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...

Source: PACS, BIDMC
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
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?
GB’s Hemorrhage: DDx

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

Now, we narrow our radiology DDx by patient history & other findings…
GB’s Intracranial hemorrhage: DDx

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No history of trauma or drug use…
GB’s Intracranial hemorrhage: DDx

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PTT, PT, and platelet count all normal.
GB’s Intracranial hemorrhage: DDx

**Intracerebral Hemorrhage:**
- HTN
- Trauma
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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
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.

Source: PACS, BIDMC
GB: Is it a Stroke?

- 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.

Source: PACS, BIDMC
They look almost identical…

- Interpretation: A high-signal non-contrast-enhancing lesion

Importantly, no evidence of midline shift

Source: PACS, BIDMC
Our DDx, revisited:

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Our DDx, revisited:

- Intracerebral Hemorrhage:
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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
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  - Bleeding Tumor
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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
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.

Source: DeAngelis LM. Brain tumors. *NEJM* 2001; 344:114-123.
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

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.


Both images are T1 post-contrast
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

Summary: Neuroimaging Work-up

- **Acute Neuro Process:** 1st 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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References