Brain Tumors and Tumor-like Lesions

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Outline

- Case-based review
- Differential diagnosis
- Tumors and Mimics
Imaging Features of *Tumors*

- **Mass Effect**
  - Tumor bulk, herniation, hydrocephalus
- **Edema**
  - Vasogenic (no invasion), infiltrative (+ invasion)
- **Hemorrhage**
  - Intratumoral, extratumoral
- **Enhancement**
  - Contrast leakage (BBB disruption)
- **Necrosis**
  - Ring-/heterogeneous enhancement
- **Post-treatment effects**
  - Leukoencephalopathy, radionecrosis, steroid-like effects

**Case 1**

55-year-old male smoker with mental status decline
Intra- or Extra-axial?

1. Intra-axial
2. Extra-axial
3. Uncertain
Extra-axial lesion signs

- Meniscus
- Veins
- CSF cleft
- Grey-white buckling

Extra-axial Meningioma

Intra- or Extra-axial?

Intra-axial (Exophytic) GBM
Solitary Lung CA Metastasis

Case 2

45-year-old woman with new-onset aphasia and weakness
Intracerebral Hemorrhage

Lobar Hemorrhage: Diagnosis?

1. Aneurysm
2. Infarct
3. Trauma
4. Vasculitis
5. Amyloid angiopathy
6. Vascular Malformation
7. Tumor
Aneurismal ICH

- History
- SAH
- Circle of Willis
- Re-bleeding

Hemorrhagic Infarct

- Primary
  - Hypertension
- Secondary
  - Transformation
  - Enhancement
    - Gyriform
    - Subacute
- History
Subacute Hemorrhagic Infarct

- History
- Anterior-inferior
- Frontal-temporal
- Multi-compartmental
- Fractures

Traumatic ICH
Vasculitis

- History
- Serologies
- DSA

DSA: CNS Vasculitis
**Amyloid Angiopathy**

- Older age
- Dementia
- T2* microbleeds

**Arteriovenous Malformation**

- Younger age
- AVM nidus
- T2 flow voids
- AV shunting
Cavernous Malformation
- Old bleeds
- Hypointense rim
- T2* blooming

T2* “Blooming” Artifact

Cavernous Angioma
Lung CA Metastases

Tumoral Hemorrhage

“MR-CT”: Hemorrhagic Mets

- Melanoma
- Renal
- Choriocarcinoma
- Thyroid

Caveat:
- Breast & Lung
  - More common overall
Case 3

34-year-old woman with altered mental status
Ring-enhancing Lesion: Diagnosis?

1. Metastasis
2. Abscess
3. Glioblastoma
4. Toxoplasmosis
5. Lymphoma
6. Tumefactive MS
7. Radionecrosis
“MAGICAL DR”: Ring Enhancing Lesions

- Metastases
- Abscess
- Glioma, granuloma
- Infarct
- Contusion
- AIDS (toxoplasmosis)
- Lymphoma
- Demyelinating disease
- Radionecrosis

Ring-enhancing Tumor

- Necrosis
- Primary
  - High-grade glioma
  - Lymphoma
  - Metastases
CNS Abscess

- Edema
- High T1/Low T2 rim
- Low ADC centrally
- Uniform rim

Multiple Sclerosis
Multiple Sclerosis

- Nodular > Arc, Rim
- Active disease
- Tumefactive
  - Edema
  - Mass

Tumefactive Demyelination
AIDS: Toxoplasmosis vs. Lymphoma

- **Toxoplasmosis**
  - Most common lesion
  - More commonly multiple
  - Basal ganglia, thalamus, hemispheres
  - PET hypometabolic

- **Lymphoma**
  - 2nd most common
  - Most common solitary/subependymal
  - Deep > subcortical
  - 201 Tl-SPECT +
  - PET hypermetabolic

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Radiation Necrosis

- **History**
  - XRT +/- surgery
  - Mimics recurrence
  - Imaging unreliable
    - MRP + MRS
    - FDG PET
Case 4

27-year-old man with seizures

Low ADC: Abscess
## Brain Tumor Symptoms

### Table 2. Symptoms of Brain Tumors.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Tumor Type</th>
<th>Low-Grade Glioma</th>
<th>Malignant Glioma</th>
<th>Meningioma</th>
<th>Nervous System</th>
<th>Lymphoma</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>percent with symptom</td>
<td></td>
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<tr>
<td>Headache</td>
<td></td>
<td>40</td>
<td>50</td>
<td>36</td>
<td>35</td>
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<tr>
<td>Seizure</td>
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<td><strong>65–95</strong></td>
<td>15–25</td>
<td>40</td>
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<td>Hemiparesis</td>
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<td>5–15</td>
<td>30–50</td>
<td>22</td>
<td>24</td>
<td></td>
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<tr>
<td>Mental-status abnormalities</td>
<td></td>
<td>10</td>
<td>40–60</td>
<td>21</td>
<td>61</td>
<td></td>
</tr>
</tbody>
</table>

*Image: MRI scans of brain showing tumor.*

**History: Seizures**
Cortical Mass + Seizures: Diagnosis?

1. Astrocytoma
2. Oligodendroglioma
3. Ganglioglioma
4. DNET
5. PXA

Low Grade Astrocytoma

- WHO grade 2
- 6-10 years survival
- Malignant progression
- Nonenhancing
- Loss of grey-white
- Extends beyond visible abnormalities
Anaplastic Astrocytoma

- WHO grade 3
- 2-3 year survival
- Malignant
- May occur following grade 2 resection
- Variable enhancement
  - 30% nonenhancing
  - May be patchy
- Extends beyond visible abnormalities

Oligodendroglioma

- WHO grade 2
  - Anaplastic = grade 3
  - Mixed oligo + astro
  - Cortical/subcortical
  - Supratentorial
  - Frontal lobe
  - Calcification
  - Variable enhancement
  - Loss of 1p, 19q heterozygosity
  - More favorable prognosis
Ganglioglioma

- WHO grade 1
  - Anaplastic: grade 3
  - Cortically-based
  - Partially cystic
  - Enhancing
- 3 patterns
  - Cyst + mural nodule
  - Solid (less common)
  - Infiltrating (uncommon)
- Calcification is common

DNET

- Benign
  - Either no growth or very slow increase
  - Recurrence rare
- “Bubbly” intracortical mass
  - Cortical dysplasia
- Seizures
Pleomorphic Xanthoastrocytoma

- WHO grade 2
  - May have anaplastic features
- Young adults
- Supratentorial
- Cortical
- Cyst + mural nodule
  - Abuts meninges

PXA can look identical
Case 5

68-year-old woman with mental status decline

Corpus Callosum Mass
“Butterfly Lesion”: Diagnosis?

1. GBM
2. Lymphoma
3. Metastasis

Glioblastoma Multiforme

- WHO grade 4
- <1 year survival
- Common
- Necrosis
- Infiltration
  - Extends beyond visible abnormalities
Primary CNS Lymphoma

- B-lymphocytes
- Immune compromised
- Necrosis
- Periventricular
Case 6

58-year-old man with asymmetric sensory neural hearing loss

Cerebellopontine Angle Mass
CPA Mass: Diagnosis?

1. Vestibular Schwannoma
2. Meningioma
3. Epidermoid

Vestibular Schwannoma

- Benign
- CN III through XII
  - CN VIII 90%
  - “Ice-cream on cone”
  - IAC extension
- Bilateral = NF2
Meningioma

- WHO grade 1-3
  - Atypical = grade 2
  - Anaplastic = grade 3
- Dural-based
- Multiple up to 10%
- <10% symptomatic

Epidermoid

- Follows CSF
- DWI useful
- No enhancement
- Subarachnoid
Epidermoid: high DWI
Case 7

21-year-old woman with headache and visual disturbance

Pineal Region Mass
Pineal Region Mass

1. Pineal Tumor
2. Germ Cell Tumor
3. Astrocytoma
4. Teratoma

Pineal Tumor

- Pineoblastoma
  - Younger age
  - Malignant
  - CSF spread
- Pineocytoma
  - Benign
  - Circumscribed
  - Calcified
Germ Cell Tumor

- Pineal region
  - germinoma
- Males 10:1

Tectal Astrocytoma

Courtesy Noriko Salamon, MD
Pineocytoma

Case 8

24-year-old with headaches
Posterior Fossa Tumor

1. Pilocytic Astrocytoma
2. Medulloblastoma
3. Ependymoma
4. Hemangioblastoma
5. Metastasis
Pilocytic Astrocytoma

- WHO grade 1
- Most common primary brain tumor in children
  - Peak 5-15 years
  - Cerebellum 60%
  - Optic pathway 25-30%
  - 3rd ventricle > brainstem
  - Enhancement with cystic features
  - Association with NF1

Medulloblastoma (PNET-MB)

- WHO grade 4
- 2nd most common PF tumor in children
  - Peak < 10 years
  - Roof of 4th ventricle
    - Solid, enhancing
    - Lateral in adults!
  - CSF dissemination
Ependymoma

- WHO grade 2 or 3
- 3rd most common in PF tumor in children
  - Peak 1-5 years
- Calcification, cysts, hemorrhage
- Extends from 4th ventricle into cisterns

Hemangioblastoma

- WHO grade 1
- Adult PF cystic mass
  - Enhancing mural nodule
  - Abuts pia
- Beware PF mets in adults!
  - More common than HGBL
  - VHL association
Residual Tumor Nodule

Hemangioblastoma

Lateral in adults!
Case 9

History Withheld

Suprasellar Mass
Suprasellar Mass - “SATCHMO”

1. Sellar mass
2. Aneurysm
3. Teratoma
4. Craniopharyngioma
5. Hypothalamic hamartoma
6. Meningioma
7. Optic Glioma

Sellar Mass - Macroadenoma
Prolactin > 120 ng/mL

Microprolactinoma

Arachnoid Cyst
**Dermoid/Teratoma**

- Follows fat
  - Fat-suppression
  - DDx: lipoma
- May rupture
  - Chemical meningitis

**Craniopharyngioma**

- Bimodal incidence
- Adamantinomatous
  - Childhood
  - Cystic
- Papillary
  - Sixth decade
  - Solid
- Heterogeneous
  - Calcifications
  - Cysts
  - Enhancement
Hypothalamic Hamartoma
- Tuber cinereum
- Non-neoplastic
- Precocious puberty
- Gelastic seizures
- Nonenhancing!

Meningioma - Tuberculum Sella
Case 10

34-year-old man with altered mental status
1. Subependymoma
2. Central Neurocytoma
3. Subependymal Giant Cell Astrocytoma
4. Choroid Plexus Papilloma/Carcinoma
5. Colloid Cyst
6. Meningioma
Subependymoma

- WHO grade 1
- Intraventricular
- Variable enhancement
  - Typically none
- Solid
  - May develop cysts, hemorrhage, calcification

Central Neurocytoma

- WHO grade 2
  - Surgery curative
  - “Bubbly”
- Septum pellucidum
  - Calcification
Intraventricular Meningioma

- Lateral Ventricle
- Atrium
- Solid

Colloid Cyst

- Obstructive Hydrocephalus
  - Monro foramen
  - Can be fatal
- Enhancement:
  - None or rim
  - Variable T1
Case 11

25-year-old male with altered mental status
Diagnosis?

Ruptured Dermoid

Thank you!

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