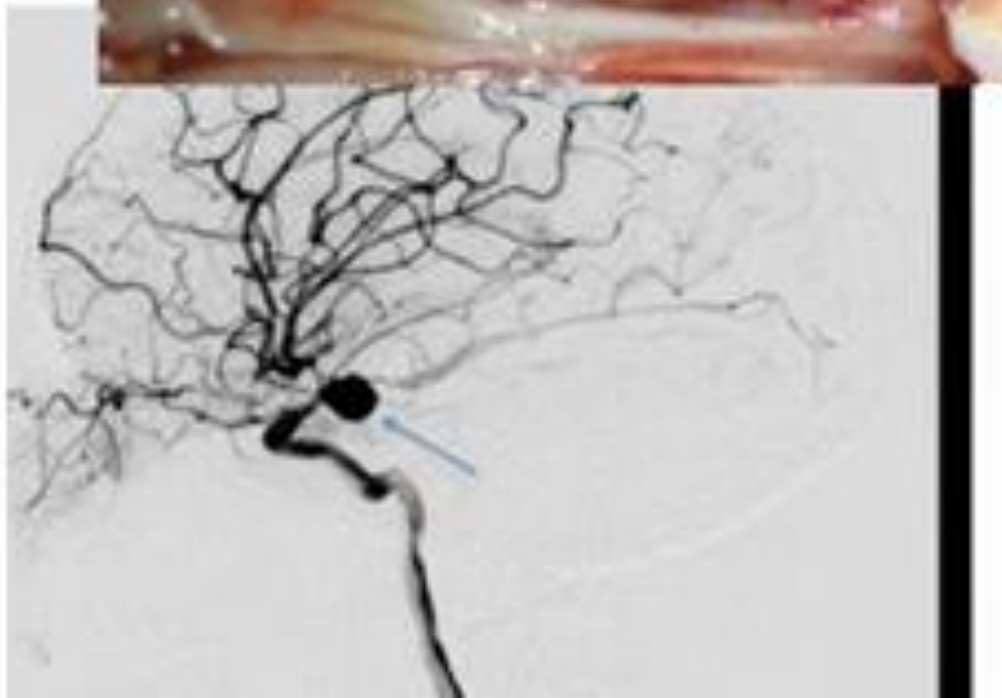
Primary Brain Parenchymal Hemorrhage



Saccular aneurysms

- A saccular aneurysm is a thin-walled outpouching of an artery beyond the neck of the aneurysm, the muscular wall and intimal elastic lamina are absent, such that the aneurysm sac lined only by thickened hyalinized intima.
- The adventitia covering the sac is continuous with that of the parent artery.
- Rupture usually occurs at the apex of the sac, releasing blood into the subarachnoid space, the substance of the brain, or both.



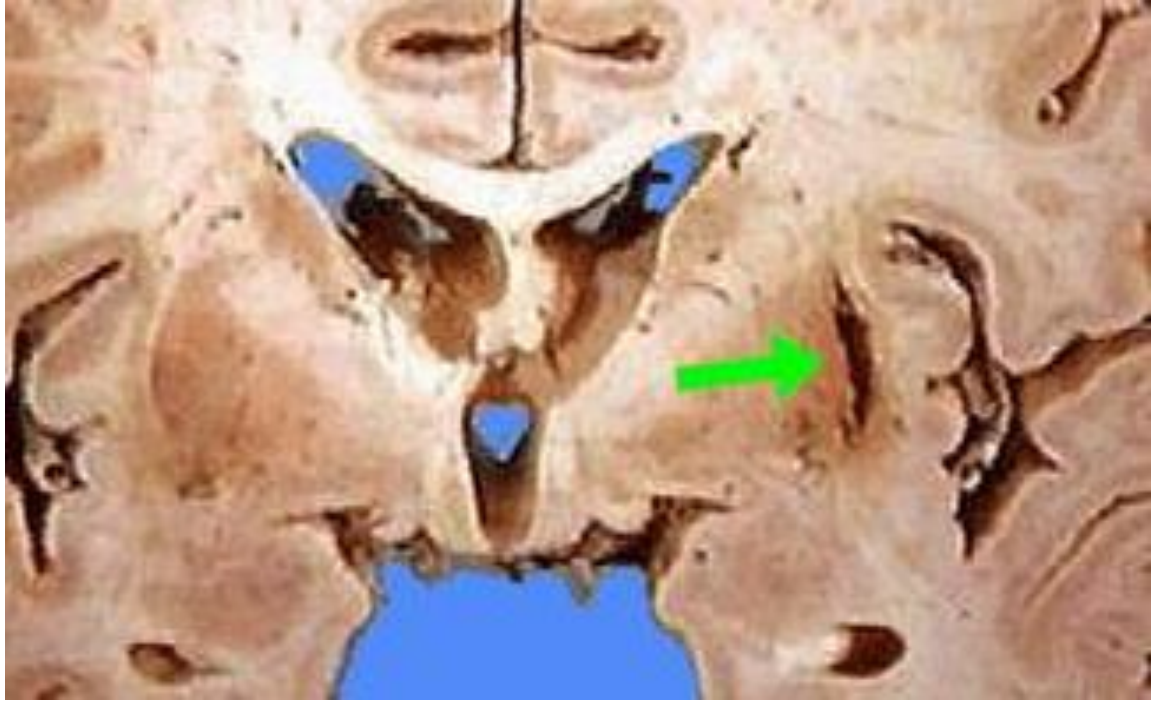


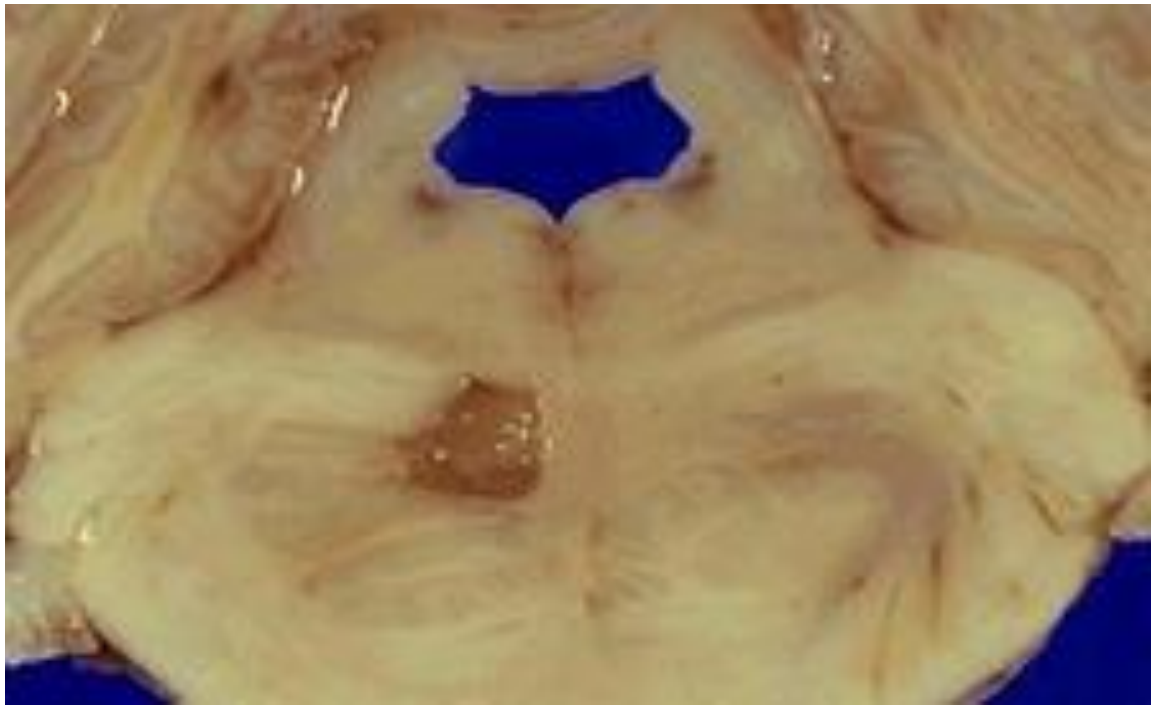
Hypertensive Cerebrovascular Disease

- I. **Slit hemorrhage** Rupture of the small-caliber penetrating vessel→ small hemorrhages.
- • After resorption → a slitlike cavity (slit hemorrhage) surrounded by brownish discoloration

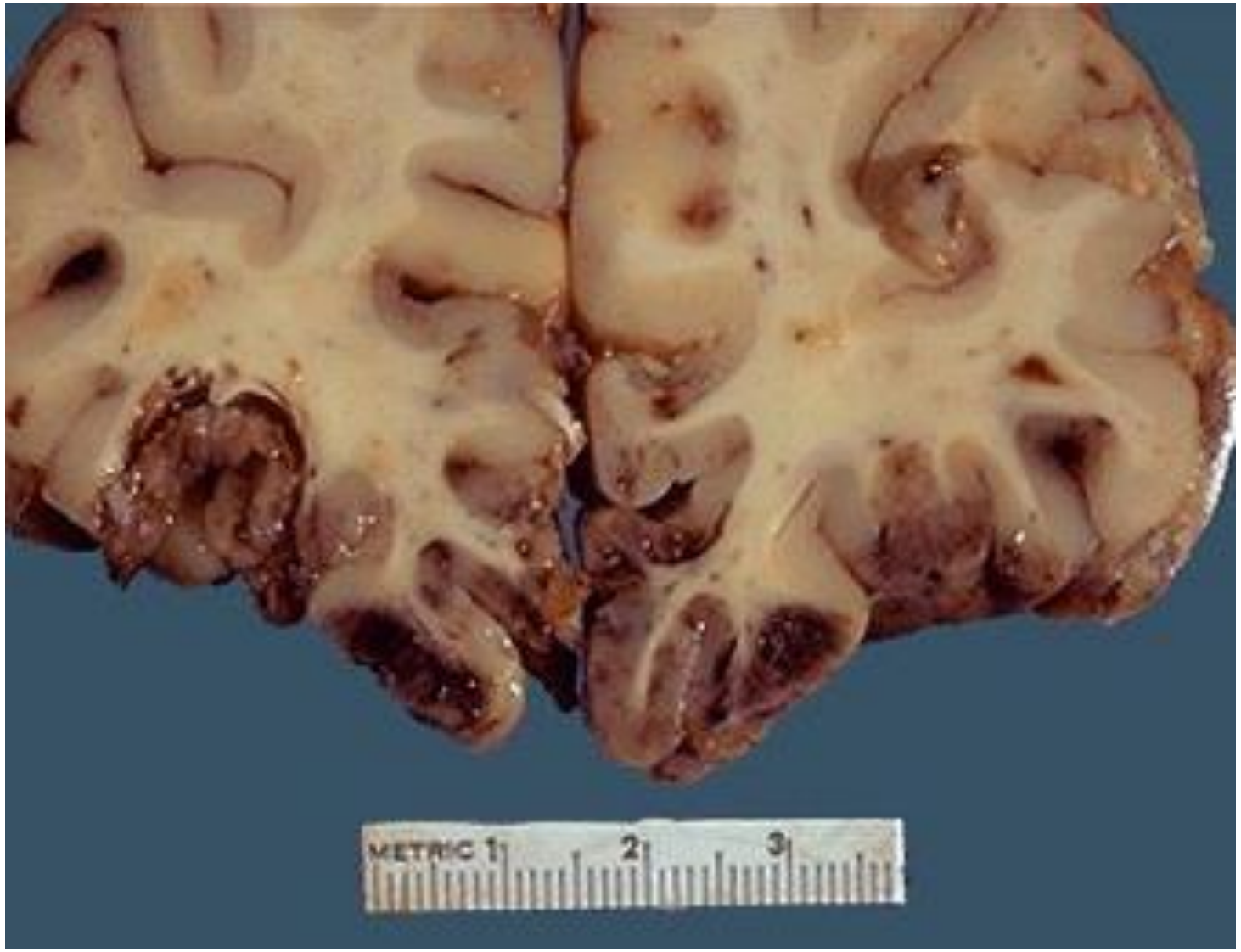
II**. Lacunes or lacunar infarcts:** small cavitary infarcts (few millimeters in size).

- • Location: most commonly in deep gray matter (basal ganglia and thalamus), internal capsule, deep white matter, the pons.
- • Caused by occlusion of a single penetrating branch of a large cerebral artery.

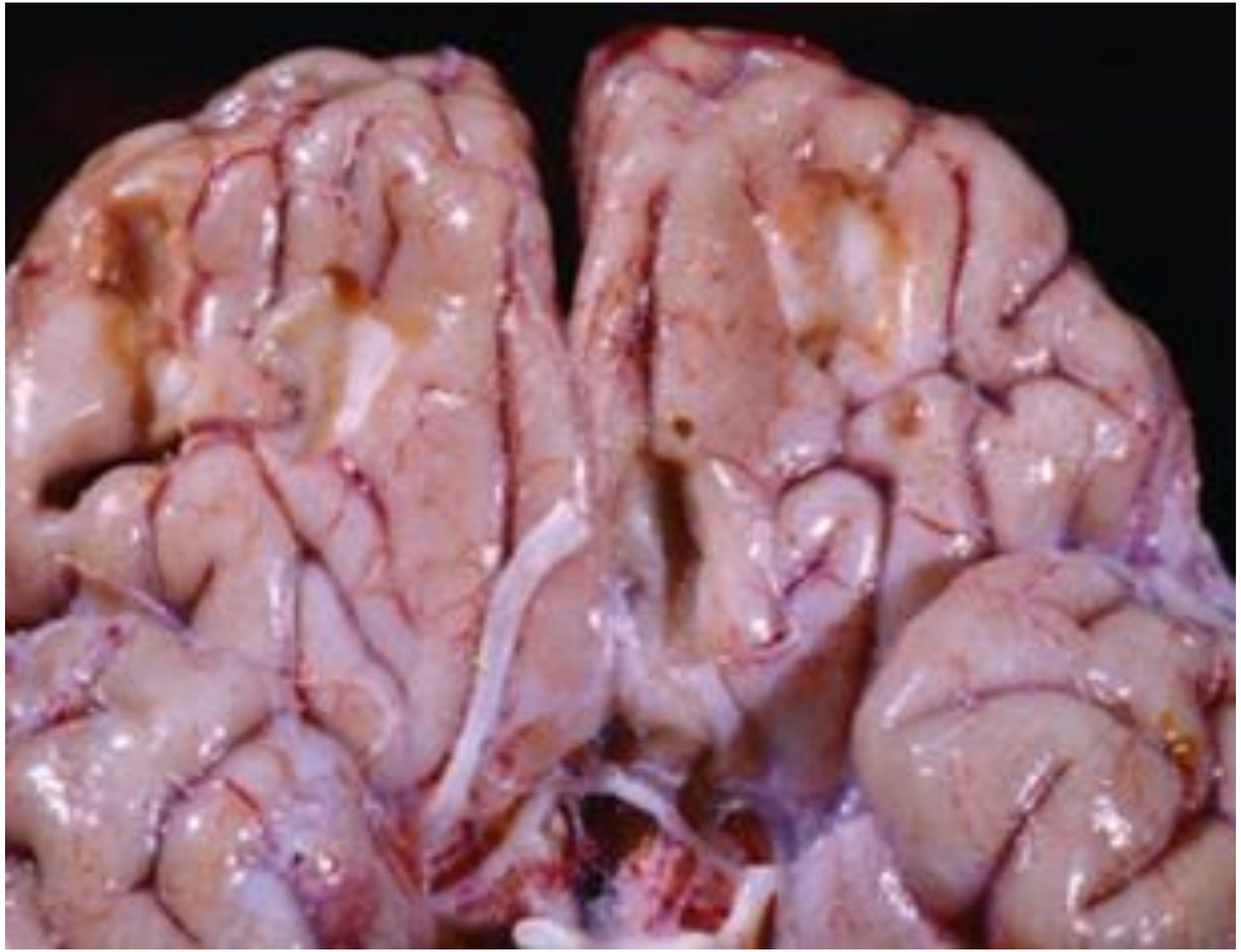




Central Nervous System Trauma

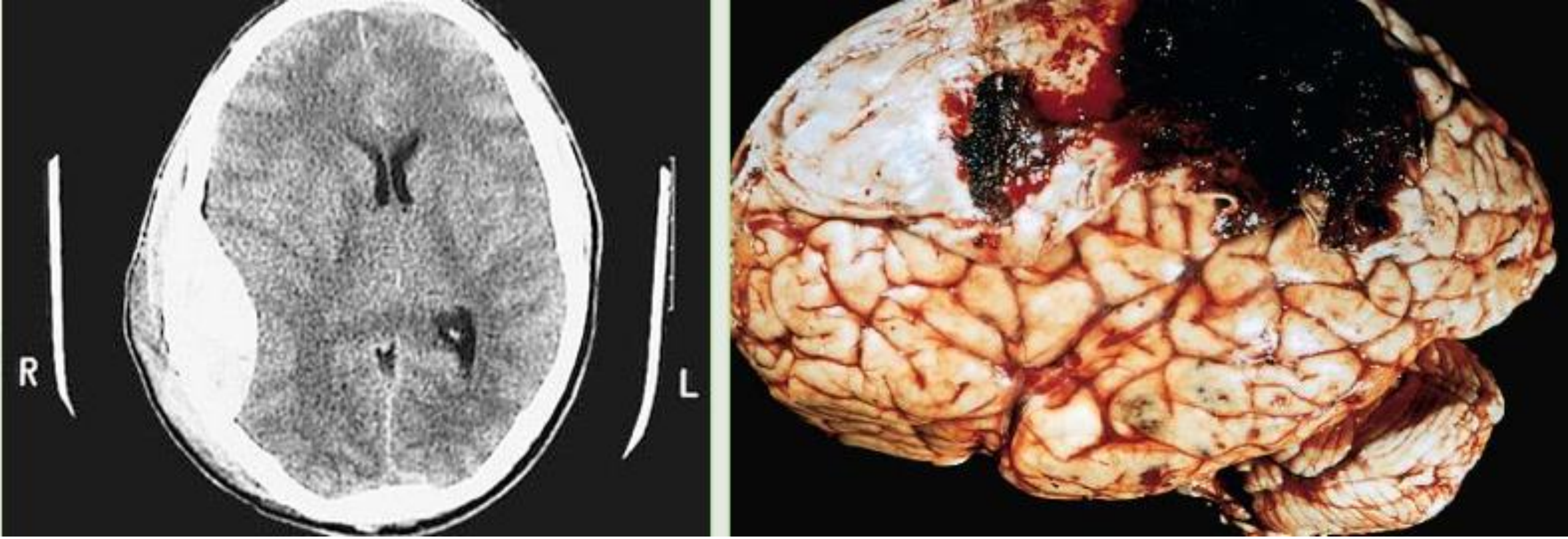


- A coronal section through the frontal lobes reveals extensive contusions involving the inferior gyri. This was a contracoup injury from a fall in the bathtub by an elderly person.

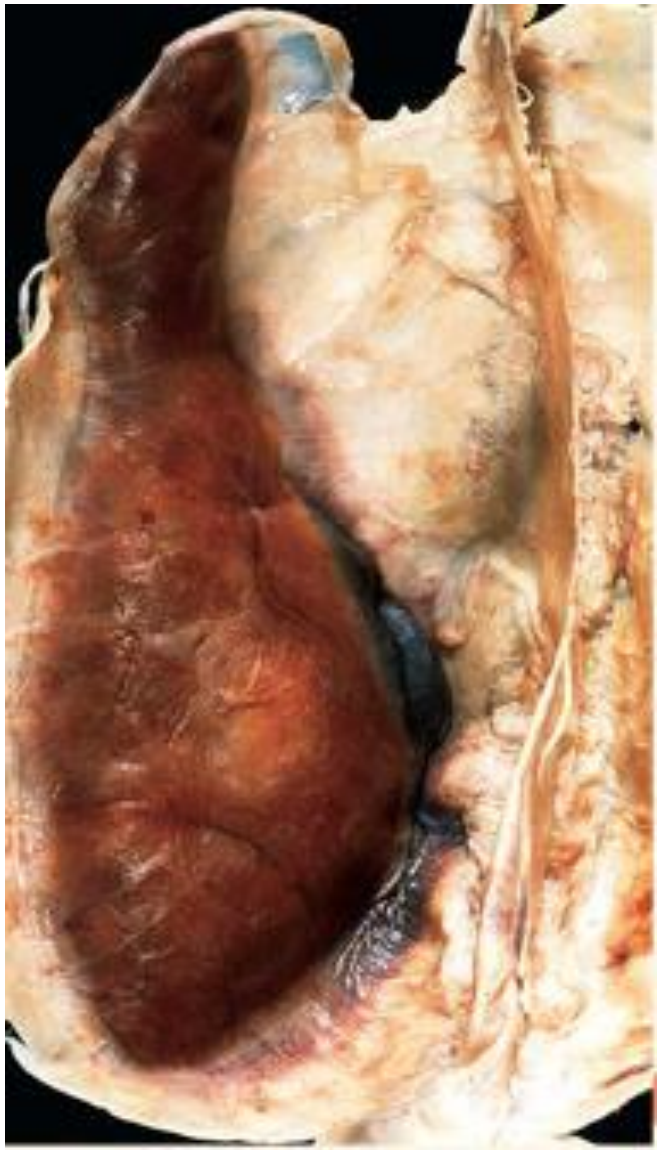


Morphology: Remote (old) contusions

- characteristically appear as depressed, retracted, yellowish brown patches involving the crests of gyri. These lesions show gliosis and residual hemosiderin-laden macrophages.



Traumatic Vascular Injury -Epidural Hematoma



Subdural Hematoma

- Appears as a collection of freshly clotted blood apposed to the contour of the brain surface without extension into the depths of sulci Underlying brain is flattened, subarachnoid space is often clear.
- Week 1: organized by lysis of the clot.
- Week 2: Growth of granulation tissue from the dural surface into the hemato1–3 months: fibrosis Subdural hematomas commonly rebleed→ from the thin-walled vessels of the granulation tissue→ microscopic findings with hemorrhages of varying ages.
- ma.

Tumors of the Central Nervous System

2016 WHO Classification of Tumors of the CNS

Histologic classification

Molecular Information

Integrated diagnosis (incorporating all tissue-based information)

WHO grade

Main histologic category (cell of origin)

01 **Gliomas:** long been classified as astrocytomas, oligodendrogliomas, and ependymomas

02 **Neuronal tumors:** composed of cells with neuronal characteristics

03 **Embryonal (Primitive) neoplasms:** have “small round cell” appearance reminiscent of normal progenitor cells in the developing CNS.

04 **Others:** Lymphoma, meningioma, germ cell tumors, metastasis

Gliomas

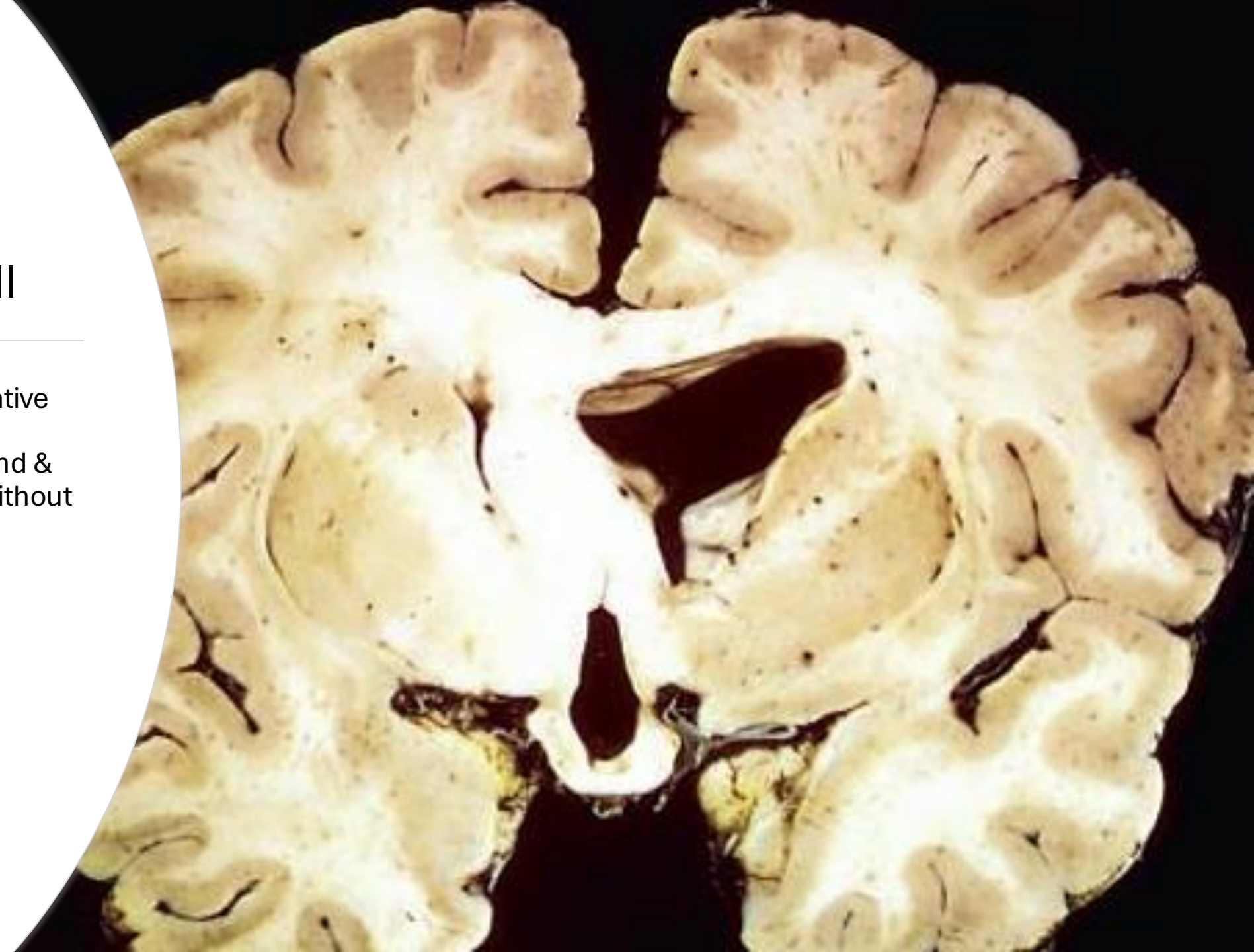
Highlights of WHO 2021 classification is the incorporation of molecular features, specifically IDH gene mutations and deletion on chromosomes segments 1p/19q

- Simplified classification of adult type diffuse gliomas into 3 groups:
  - Astrocytoma, IDH mutant, WHO grade 2 – 4
  - Glioblastoma, IDH wildtype, WHO grade 4
  - Oligodendroglioma, IDH mutant and 1p / 19q co-deleted, WHO grade 2 - 3 .

Localized astrocytomas; of which the most common are the pilocytic astrocytomas

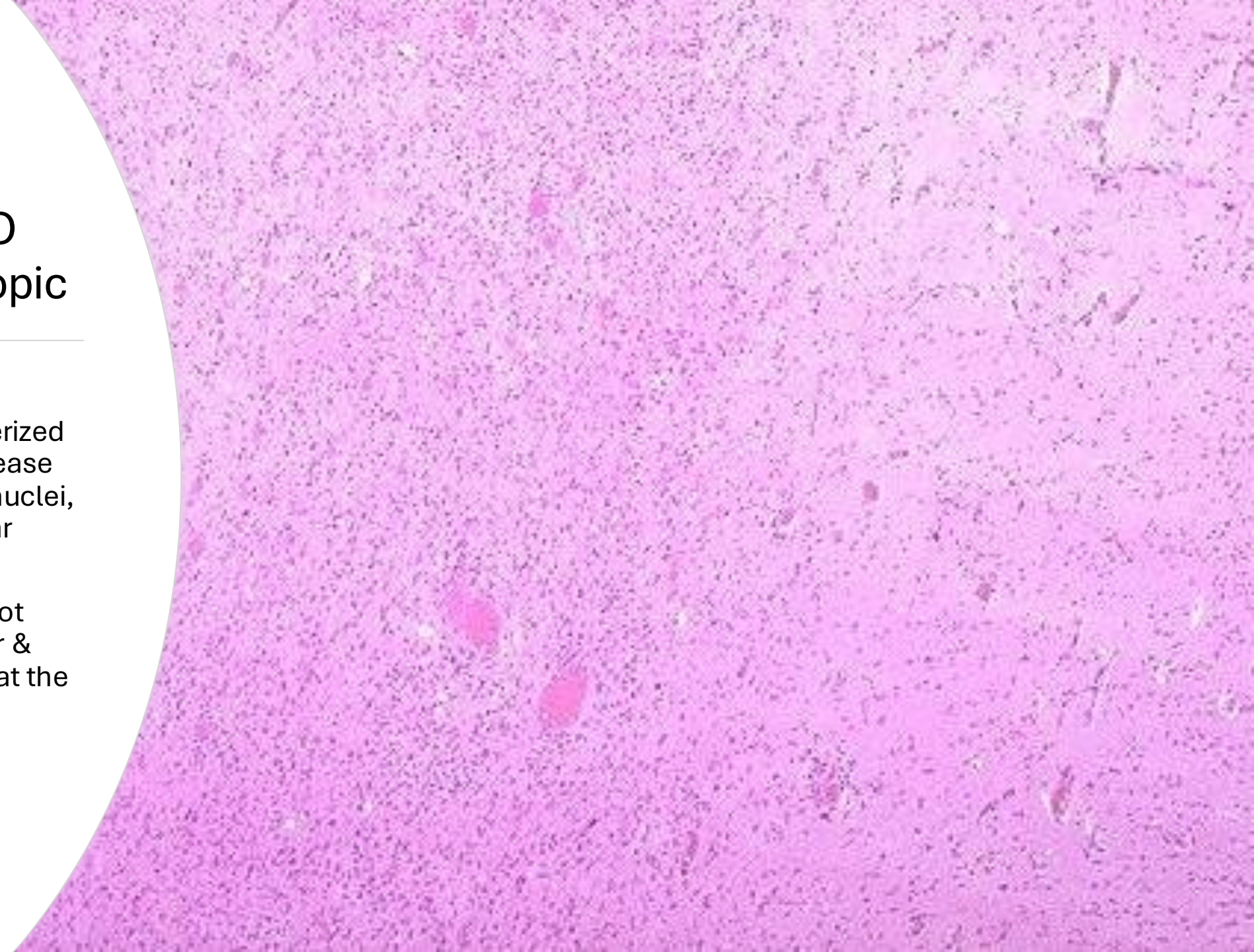
WHO grade II and III

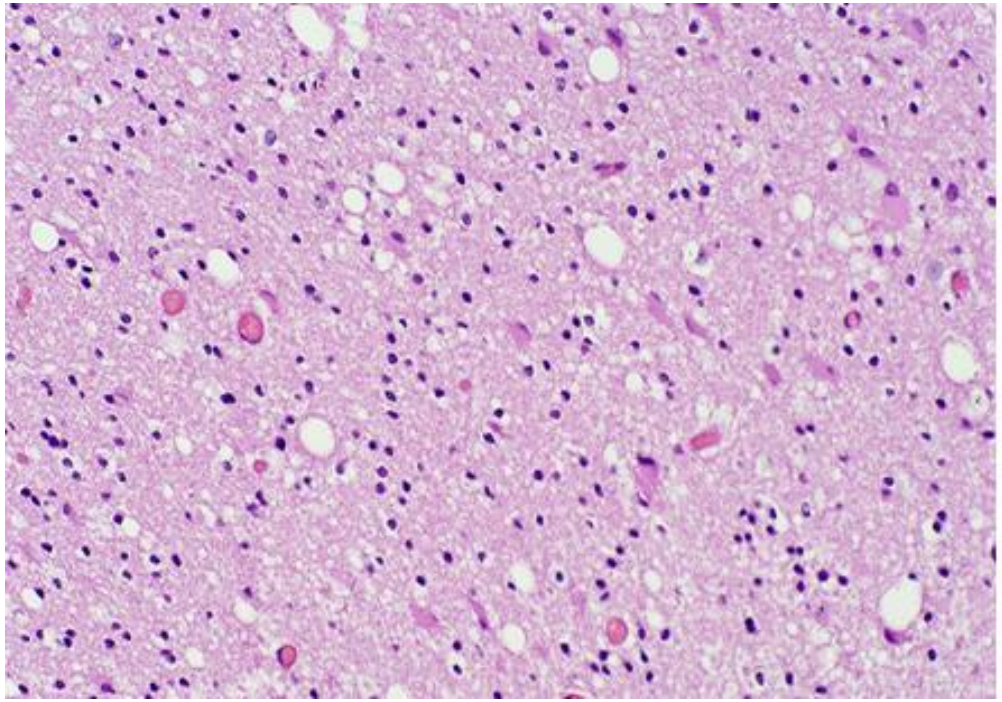
- Poorly defined, gray, infiltrative (beyond grossly evident margins) tumors that expand & distort the invaded brain without forming a discrete mass.

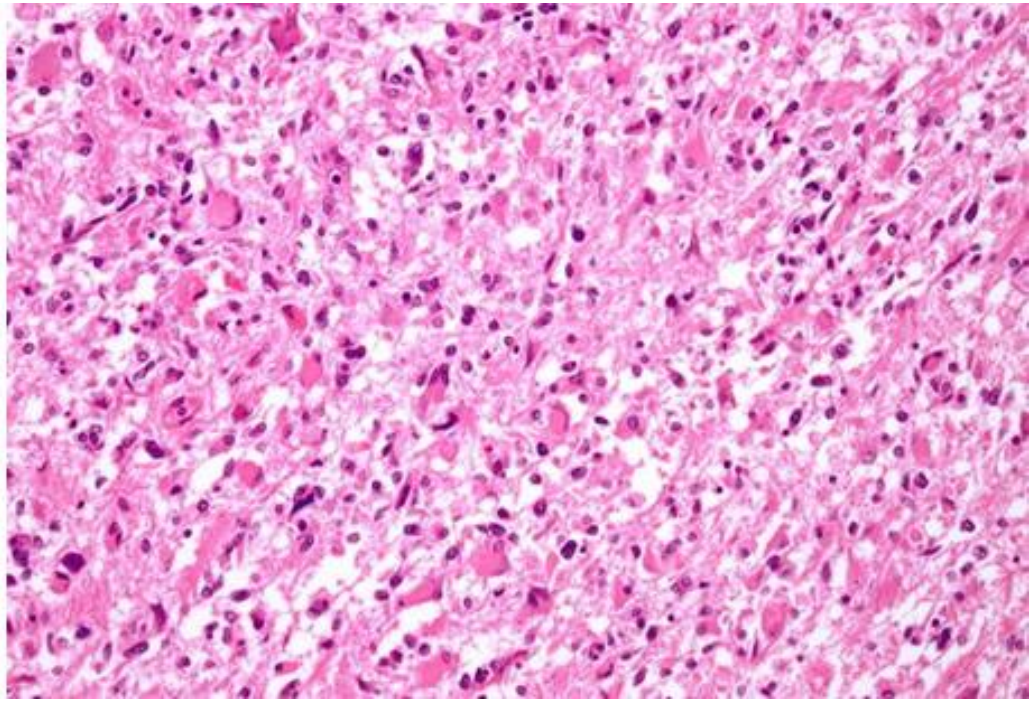


Astrocytoma (WHO grade 2) - microscopic

- low-grade (WHO grade II) astrocytomas are characterized by a mild to moderate increase in the number of glial cell nuclei, some what variable nuclear pleomorphism.
- Notice how the margin is not distinct between the tumor & the normal adjacent brain at the right



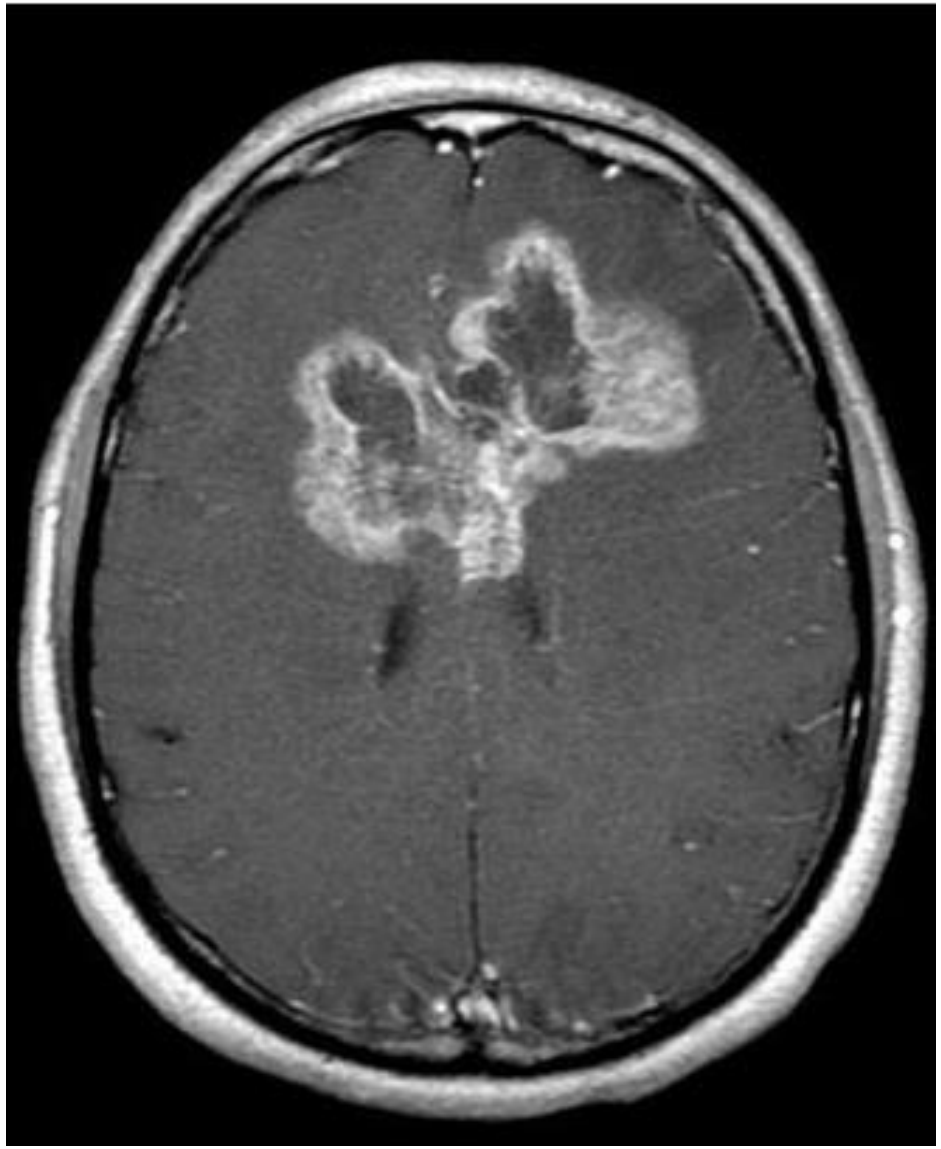




Astrocytoma WHO 2 vs WHO 3 –Microscopic: grade 3 shows more densely cellular & have greater nuclear pleomorphism; more mitotic figures.

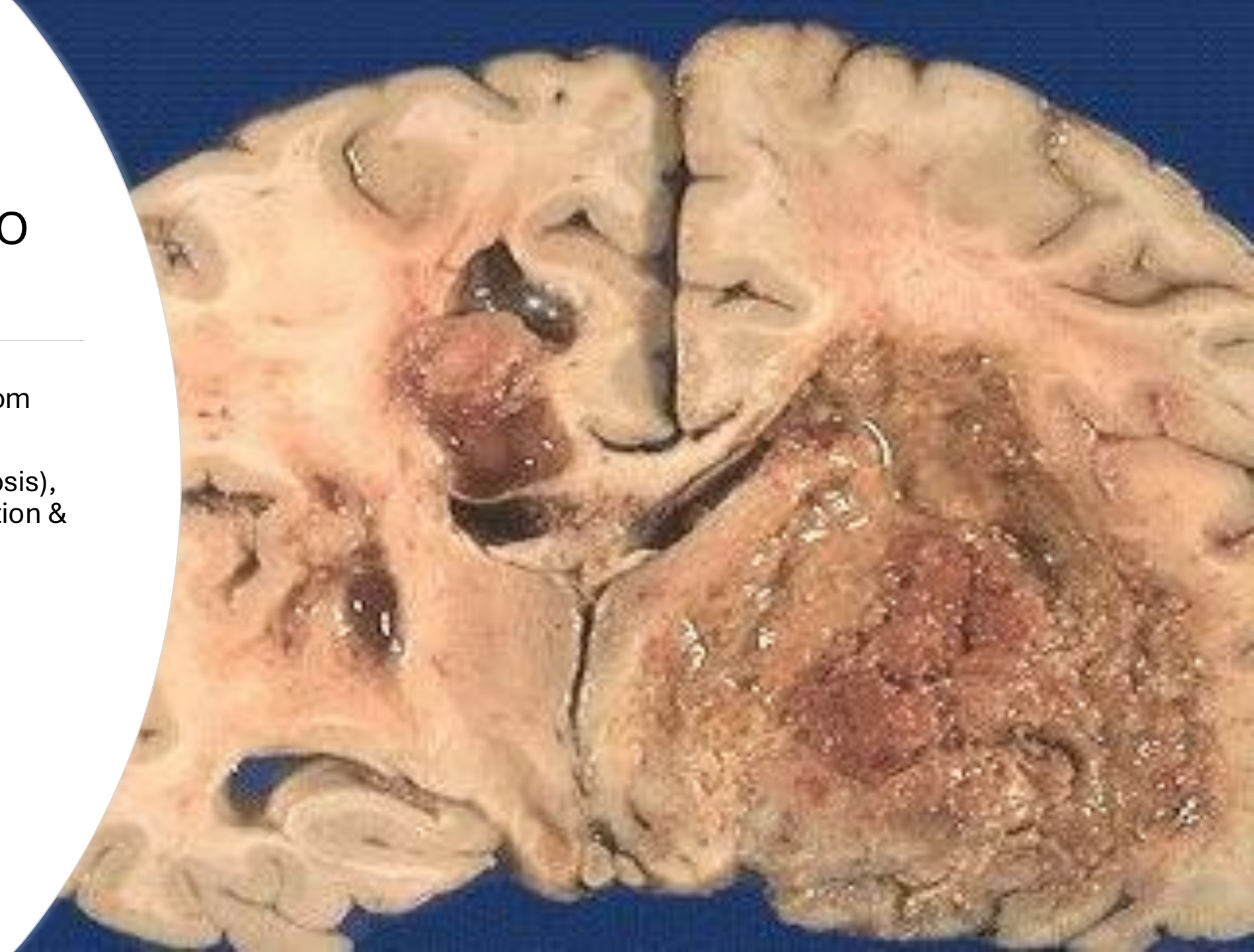
Glioblastoma (WHO grade 4) - MRI

Imaging studies most often reveal a ring enhancing lesion, abnormal vessels that are “leaky,” + abnormally permeable blood-brain barrier (BBB) → contrast enhancement on imaging studies.



Glioblastoma (WHO grade 4) - Gross

- Characteristic variation from adjacent normal area.
- Soft & yellow (tissue necrosis), regions of cystic degeneration & hemorrhage.

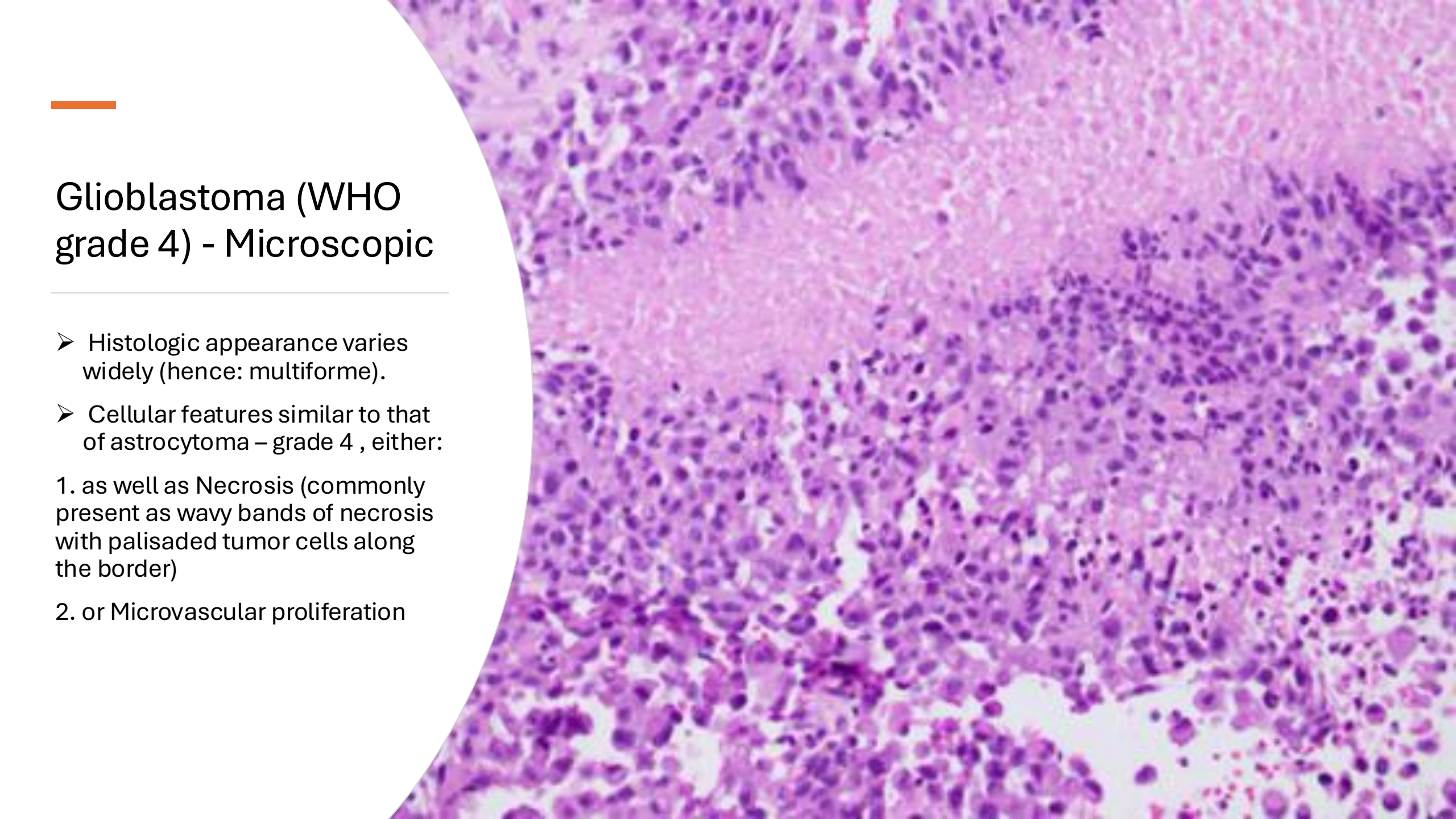


Glioblastoma (WHO grade 4) - Microscopic

- Histologic appearance varies widely (hence: multiforme).
- Cellular features similar to that of astrocytoma – grade 4 , either:

1. as well as Necrosis (commonly present as wavy bands of necrosis with palisaded tumor cells along the border)

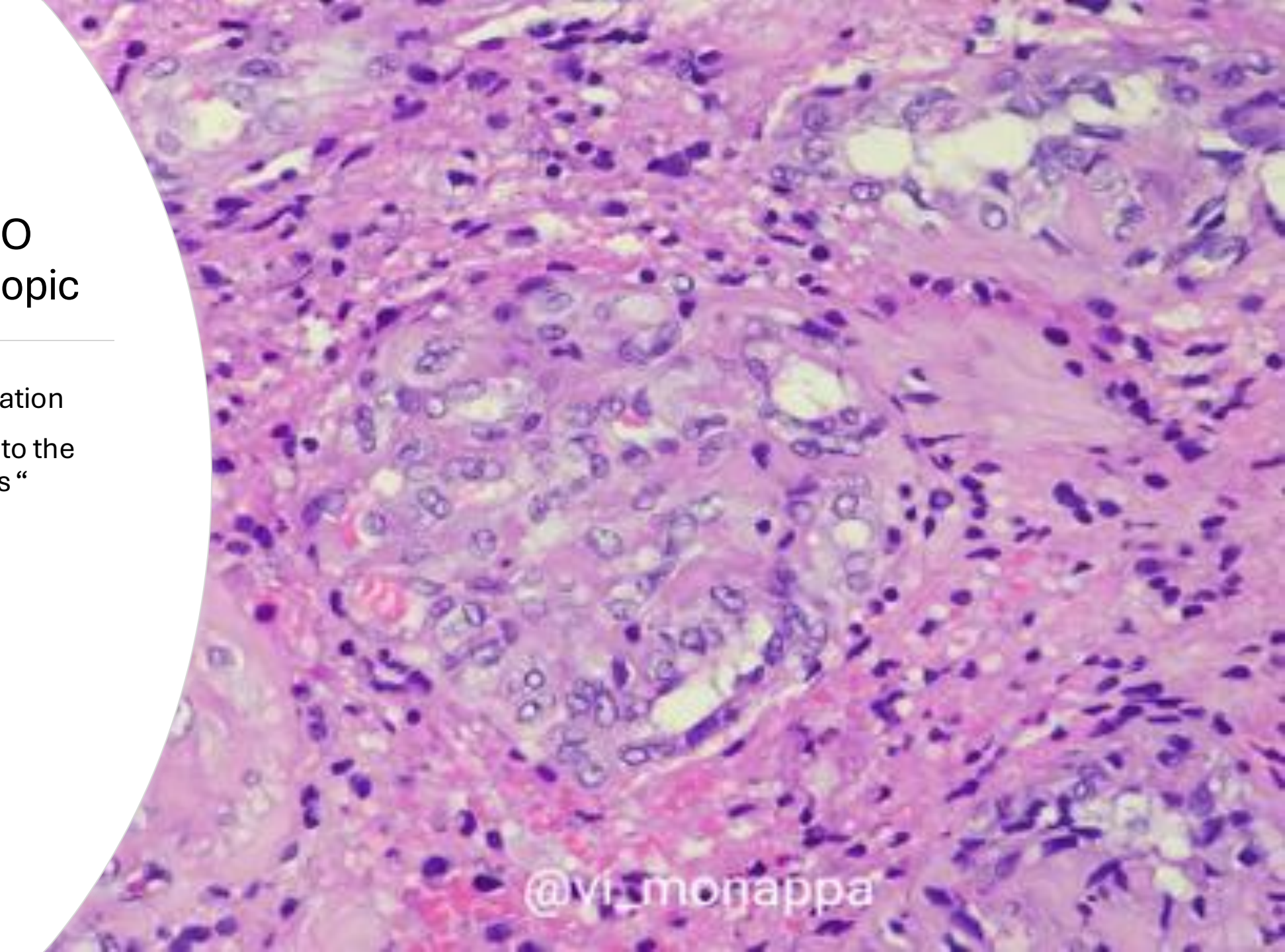
2. or Microvascular proliferation



Glioblastoma (WHO grade IV) - Microscopic

2. or Microvascular proliferation

(forming tufts that bulge into the lumen → ball-like structures “ glomeuloid” bodies)



Oligodendroglioma

Age

30s-40s
5% to 15% of gliomas

01

Location

In the cerebral hemispheres , mainly in **white matter** in frontal or temporal lobes.

02

Genetics

- IDH1/IDH2 mutations
- 1p and 19q co-deletions

03

Gross

Infiltrative tumors, form gelatinous, gray masses & may show **cysts, focal hemorrhage, & calcification.**

04

WHO garding (2 & 3)

grade 3 is a more aggressive, higher cellularity, nuclear anaplasia, more mitoses, & microvascular proliferation.

05

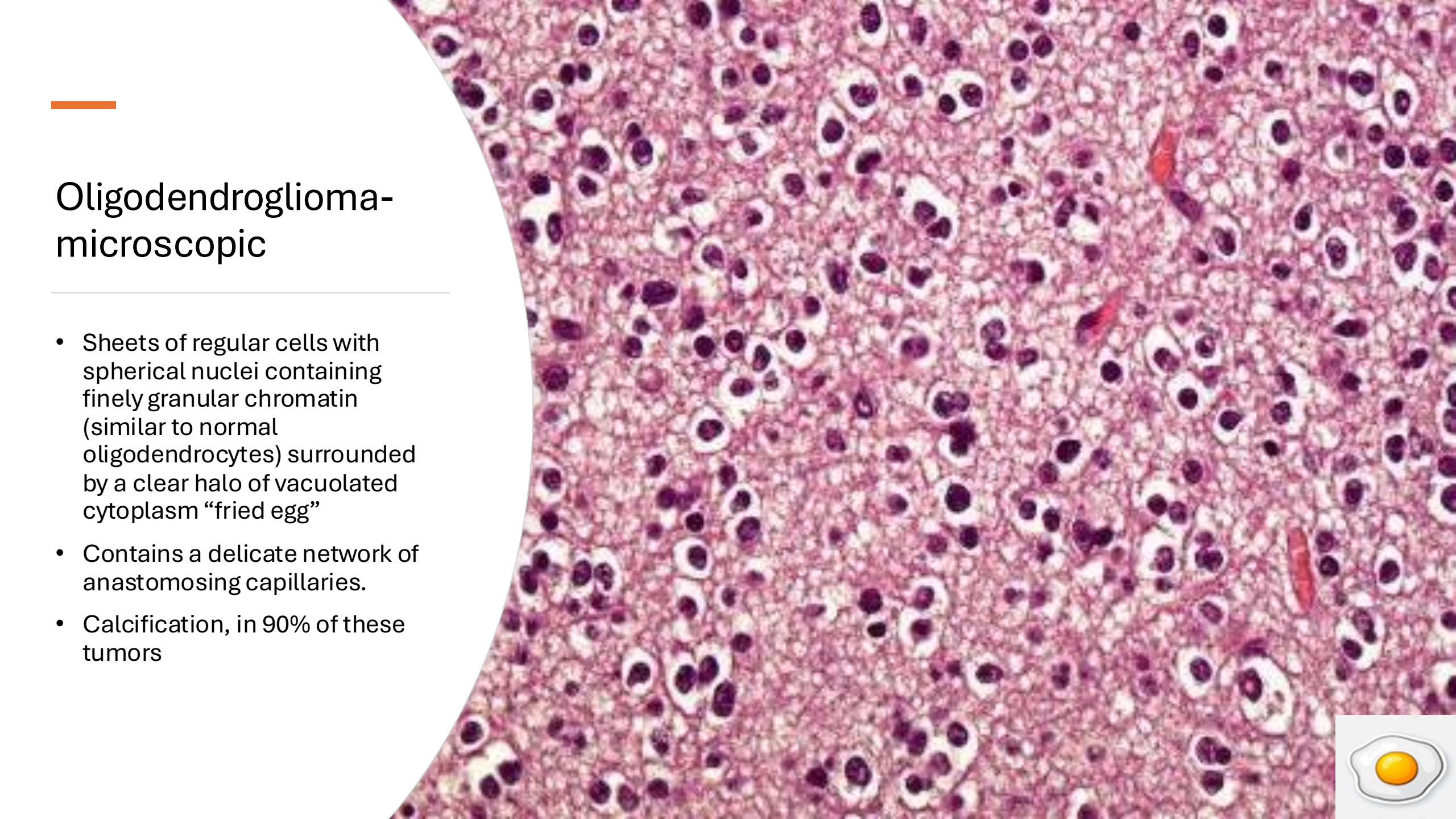
Prognosis

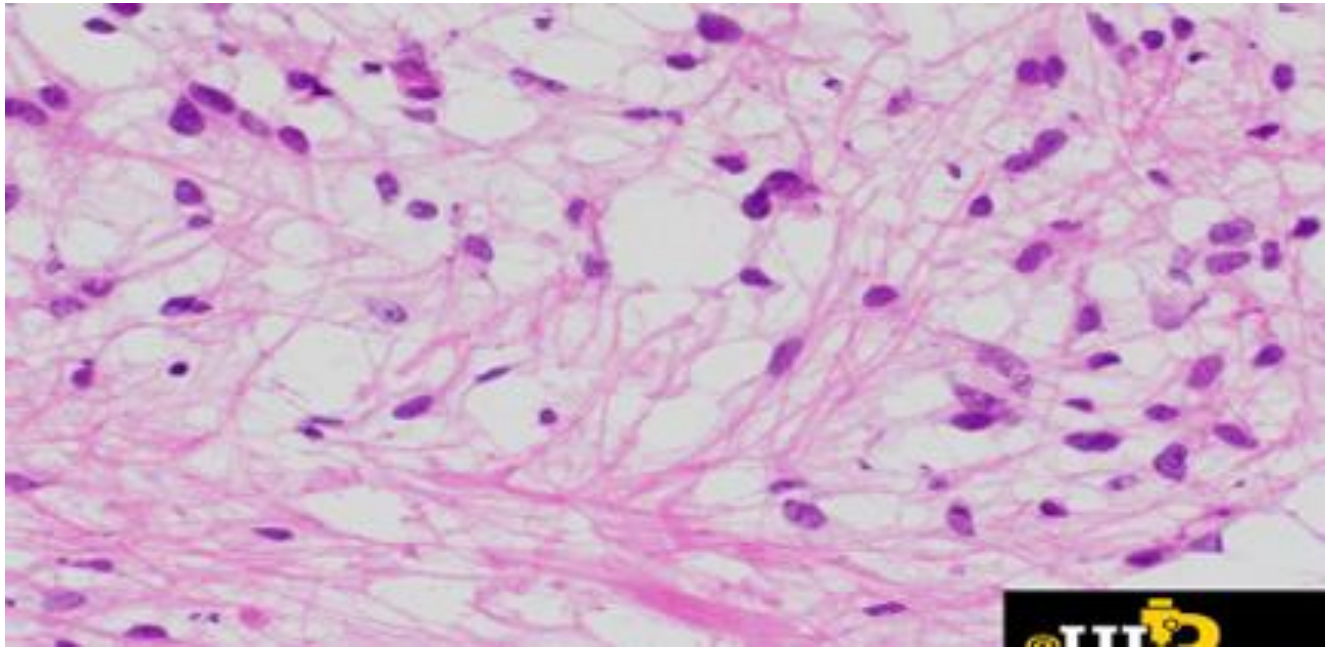
+ Best prognosis among diffuse gliomas.
+ surgery, chemo,& radio
average survival of 5 to 10 years

06

Oligodendroglioma-microscopic

- Sheets of regular cells with spherical nuclei containing finely granular chromatin (similar to normal oligodendrocytes) surrounded by a clear halo of vacuolated cytoplasm “fried egg”
- Contains a delicate network of anastomosing capillaries.
- Calcification, in 90% of these tumors

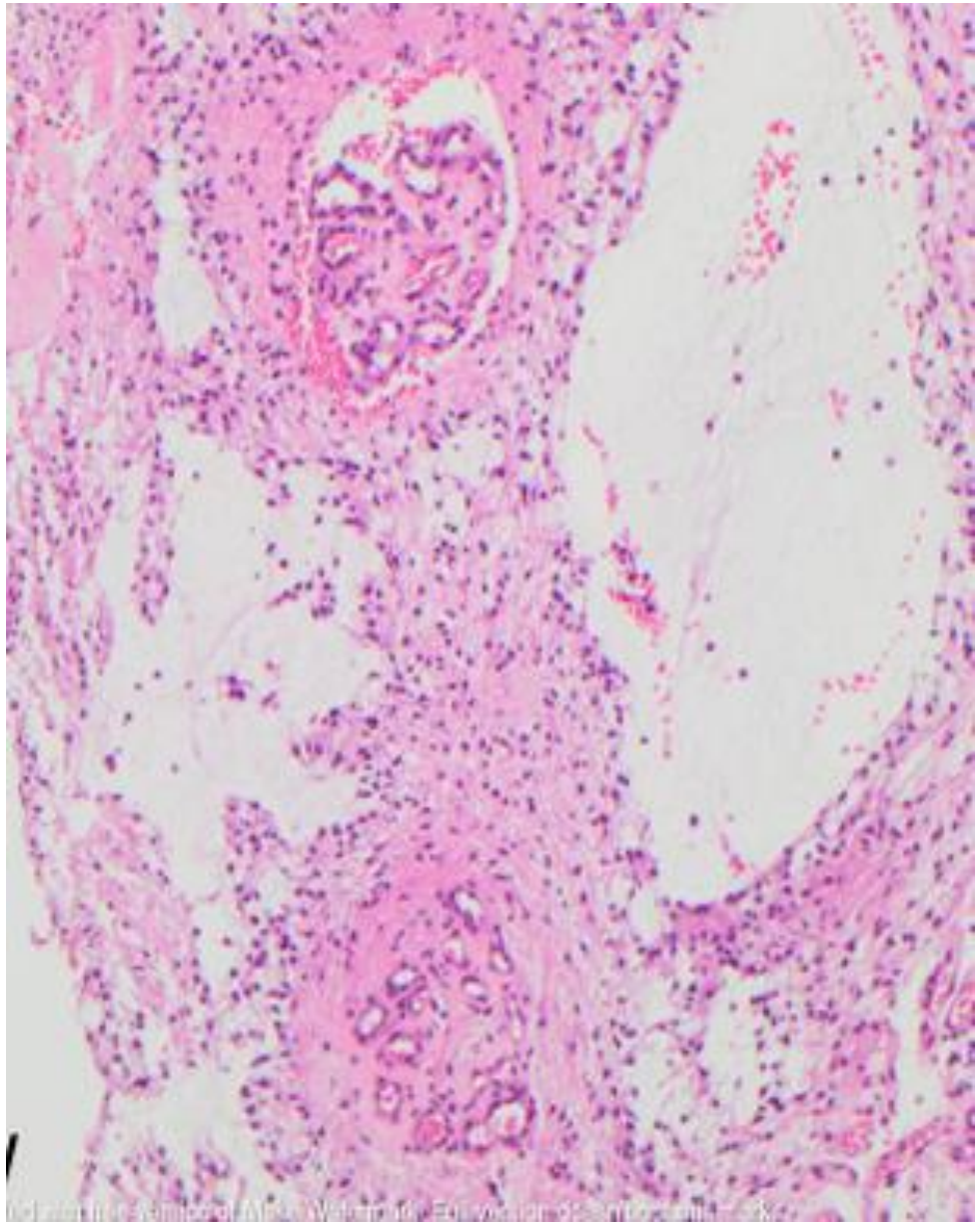




Pilocytic Astrocytoma (WHO grade 1) -microscopic

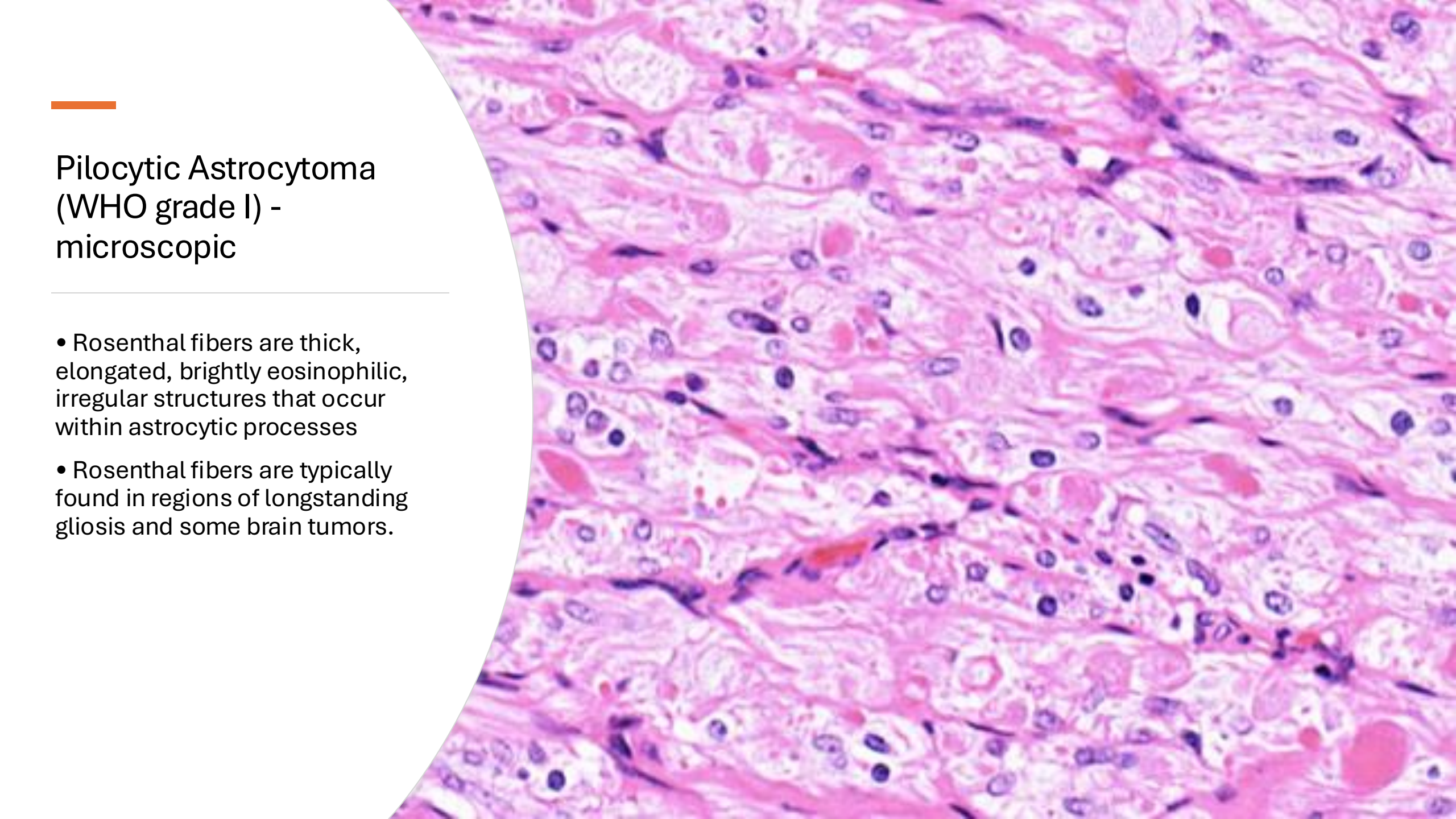
The tumor is composed of:

- Bipolar cells with long, thin “hair-like” (pilo) processes.
- Rosenthal fibers.
- Eosinophilic granular bodies.
- Microcysts often present.
- Necrosis & mitoses are rare.



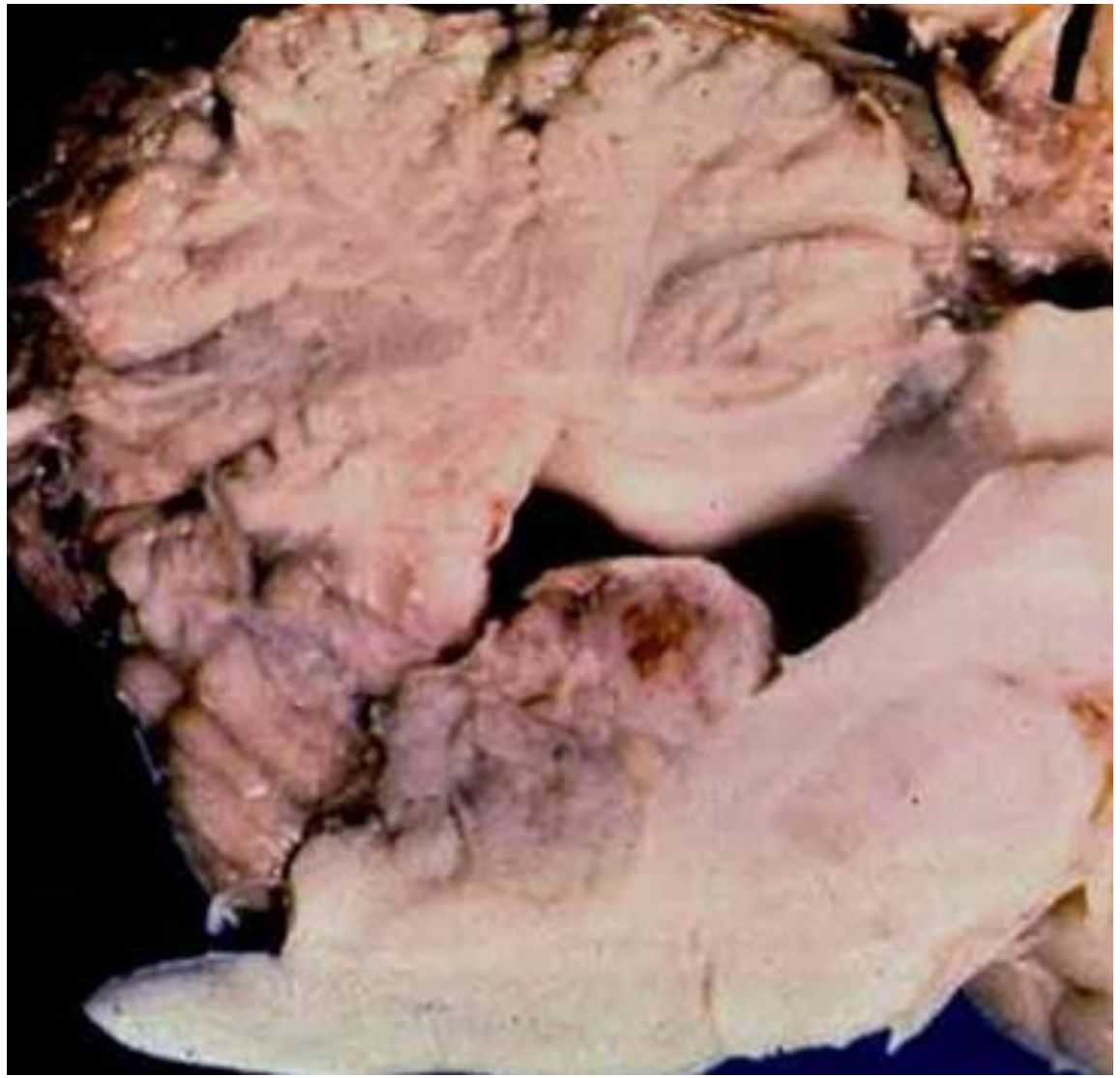
Pilocytic Astrocytoma (WHO grade I) - microscopic

- Rosenthal fibers are thick, elongated, brightly eosinophilic, irregular structures that occur within astrocytic processes
- Rosenthal fibers are typically found in regions of longstanding gliosis and some brain tumors.



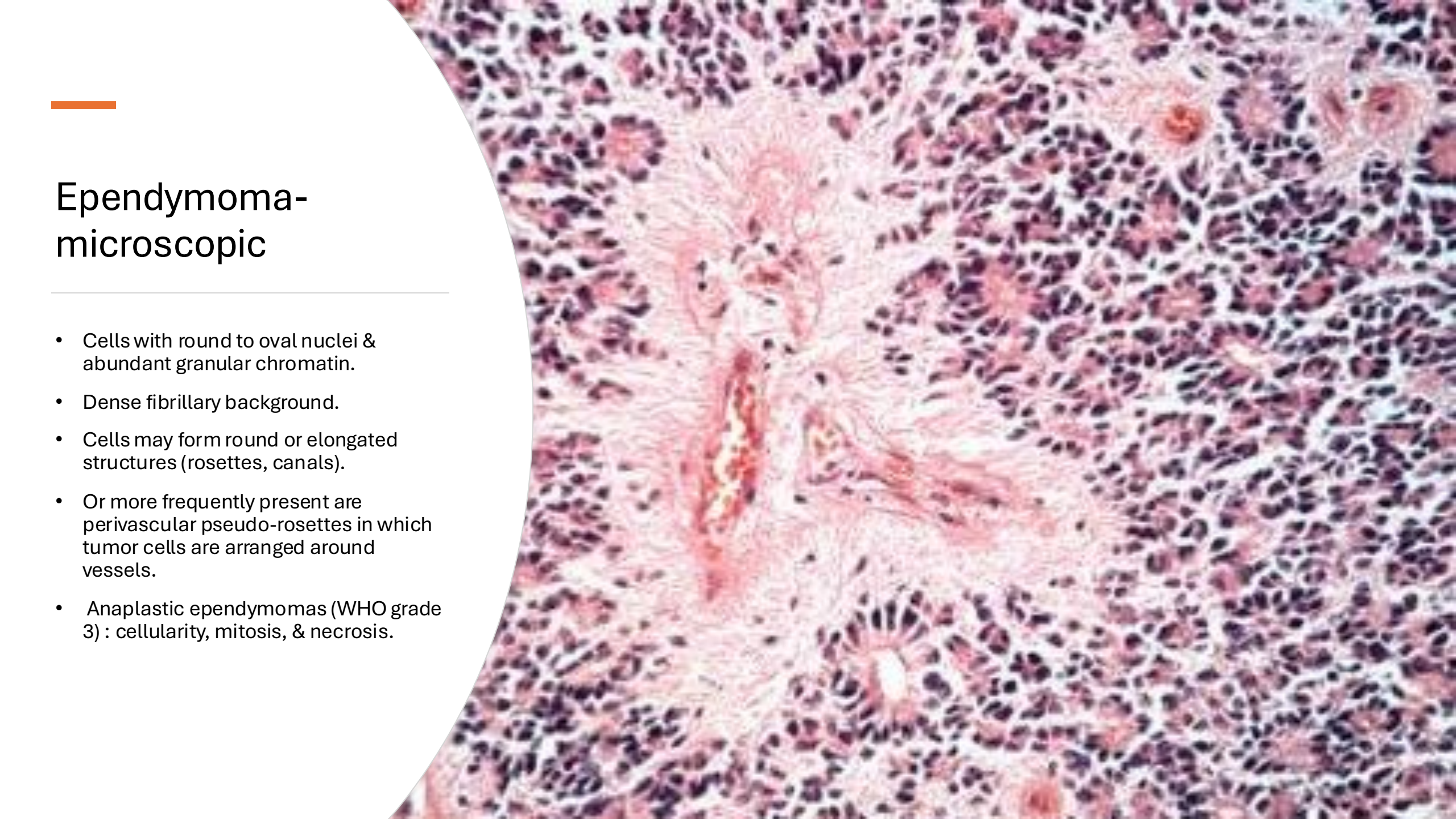
Ependymoma-Gross

- In the fourth ventricle, ependymomas typically are solid or papillary masses extending from the ventricular floor.



Ependymoma-microscopic

- Cells with round to oval nuclei & abundant granular chromatin.
- Dense fibrillary background.
- Cells may form round or elongated structures (rosettes, canals).
- Or more frequently present are perivascular pseudo-rosettes in which tumor cells are arranged around vessels.
- Anaplastic ependymomas (WHO grade 3) : cellularity, mitosis, & necrosis.



Neuronal Tumors

Far less common than gliomas.

Typically, lower-grade lesions, often present with seizure.

Tumors composed of cells with neuronal features express neuronal markers; synaptophysin & neurofilaments

Examples: Gangliogliomas, central neurocytoma

Embryonal(Primitive) Neoplasms

Tumors with Primitive “small round cell” appearance that is reminiscent of normal progenitor cells encountered in the developing CNS.

The most common is the medulloblastoma, accounting for 20% of pediatric brain tumors

Medulloblastoma- Gross

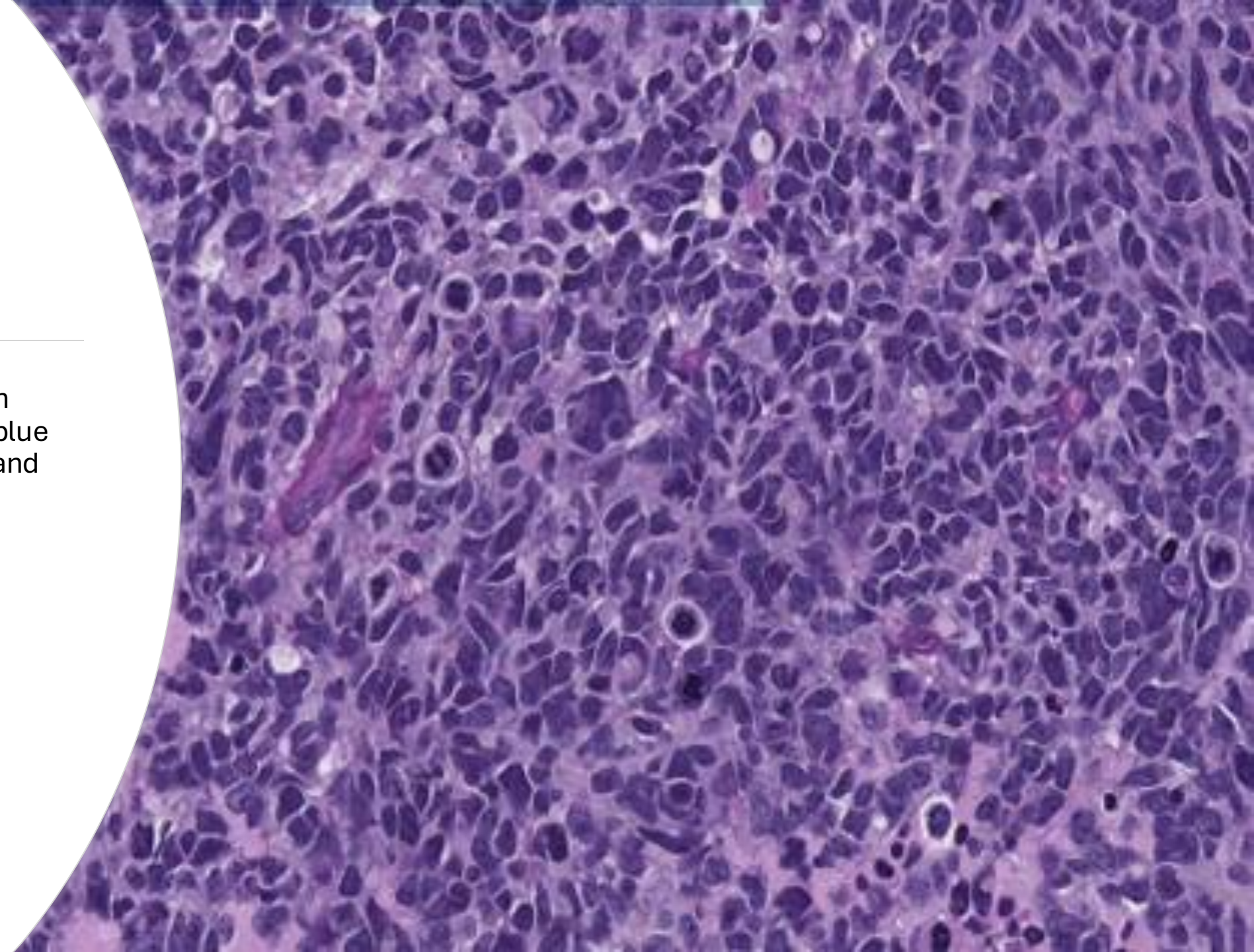
often well circumscribed, gray, & friable.

Maybe Extending to the surface of the cerebellar folia & leptomeninges

Medulloblastoma- Morphology

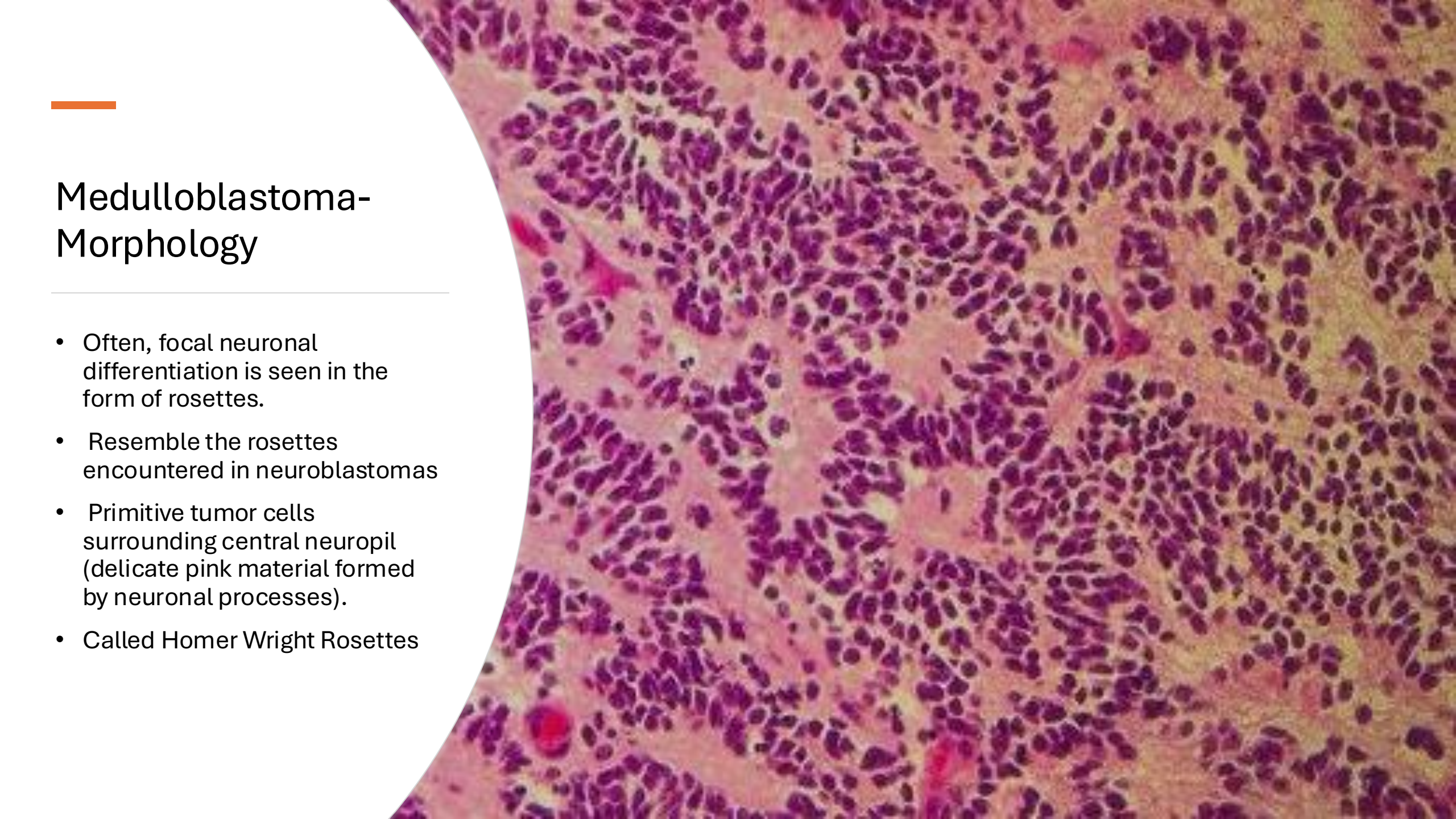
Densely cellular tumor → with sheets of anaplastic (“small blue cells”), with little cytoplasm and hyperchromatic nuclei.

Mitoses are abundant.



Medulloblastoma- Morphology

- Often, focal neuronal differentiation is seen in the form of rosettes.
- Resemble the rosettes encountered in neuroblastomas
- Primitive tumor cells surrounding central neuropil (delicate pink material formed by neuronal processes).
- Called Homer Wright Rosettes



Primary Central Nervous System Lymphoma

Type

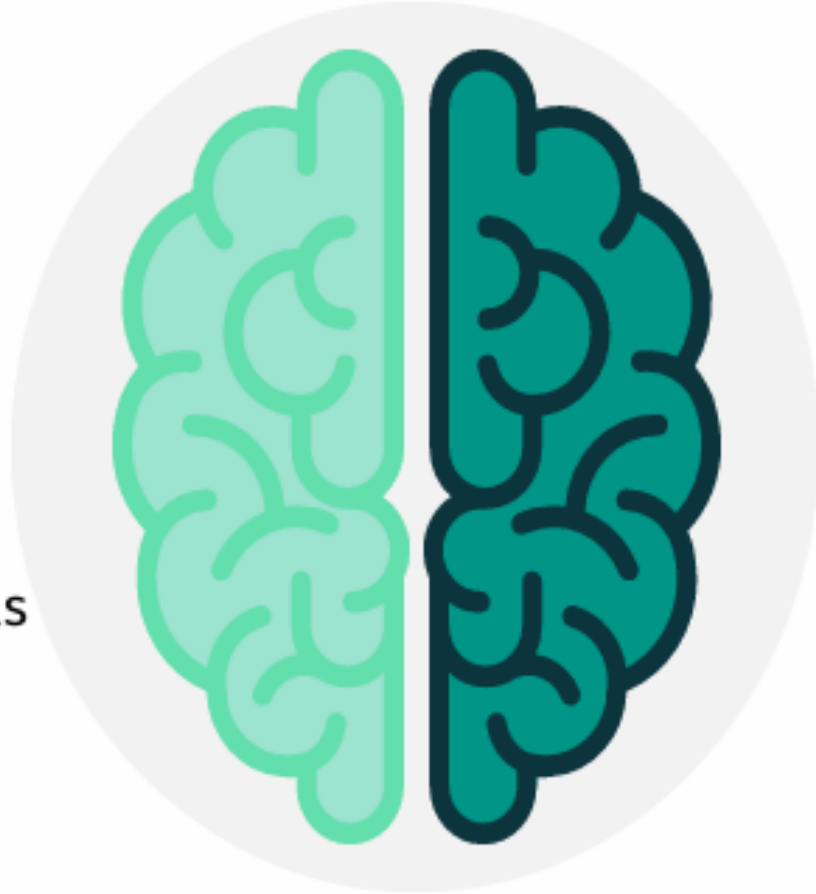
Occurring mostly as diffuse large B-cell lymphomas

Epidemiology

1% of intracranial tumors.
It is the most common CNS neoplasm in immunosuppressed individuals

Prognosis

An aggressive disease with a poor response to chemotherapy compared with peripheral lymphomas.



Gross/radio

Multiple tumor nodules within the brain parenchyma.
Periventricular spread is common.

Microscopic

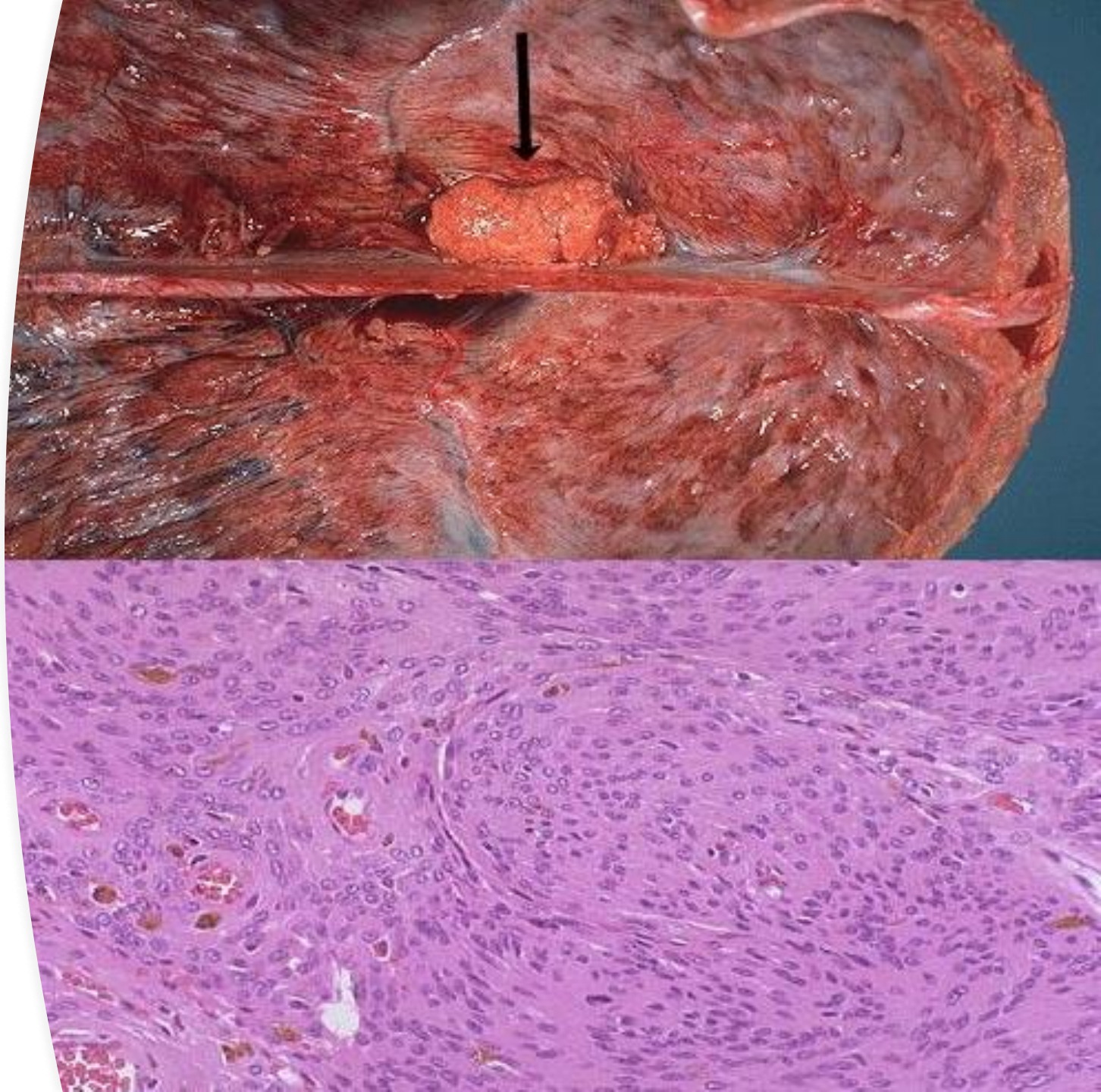
Malignant lymphoid cells accumulate around blood vessels & infiltrate the surrounding brain parenchyma.

Spread

Spreading outside the brain happens rarely.
Peripheral lymphoma rarely spreads to the brain.

Meningiomas - WHO grade I

- Well-defined include masses that may compress the brain but no invasion.
- Extension into the overlying bone may be present.
- Variable histologic patterns include, most common meningothelial; named for whorled, tight clusters of cells without visible cell membranes



Meningiomas - WHO grade I

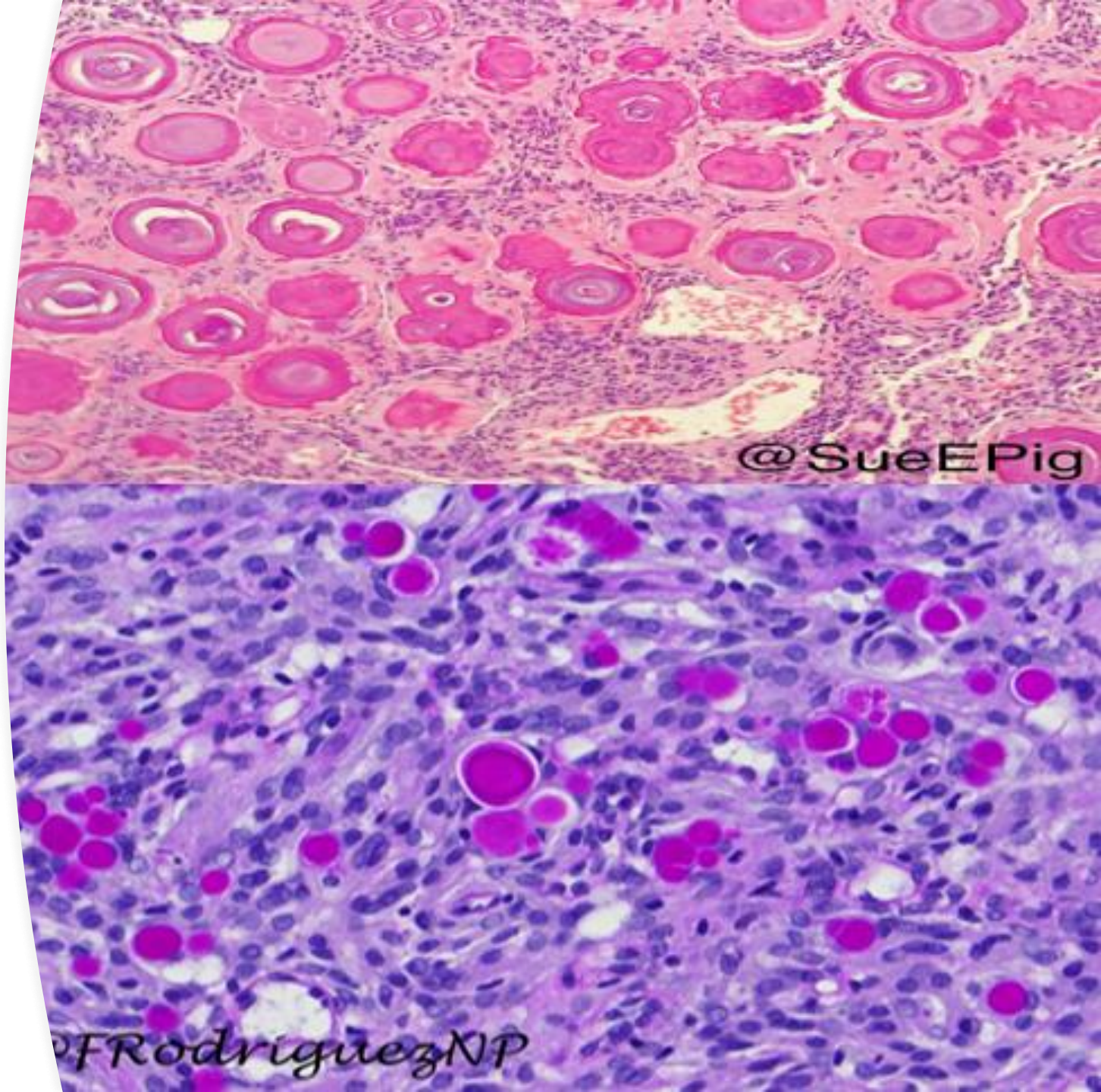
- Other varients:

1. fibroblastic, with elongated cells & abundant collagen

2. transitional, with features of the meningothelial & fibroblastic

3. psammomatous, with numerous psammomabodies.

4. Secretory, with glandlike spaces containing PAS-positive eosinophilic material



Meningiomas-WHO grade 2

- Features include:

1. Increased mitotic rate.

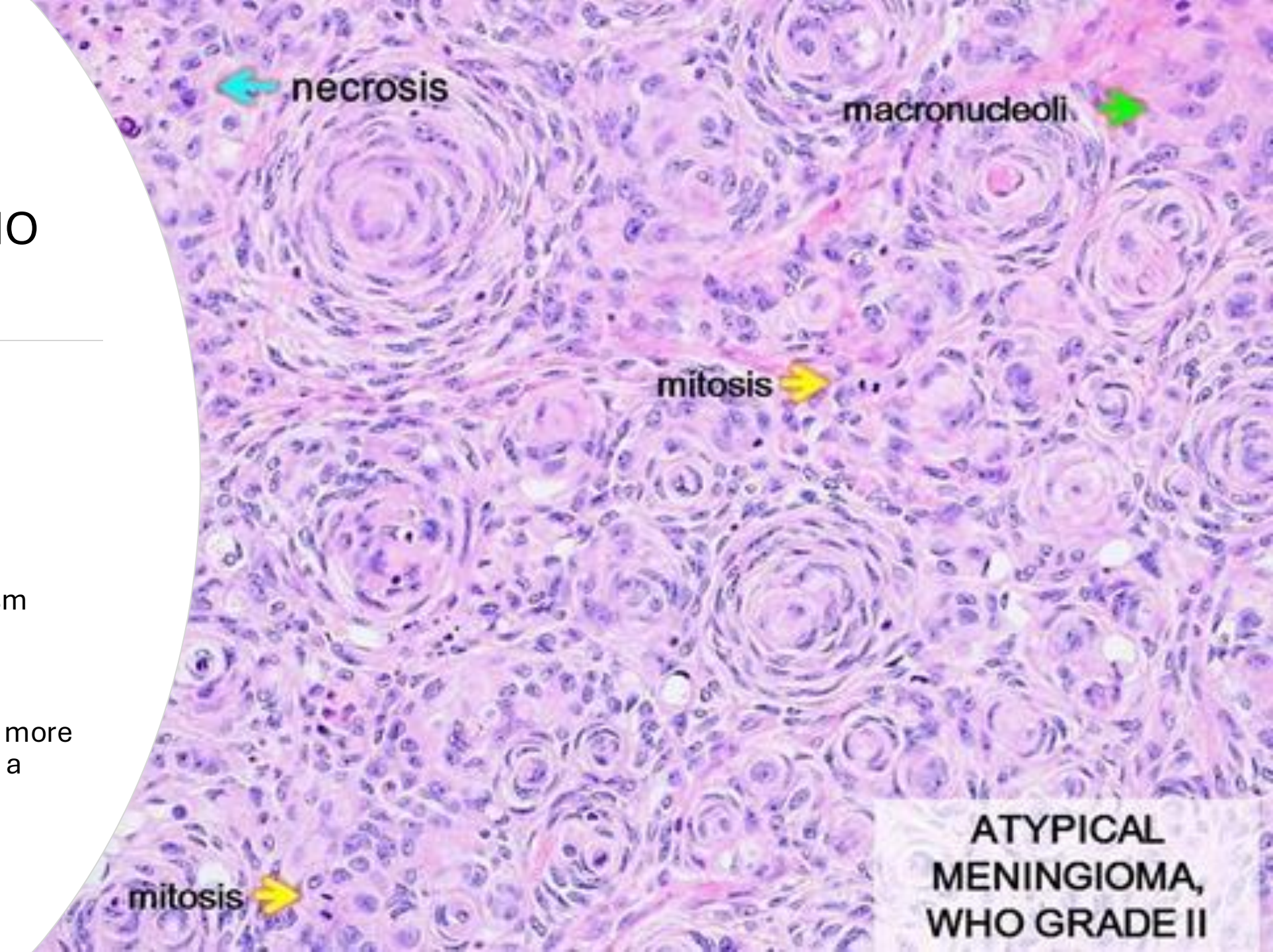
2. Prominent nucleoli.

3. Increased cellularity.

4. High nucleus-to-cytoplasm ratio.

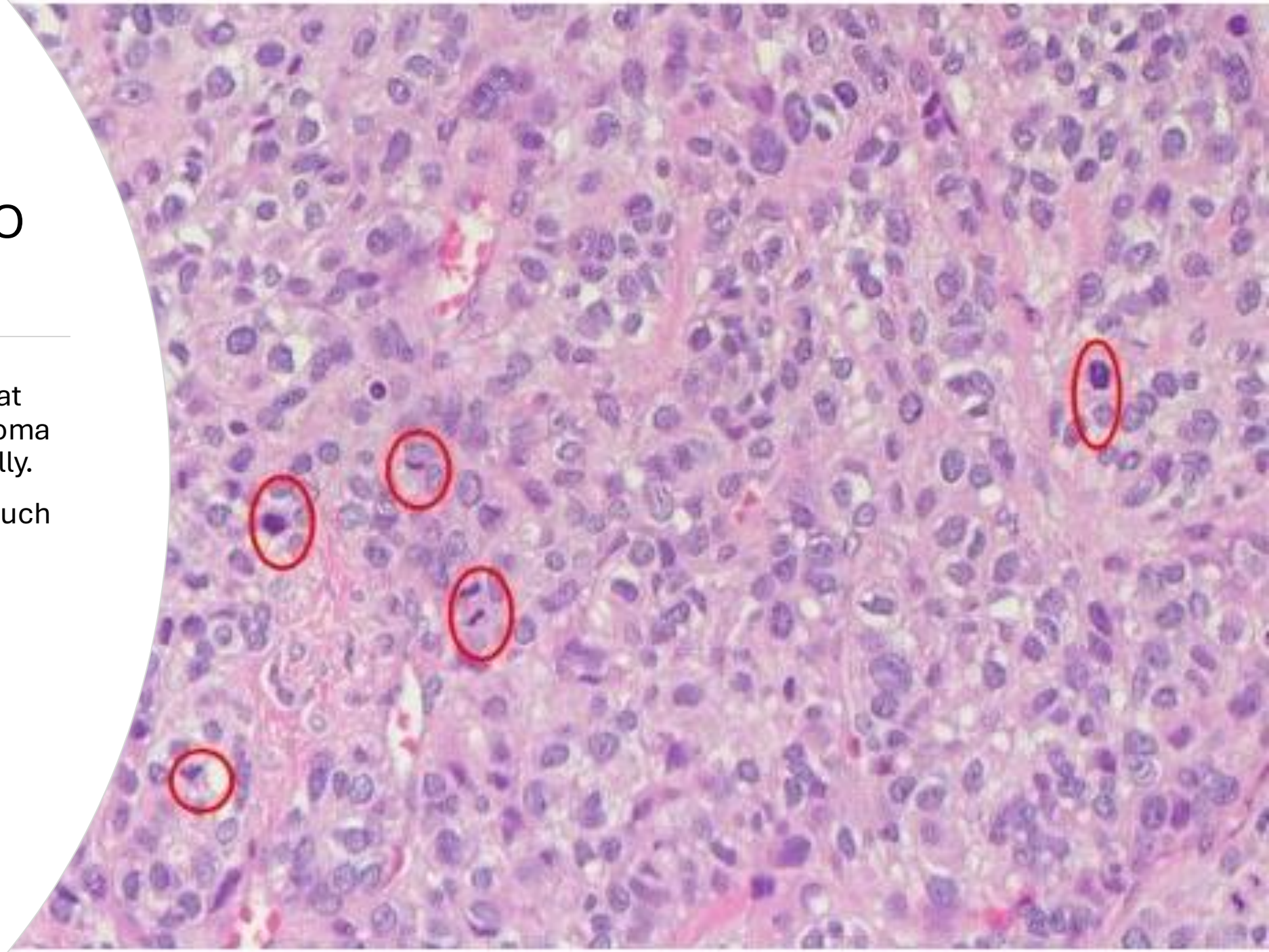
5. Necrosis.

These tumors demonstrate more aggressive local growth and a higher rate of recurrence.



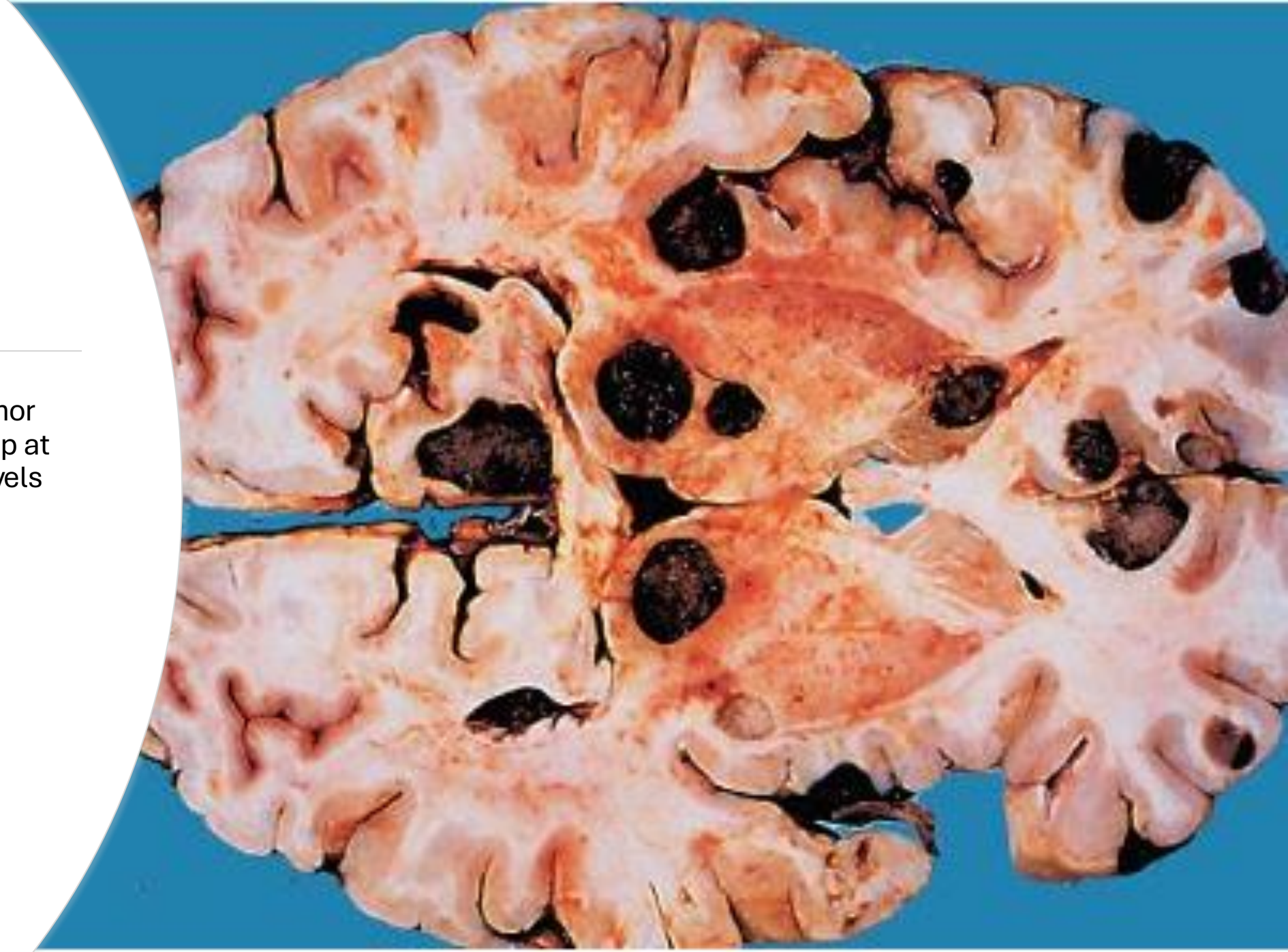
Meningiomas - WHO grade 3

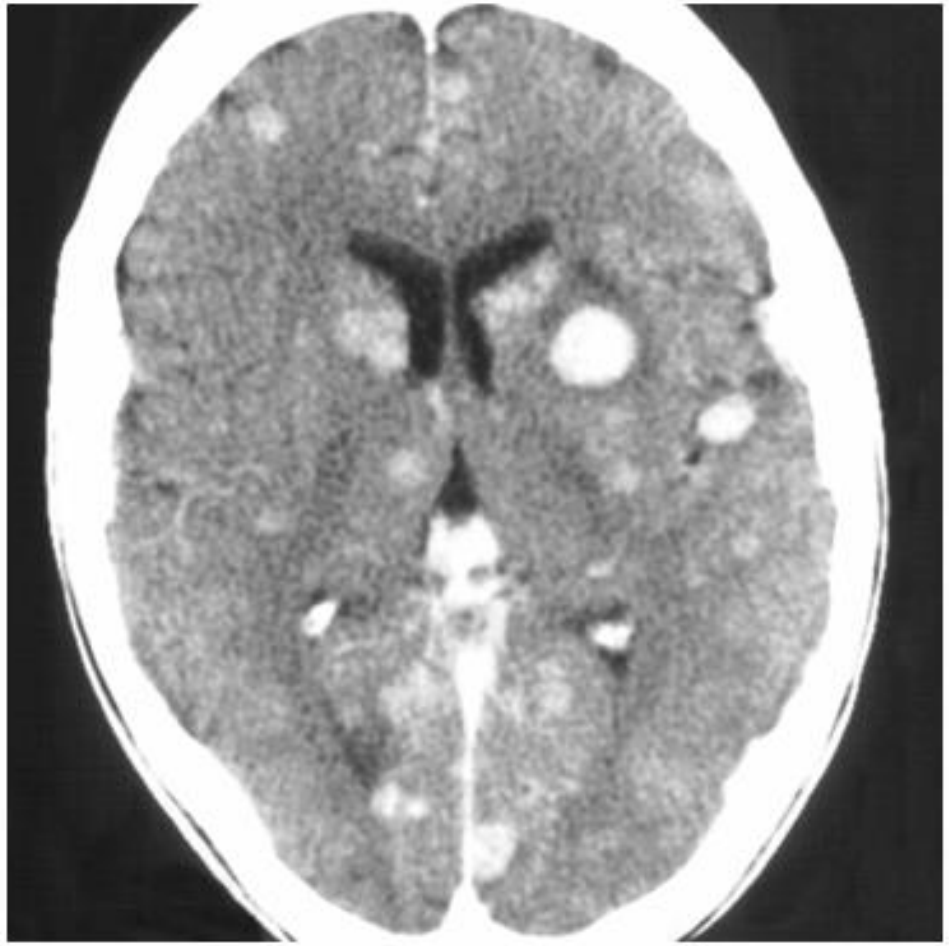
- Highly aggressive tumors that resemble a high-grade sarcoma or carcinoma morphologically.
- Mitotic rates are typically much higher than in grade 2 meningiomas.

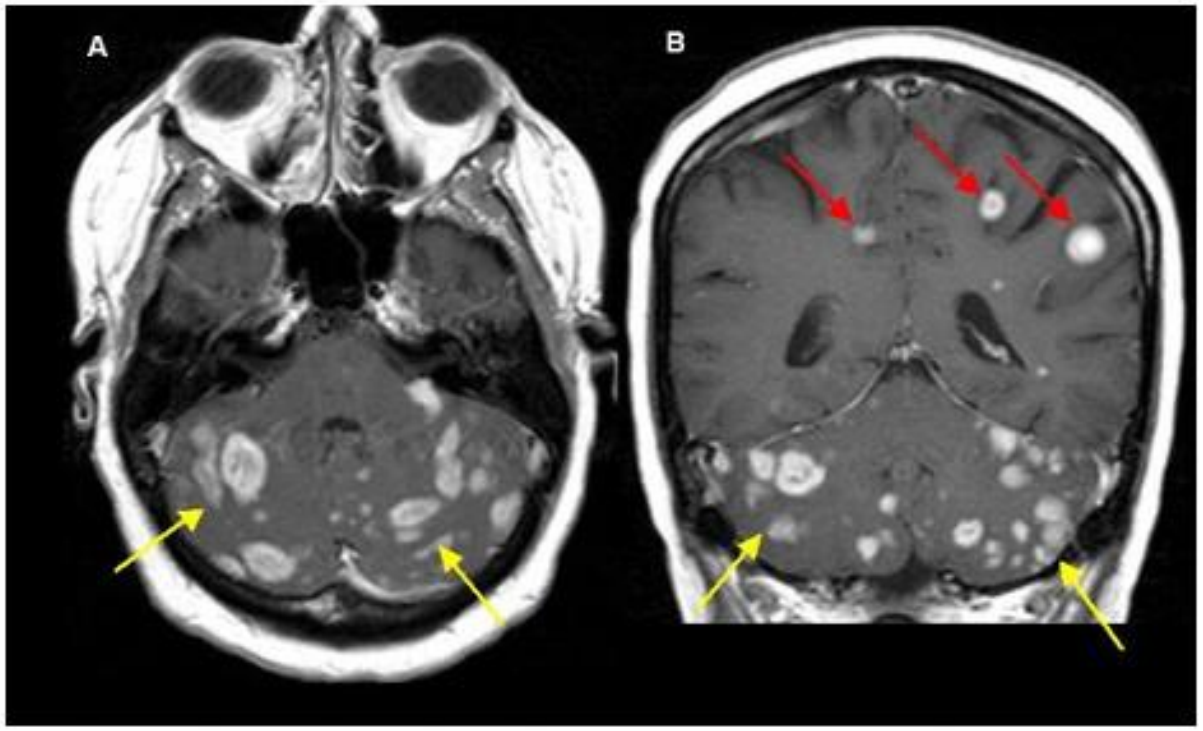


Metastatic Tumors

- The boundary between Tumor and brain parenchyma is sharp at the gross and microscopic levels







Metastatic Tumors

THANK YOU