CNS Tumors

Part I

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The annual incidence of tumors of the CNS ranges from:

- 10 to 17 per 100,000 persons for intracranial tumors
- 1 to 2 per 100,000 persons for intraspinal tumors
- About half to three-quarters are primary tumors, and the rest are metastatic.

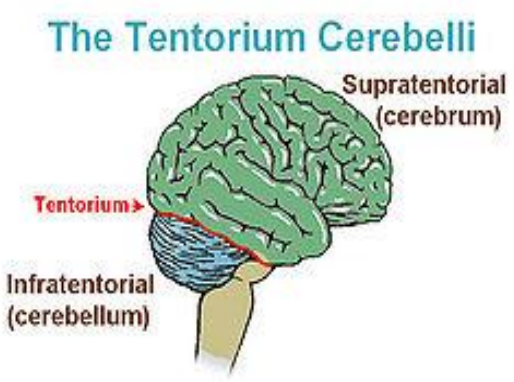
Incidence: is the rate of occurrence for new cases of a particular disease in a population being studied

CNS tumors in children:

- Tumors of the CNS are larger proportion of cancers of childhood, accounting for as many as 20% of all tumors.
- CNS tumors in childhood differ from those in adults both in histological subtype and location
- In childhood, tumors are likely to arise in the posterior fossa (infratentorial), while in adults they are mostly supratentorial

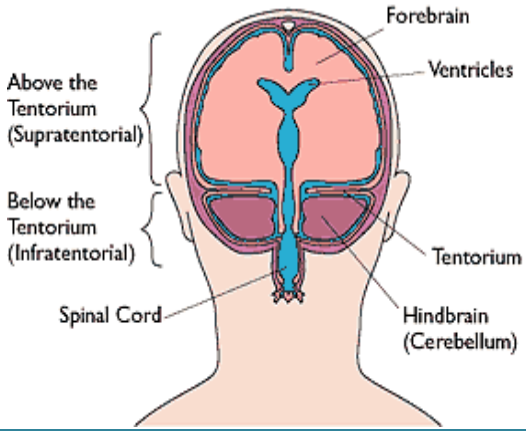
For your information: the most common type of cancers in children is leukemia but CNS tumors are the most common type of solid tumors.

The **tentorium cerebelli** or **cerebellar tentorium** is an extension of the dura mater that separates the cerebellum from the inferior portion of the occipital lobes (cerebrum).



The **posterior (cranial) fossa** or **(infratentorial)** contains the brainstem and cerebellum **.**

Supratentorial: contains cerebrum



CNS tumors (general characteristics):

1. The anatomical site of the neoplasm can have lethal (harmful) consequences irrespective (regardless) of histological classification (benign or malignant)

   (i.e. benign tumors can be fatal in certain locations)

Staging system: deals with location

→ *Examples on such locations?*

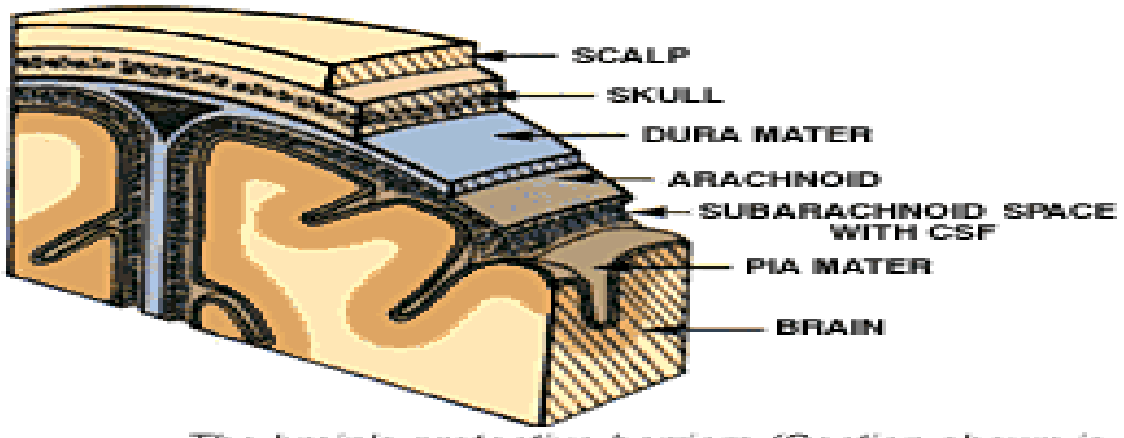
Benign meningioma is a harmful benign because it may compress the cardiac and respiratory centers in the medulla, leading to cardiorespiratory arrest.

2. The pattern of spread to primary CNS neoplasms differs from that of other tumors found in other parts of the body in:
   - rarely metastasize outside the CNS
   - the subarachnoid space does provide a pathway for spreading of the tumors away from its original site inside the CNS (brain and spinal cord)

So CNS receives tumors from other organs but never sends tumors to other sites outside it.

→ *What are the layers that surround subarachnoid space?*

PAD: Pia, Arachnoid, Dura



The brain's protective barriers (Section shown is from top, center of head)

General manifestation (clinical presentation) :

- Seizures, headaches, vague symptoms (being ill or having lack of energy or motivation).
- Focal neurologic deficits related to the anatomic site of involvement.
- Rate of growth may correlate with history (higher rate of cellular growth = short history of the disease)

A main feature of temporal lesions is seizure activity

These manifestations can be seen in both children and adult

Classifications of the tumors according to their origin:

1. cells intrinsic to the brain (gliomas, neuronal tumors, choroid plexus tumors)
2. cells of the coverings (meningiomas)
3. other cell populations within the skull (primary CNS lymphoma, germ-cell tumors)
4. they may spread from elsewhere in the body (metastases)

Primary CNS lymphoma: mostly occurs to HIV patients.

Germ-cell tumors : especially with pineal glands

• Gliomas (tumors' cells intrinsic to the brain):

Are neoplasmic cells arising from glia cells (neuroglial)

Remember: diffuse astrocytoma is the prototype of brain tumors.

Types of gliomas :

1. *Astrocytomas* (which are divided into fibrillary and pilocytic)
2. *Oligodendrogliomas*
3. *Ependymomas*

1. Astrocytomas

Types of Astrocytomas

	Fibrillary (thin fiber)	Pilocytic *(thick hair)*
Age Group	Adults in the 4th to 6th decade	Children and young adults
Area	Commonly cerebral hemisphere *(supratentorial)*	Commonly cerebellum (infratentorial)
classification	• Diffuse astrocytoma • Anaplastic astrocytoma • Glioblastoma (GBM)	Relatively benign

Remember the Grading system of Tumors:

Grading system: deals with the appearance of tumor cells under the microscope.

- **Grade I** tumors are slow-growing, nonmalignant, and associated with long-term survival. (benign)
- **Grade II** tumors are relatively slow-growing but sometimes recur as higher grade tumors. They can be nonmalignant or malignant.
- **Grade III** tumors are malignant and often recur as higher grade tumors.
- **Grade IV** tumors reproduce rapidly and are very aggressive malignant tumors.

Now this is another classification of the fibrillary astrocytomas' subtypes but according to the grading system :

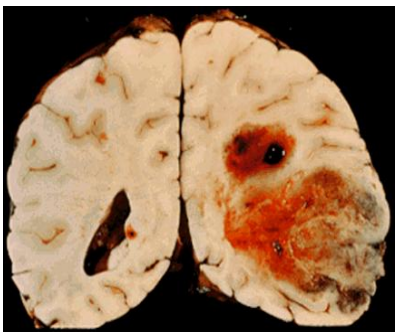
Differentiation: the possession of a character or function different from that of the original type.

1. ***Well differentiated (grade II) :***
   - Diffuse Astrocytoma
     - Static or progress slowly (means survival of more than 5years)
     - Moderate cellularity
     - Variable nuclear pleomorphism

cellularity :is the state of a tissue or other mass as regards the number of its constituent cells.

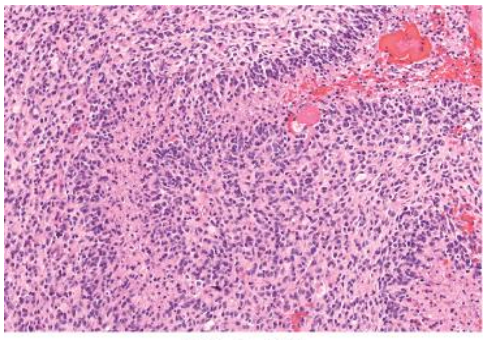
Nuclear pleomorphism: having more than one shape or form

2. ***Less differentiated (higher-grade):***
   - Anaplastic astrocytoma (grade III)
     - More cellular
     - Greater nuclear pleomrophism
     - Mitosis
   - Glioblastoma-GBM- (grade IV)
     - Progress quickly
     - With treatment, means survival of 8-10 months
     - *Causes pseudopalisading necrosis* **and/or** *vascular endothelial cell proliferation .*



Palisading: is a descriptive term for a light microscopic appearance of elongated and compressed cells.

Endothelial cell proliferation means: increasing layer of endothelial cells inside the vessel by proliferation, not increasing in the number of the vessels.



Glioblastoma Multiform (the most aggressive type of – fibrillary- astrocytomas):

It could be primary or secondary:

- **Primary "de novo" (start from the beginning as glioblastoma) caused by:** amplification of (EGFR) gene.
- **Secondary (low grade tumor occurs first,then progress to the glioblastoma) caused by:** mutation in P53 (tumor suppressor gene) and result in low-grade gliomas.

Epidermal growth factor receptor (EGFR) is a cell-surface receptor and any mutation affecting it could result in cancer.

Pilocytic Astrocytoma:

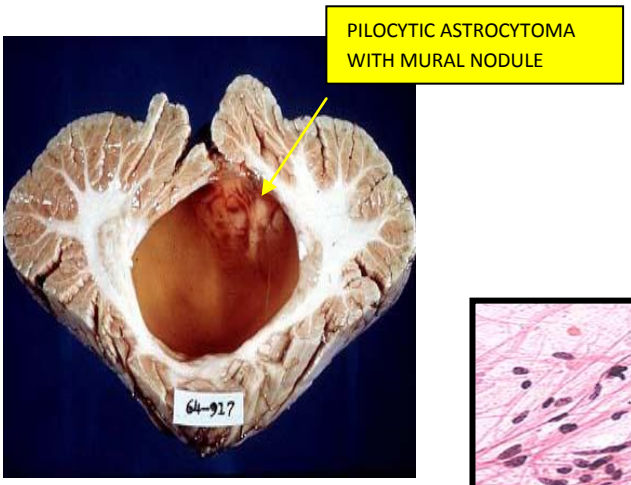
- Well circumscribed (low grade tumor = benign)
- It has pilocytic ="hairlike" processes that are GFAP +ve
- Often cystic, with a mural nodule (mass found on the wall)

Glial fibrillary acidic protein: is a cell-specific marker that generally distinguishes astrocytes from other glial cells.

- Histological findings:

1. Rosenthal fibers & hyaline granular bodies
2. No necrosis and mitoses (because it's grade I)

It can be tested on the molecular level using Immunohistochemistry (purified antibodies+ brown chromogen) on the tissue.



Rosenthal fibers are thick, elongated, worm-like or "corkscrew" eosinophilic (pink) bundles that are found on H&E staining of the brain.