Brain Tumor 101

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Objectives

Identify the different parts of the brain

Describe how each part of the brain works

Connect each part of the brain with how a problem in that area affects a brain tumor patient

Explain the function of each cranial nerve and an associated problem with each

Explain the types of brain tumors, their grades, and aggressiveness
Anatomy

Monro-Kelly Hypothesis

- The brain as a box
- 3 equal parts
  - Blood
  - Brain
  - Spinal fluid
Anatomy

- Two cerebral hemispheres
  - Right – creative
  - Left – technical

- Left v. Right dominance
  - 95% of right-handed people have left-hemisphere dominance for language
  - Only 18.8% of left-handed people have right-hemisphere dominance for language function
  - 19.8% of left-handed people have bilateral language functions
Anatomy

- Cerebral hemispheres made up of lobes
  - Frontal
  - Parietal
  - Temporal
  - Occipital
- Cerebellum
- Brain Stem
- Ventricular System
Frontal Lobe

**Normal functions**
- Personality
- Inhibition
- Motor
- Expressive speech (Broca)

**Tumor may cause**
- Loss of movement (paralysis)
- Repetition of a single thought or word
- Unable to focus
- Mood swings, impulsiveness
- Changes in social behavior
- Difficulty problem solving
- Language: can’t get words out (aphasia)
Parietal Lobe

- **Normal functions**
  - Sensation
  - Spatial perception

- **Tumor may cause**
  - Difficulty distinguishing left from right
  - Lack of awareness or neglect of certain body parts
  - Difficulty eye-hand coordination
  - Problems reading, writing, naming
  - Difficulty with math
Temporal Lobe

**Normal functions**
- Memory
- Receptive speech (Wernicke)
- Dominant vs. non-dominant

**Tumor may cause**
- Difficulty understanding language and speaking (aphasia)
- Difficulty recognizing faces
- Difficulty naming / identify objects
- Problems with short and long term memory
- Changes in sexual behavior
- Increased aggressive behavior
Occipital Lobe

- **Normal functions**
  - Vision

- **Tumor may cause**
  - Defects in vision or blind spots
  - Blurred vision
  - Visual hallucinations
Cerebellum

- Normal functions
  - Coordination and fine motor movements
  - Balance

- Tumor may cause
  - Difficulty coordinating fine movements
  - Difficulty walking
  - Tremors
  - Dizziness
  - Slurred speech
Brain Stem

**Normal functions**
- Origin of many cranial nerves
- Respiratory center
- Level of consciousness

**Tumor may cause**
- Changes in breathing
- Difficulty swallowing (dysphagia)
- Problems with balance and movement
- Dizziness and nausea
Cranial Nerves

I  olfactory  smell
II  optic  sight
III  oculomotor  eye movement
IV  trochlear  eye movement
V  trigeminal  face sensation
VI  abducens  eye movement
VII  facial  face movement
VIII  vestibulocochlear  hearing, balance
IX  glossopharyngeal  taste, swallowing
X  vagus  heart rate, digestion
XI  spinal accessory  head movement
XII  hypoglossal  tongue movement
Ventricular System

β Normal functions
- Cerebrospinal fluid flow pathway
- Cerebrospinal fluid bathes and cushions the brain and spinal cord

β Tumor may cause
- Blockage of CSF
- Hydrocephalus
Central Nervous System Tumors

- Primary v. secondary
- Classification system (WHO)
- Benign v. malignant
- De novo v. dedifferentiated
Brain tumors

Primary - originates in brain

Metastatic (secondary) - cancer that spread to brain from somewhere else

ventricle blocked
brain compressed and displaced (mass effect)
arteries and nerves compressed
skull
dura

metastatic brain tumors
melanoma (primary cancer site)
World Health Organization

- Grading scale based on cell type and tumor aggressiveness

- Applies to all tumors
  - Glioma – Grades I – IV
  - Meningioma – Grade I – III
  - Pituitary adenoma – Grade I
  - Acoustic neuroma – Grade I
Glioma Grading*

**Grade I** (pilocytic astrocytoma)
- Slow growing cells
- Least malignant

**Grade II** (astrocytoma)
- Relatively slow growing cells
- Can invade nearby tissue
- Sometimes recur as a higher grade

**Grade III** (anaplastic astrocytoma)
- Actively reproducing abnormal cells
- Infiltrate normal tissue
- Tend to recur, often as a higher grade

**Grade IV** (glioblastoma)
- Rapidly reproducing abnormal cells
- Area of dead cells (necrosis) in center
- Form new blood vessels to maintain growth

*World Health Organization (WHO) Glioma Scale*
# Brain tumor types

<table>
<thead>
<tr>
<th>Low-grade</th>
<th>High-grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meningioma</td>
<td>Anaplastic astrocytoma</td>
</tr>
<tr>
<td>Pituitary adenoma</td>
<td>Anaplastic oligodendroglioma</td>
</tr>
<tr>
<td>Acoustic neuroma</td>
<td>Glioblastoma (GBM)</td>
</tr>
<tr>
<td>Low grade glioma – astrocytoma, oligo</td>
<td></td>
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</tbody>
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![Brain MRI images](image)
Rate of growth

- Higher grade $\rightarrow$ faster the tumor is growing
- Benign is slow growing (WHO I and II)
- Malignant is faster growing (WHO III and IV)
- Tumors can have characteristics of two different grades = mixed glioma, treatment is defined by the more malignant portion being the more aggressive portion
Origin of tumor

- Primary versus Secondary Glioblastoma
- Primary or De novo means “of the new” – a tumor that spontaneously arises
- Secondary = one that has “dedifferentiated” or “evolved” from a lower grade tumor
- Treatment is the same
- Genetics are different
  - Possible opportunities for unique treatments in the future directed at these genetic differences