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# Case Presentation: Evaluating a New Brain Lesion

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# Our Index Patient: GB

- CC: Headache & Confusion
- HPI:
  - 62 y.o. ambidextrous woman with MS and rheumatoid arthritis presents in ED with a 10-day history of severe headache, plus new-onset confusion.
  - Twice in the past week, GB became lost while in her own neighborhood



# GB's Exam

- In the E.D., exam notable for:
  - BP 162/86
  - Mild L-sided neglect (extinction to visual double-sided stimulation)
  - Difficulty copying a complex image
- FIRST STUDY?
  - Non-Contrast Head CT (NCHCT)
  - Must rule out hemorrhage before proceeding



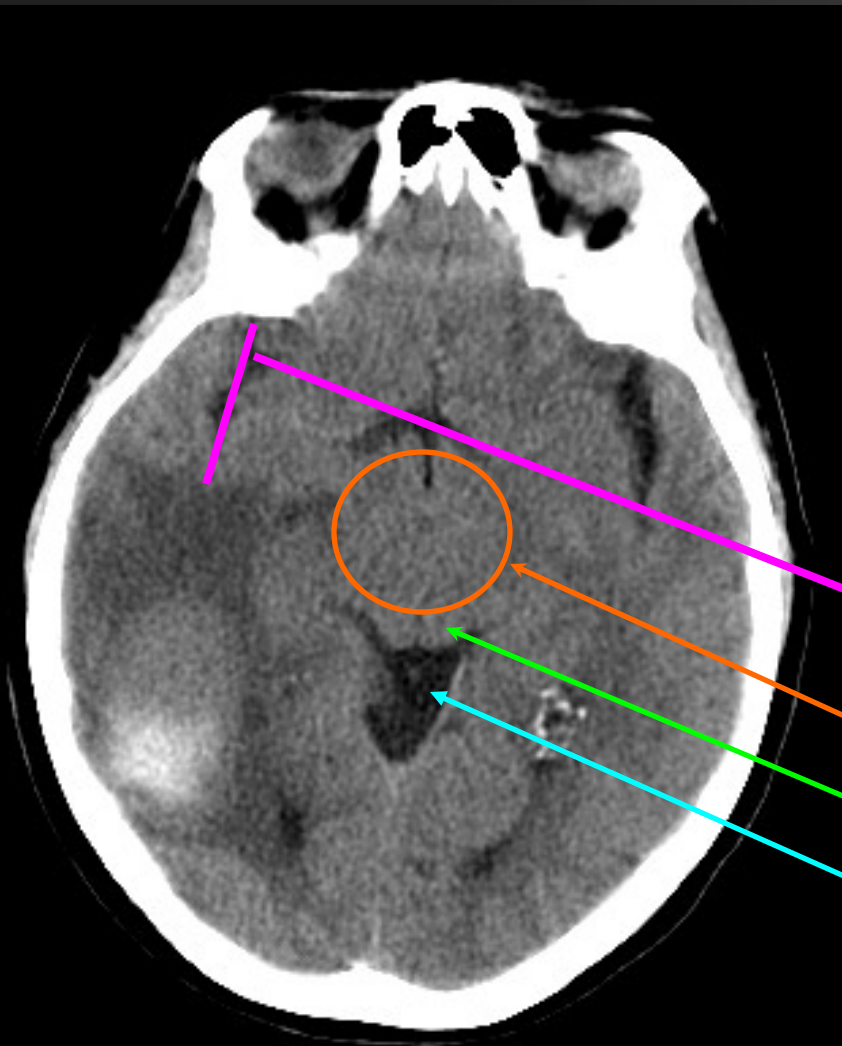
# GB: Non-Contrast Head CT



- High attenuation region on NCHCT = Blood!
- Note the hemorrhage within a larger low attenuation region – blood in a less dense region
- Where precisely is the lesion? Let's quickly review some neuroanatomy...



# Head CT: Neuroanatomy



- Tempting to localize the hemorrhage to the parietal lobe (since that's where the HPI & neuro exams point)
- But superior colliculi & thalamus tell us we're more inferior.
- Note the Sylvian fissure
- *Location? Right Temporal Lobe*

Sylvian Fissure

Thalamus

Superior colliculus

Quadrigeminal cistern



# GB's Intracranial hemorrhage: DDx



- GB has hemorrhage within a larger low attenuation region.
- What is the low attenuation region?
- It is less dense than surrounding brain tissue. Could be...
  - Edema
  - Area of infarcted brain
  - A mass
- But what's causing the hemorrhage?

Source: PACS, BIDMC



# GB's Hemorrhage: DDx



- Intracerebral Hemorrhage:
  - HTN
  - Trauma
  - Amyloid Angiopathy
  - Vascular Malformation
  - Conversion of Infarct
  - Bleeding Tumor
  - Coagulopathies
  - Drugs (e.g. cocaine)

Source: PACS, BIDMC

***Now, we narrow our radiology DDx by patient history & other findings...***



# GB's Intracranial hemorrhage: DDx



## ■ Intracerebral Hemorrhage:

- HTN
- ~~■ Trauma~~
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- Vascular Malformation
- Conversion of Infarct
- Bleeding Tumor
- Coagulopathies
- ~~■ Drugs (e.g. cocaine)~~

Source: PACS, BIDMC

*No history of trauma or drug use...*





# GB's Intracranial hemorrhage: DDx



## ■ Intracerebral Hemorrhage:

- HTN
- ~~■ Trauma~~
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Source: PACS, BIDMC

***PTT, PT, and platelet count all normal.***



# GB's Intracranial hemorrhage: DDx



## ■ Intracerebral Hemorrhage:

- ~~HTN~~
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- Vascular Malformation
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- ~~Drugs (e.g. cocaine)~~

Source: PACS, BIDMC

***GB has no history of HTN; + this isn't the right location for a hypertensive bleed (putamen, thalamus, pons).***



# GB's Intracranial hemorrhage: DDx

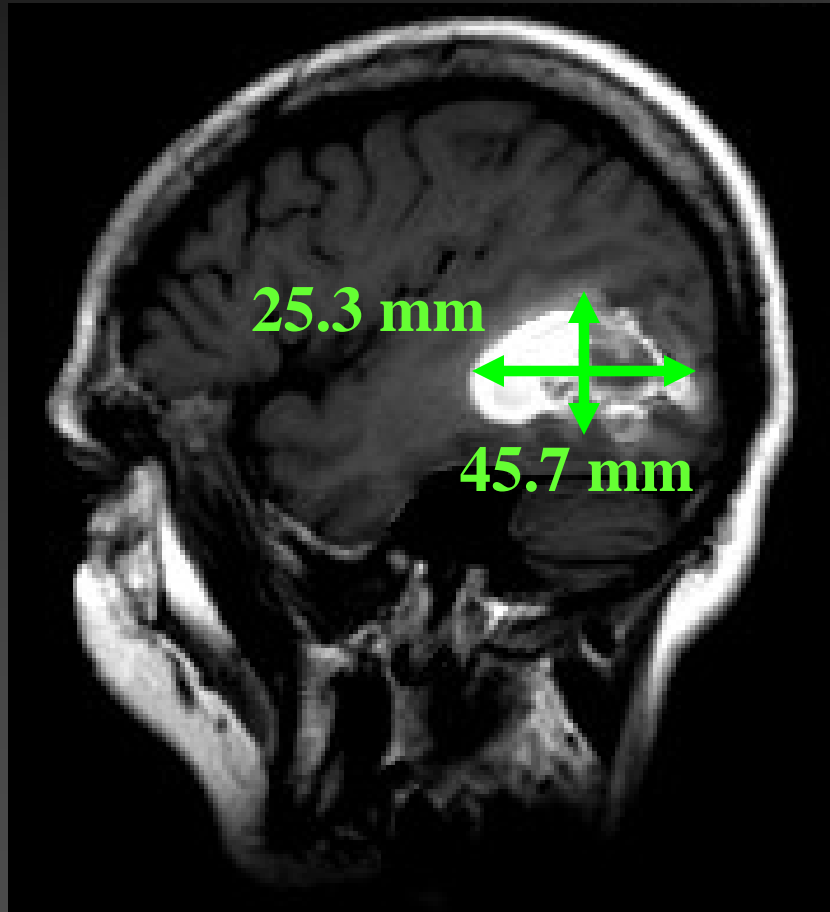
- History & labs helped somewhat...
- But we need additional imaging to evaluate:
  - Ischemic stroke w/ hemorrhagic conversion
  - AVM or ruptured aneurysm
  - Bleeding tumor
  - Previous bleeds (amyloid angiopathy)

## NEXT STUDY?

- Head & Neck MRI/MRA provides information on each of these possibilities



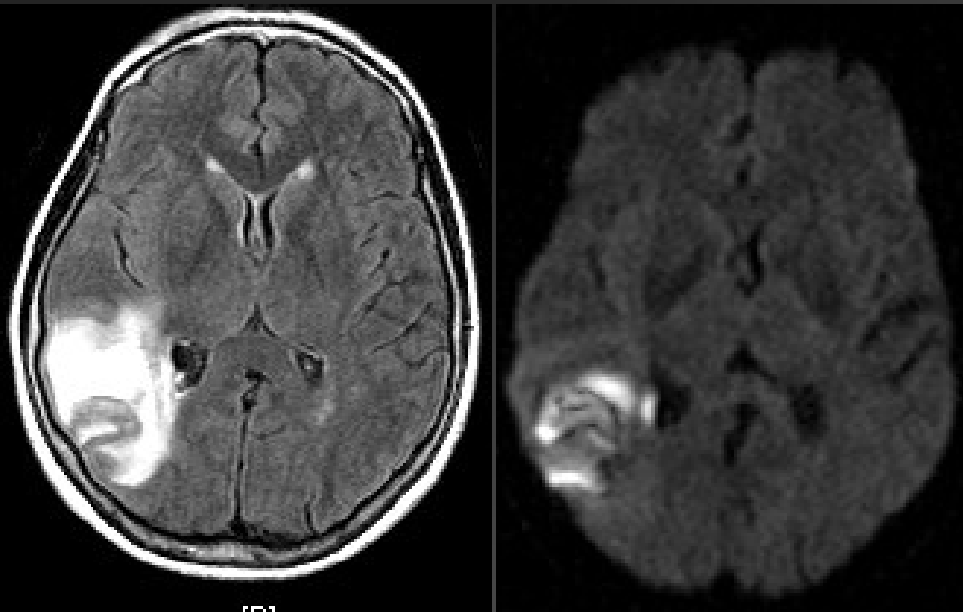
# GB: T1-Weighted Sagittal MRI



- A high-signal lesion in the posterior of the R temporal lobe, with an inner low-signal region.
- The lesion is roughly 4.5 x 2.5 cm in this plane; 3 cm wide on axial.



# GB: Is it a Stroke?



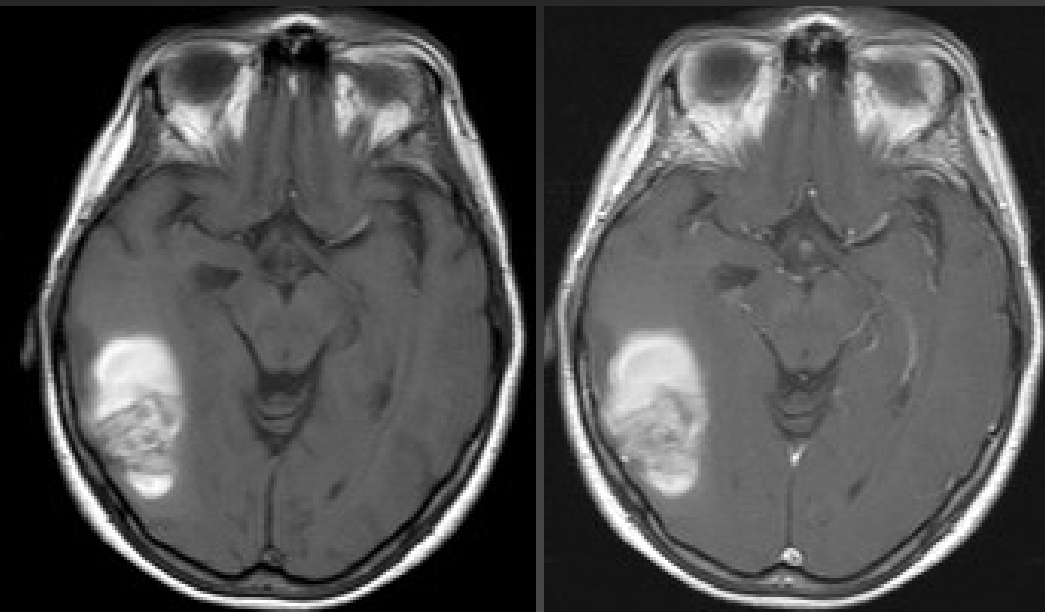
FLAIR

DWI

- At first, high signal on DWI (reduced diffusion) seems consistent with ischemic stroke.
- But hemorrhage interferes with DWI signal. Also, there is no reduced diffusion in the surrounding edema.
- MRA showed no stenosis in head or neck, carotid US was clear, and echo ruled out cardiac emboli.



# GB: T1 Pre & Post Contrast



Pre-contrast

Post-contrast

- They look almost identical...
  - Interpretation:  
*A high-signal non-contrast-enhancing lesion*
- Importantly, no evidence of midline shift



# Our DDx, revisited:

- Intracerebral Hemorrhage:
  - ~~HTN~~
  - ~~Trauma~~
  - Amyloid Angiopathy
  - Vascular Malformation
  - Conversion of Infarct
  - Bleeding Tumor
  - ~~Coagulopathies~~
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# Our DDx, revisited:

## ■ Intracerebral Hemorrhage:

- ~~HTN~~
- ~~Trauma~~
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*No signs of previous lobar hemorrhages (amyloid angiopathy), no evidence of ischemic stroke.*





# Our DDx, revisited:

## ■ Intracerebral Hemorrhage:

- ~~HTN~~
- ~~Trauma~~
- ~~Amyloid Angiopathy~~
- Vascular Malformation
- ~~Conversion of Infarct~~
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*We're left with two main possibilities: a vascular malformation (AVM or aneurysm), and a bleeding tumor.*



# Our DDx, revisited:

- We already have MRA showing no vascular malformations, but cerebral angiography is the gold standard.
  - Angiogram showed no abnormalities
- This leaves a hemorrhaging brain tumor as the presumed diagnosis.



# Work-Up for a Brain Tumor

- Tumors in the brain:
  - >80% metastatic; <20% primary brain tumors
- For solitary brain lesion, in order to rule out metastasis we look elsewhere for the primary:
  - Chest X-Ray (lung is primary in ~50%)
  - Mammogram (breast is primary in 15-20%)
  - Abdominal CT (renal & colon ~5-10% each)
  - Skin Exam (melanoma ~5-10%)
  - 10% - primary never found



# GB's Work-Up

- CXR and Chest+Abdominal+Pelvic CT were all negative
- GB had a negative bone scan
  - Probably an unnecessary study, since bone primaries to brain are highly unlikely
- GB had a normal mammogram from earlier in the year
- Skin exam unremarkable



# GB's Diagnosis?

- No radiologic evidence that GB's brain lesion is a metastasis
- GB went to surgery for resection of a presumed hemorrhagic primary brain tumor
  - Pathology showed hemorrhagic necrosis of uncertain etiology...
- So, GB still has no diagnosis - but presumed to be a hemorrhaging glioma missed on biopsy



# Astrocytomas: Overview

- So let's review some of the basic pathology and typical radiological images for GB's presumed diagnosis...
- Most common type of glioma?  
Astrocytomas...



# Astrocytomas: Overview

- Most common primary brain tumor (> 50%)
- Low Grade – also called ‘pilocytic’ (Grade I) & ‘fibrillary’ (Grade II)
  - Survival – highly variable... Can be decades
- High Grade – either ‘anaplastic’ (Grade III) or ‘glioblastoma multiforme’ (GBM = Grade IV)
  - Median Survival (Grade III) – 3 years
  - Median Survival (Grade IV) – 1 year

*For any suspected brain tumor, the imaging modality of choice is MRI with gadolinium*

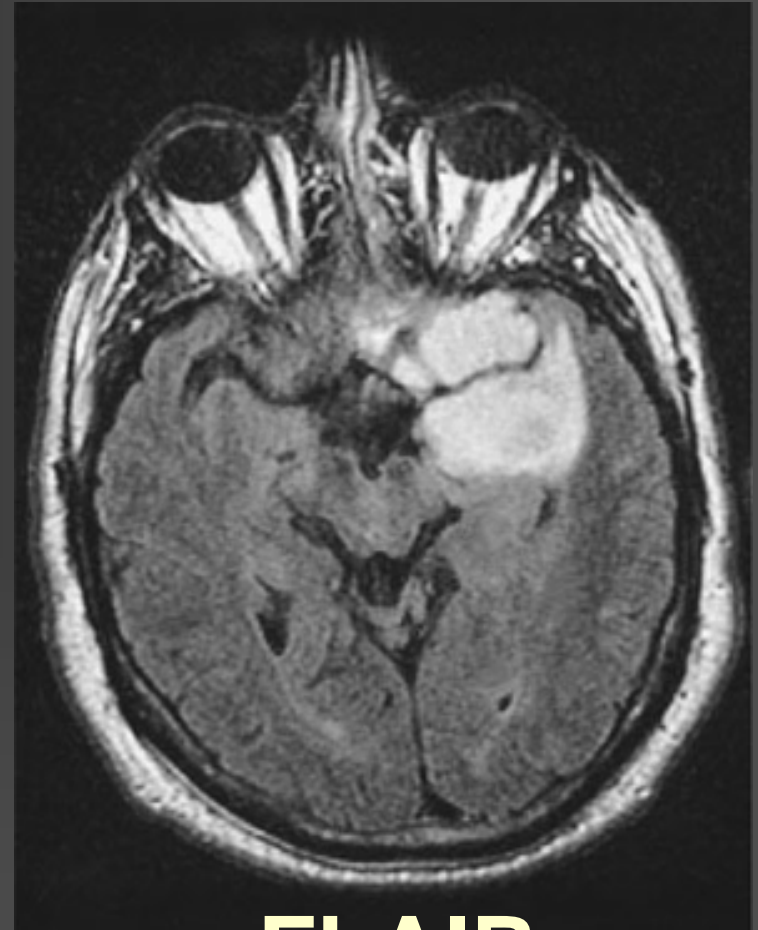


# Patient #2: Low-Grade Astrocytoma

- *Non-enhancing* low-signal mass on T1
- A high-signal lesion on T2 / FLAIR, typically without pronounced mass effect

Example FLAIR Image →

- High signal mass in L fronto-temporal lobe.



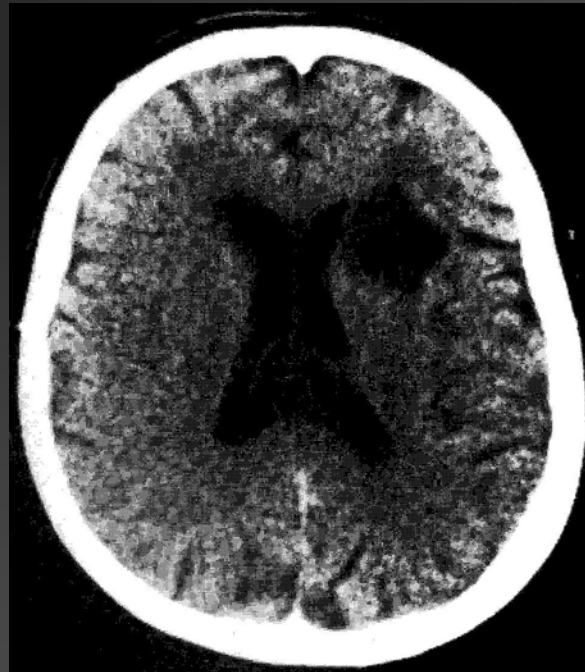
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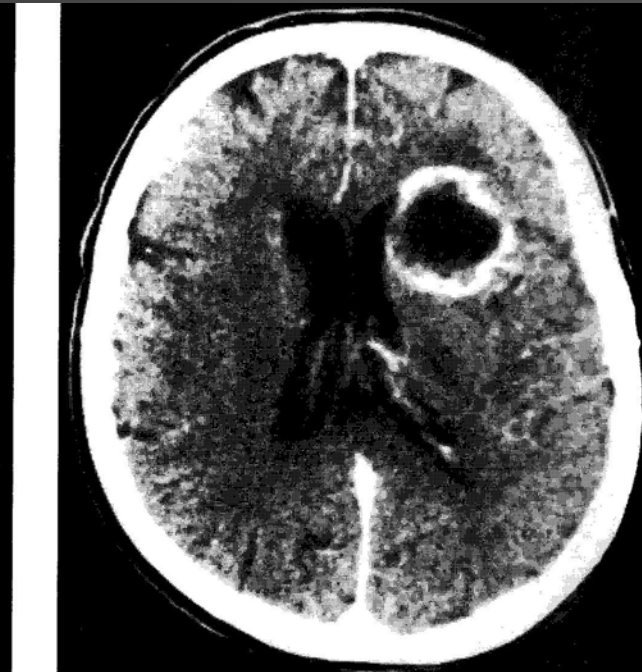


# Patient #3: High-Grade Astrocytoma (GBM)

- Low-signal lesion on T1
- Classic 'ring-enhancing' pattern with contrast
- Usually produces significant edema
- Non-enhancing regions are typically necrotic



T1 pre-contrast



T1 post-contrast

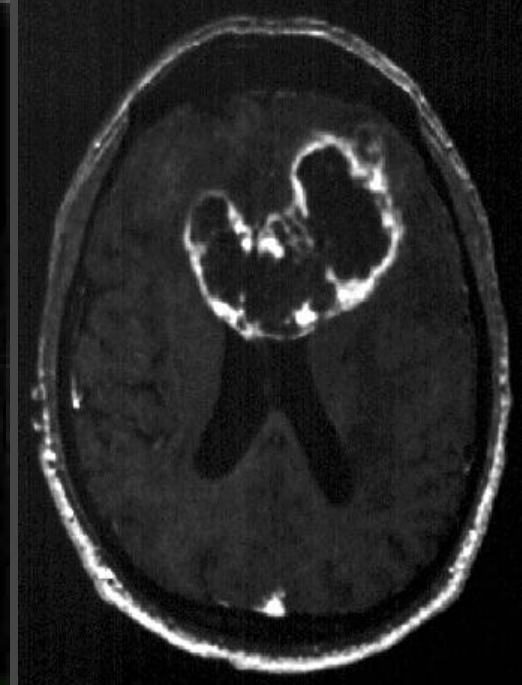


# More Glioblastoma Multiforme

- Can be a heterogeneous enhancing lesion without the classic ring
- Can cross the corpus callosum: “butterfly lesions”
- Why didn't GB's presumed tumor enhance?
  - It was already filled with blood.



Patient #4



Patient #5

*Both images are T1 post-contrast*



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# Patient #5: Glioblastoma?

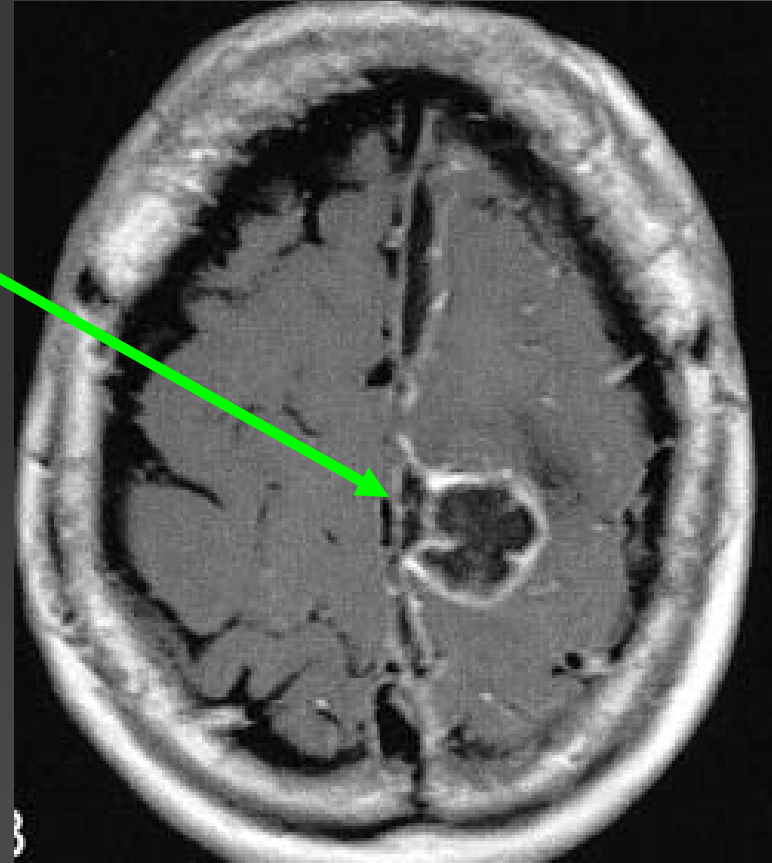


T1 post-Contrast MRI



# Glioblastoma Look-Alikes

- Brain Abscess
  - HPI = infectious
  - Thin, well-demarcated ring
  - Often other abscesses on CXR
- Brain Metastasis
  - Can look identical to GBM
  - Look for the primary!
- Others...
  - Primary CNS Lymphoma
  - Toxoplasmosis



T1 post-Contrast MRI



# Summary: Neuroimaging Work-up

- Acute Neuro Process: 1<sup>st</sup> Study in ED
  - Non-Contrast Head CT – Look for Blood
- Tumor Evaluation: MRI with gadolinium contrast – look for enhancement on T1
- Brain Tumor DDx: Primary vs. Metastasis
  - Look for the Primary



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