Intro to MRI for Neurology

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Stroke Center

MRI

- Uses magnetic field and radio-frequency of water and fat hydrogen protons
- Does not use radiation
- Multiplanar
- Imaging depends on intrinsic signal of tissue - Multimodal

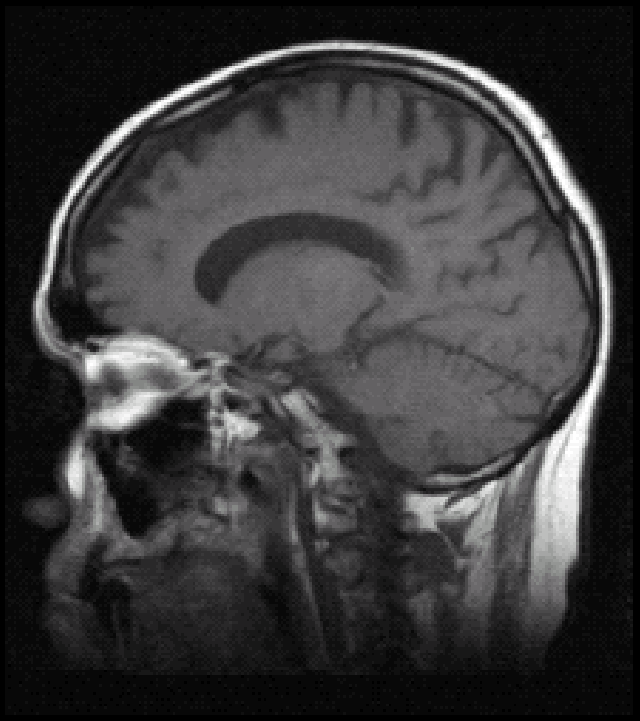
- Dark on all sequences:
  - Air, dense bone, metal

- Terms –
  - Hyperintense (bright)
  - Hypointense (dark)

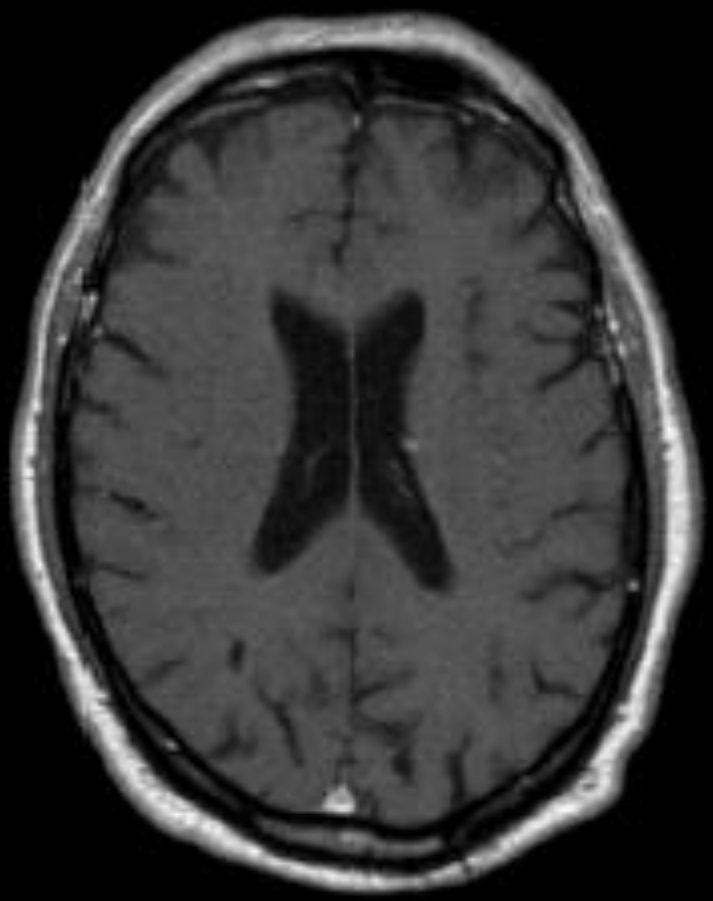
Transverse
("Axial")

Coronal

Sagittal



T1-Weighted Image



Dark on T1

(Low signal)

- Air
- Calcium

Gray on T1 (long T1)

- Edema
- Most lesions
- Brain

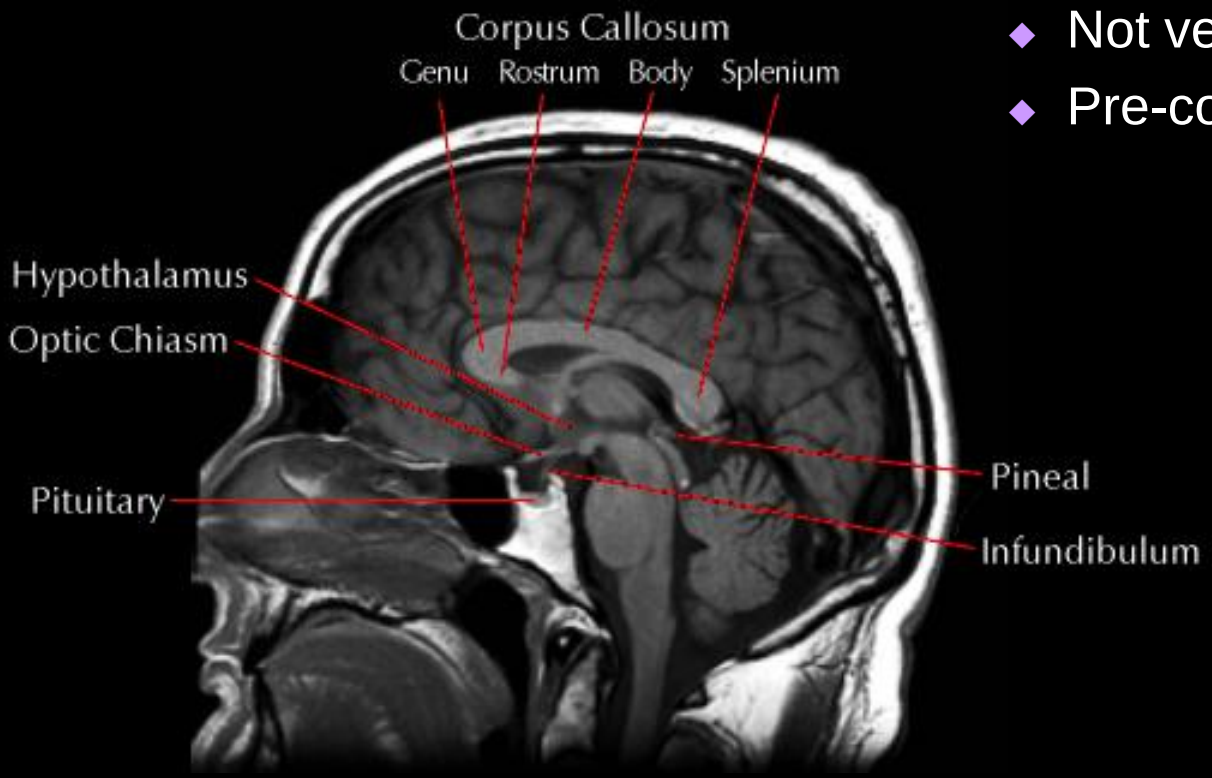
- CSF

Bright on T1

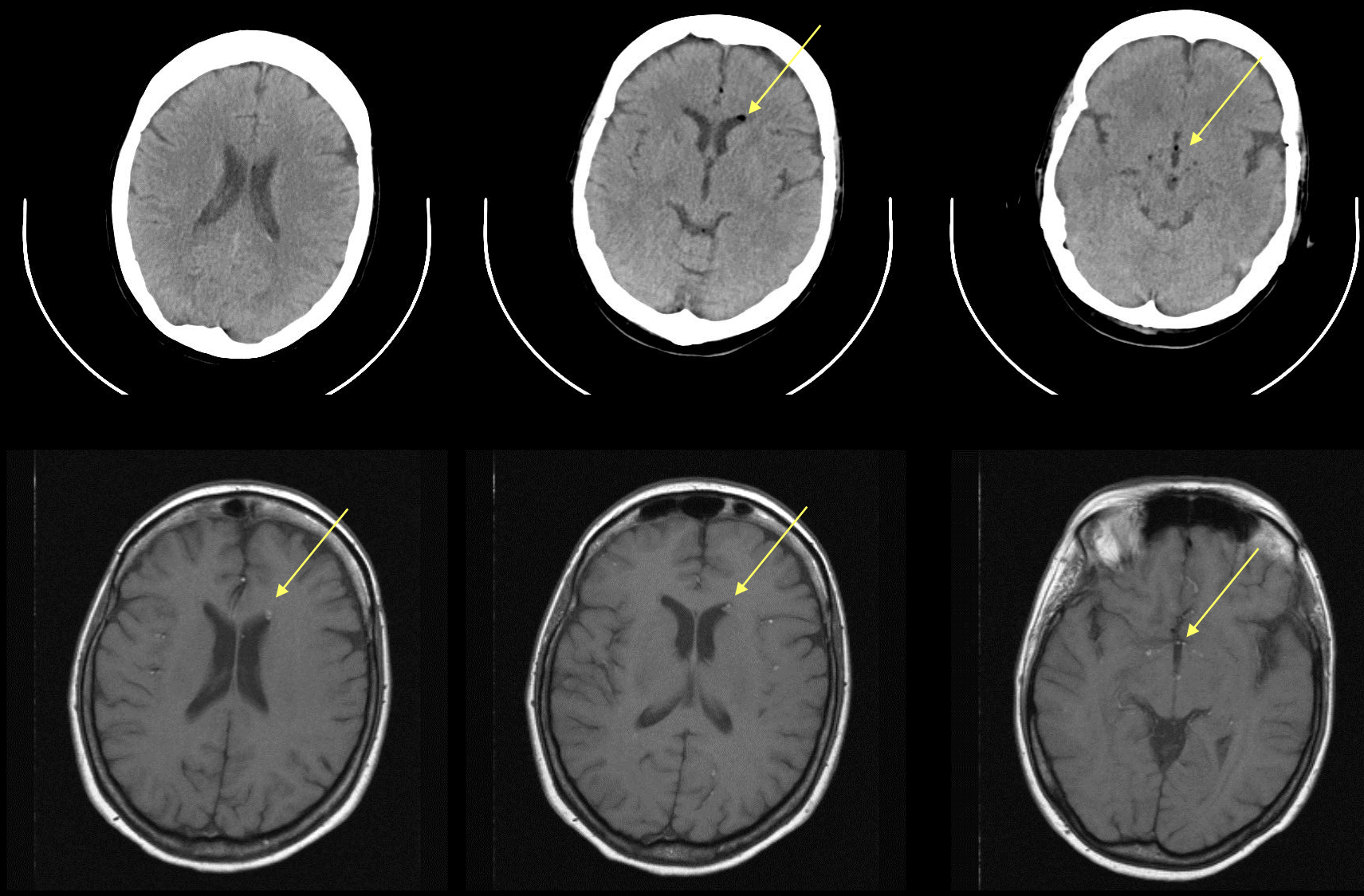
(High signal, short T1)

- Blood (sometimes)
- Fat
- Gadolinium (Gd contrast)

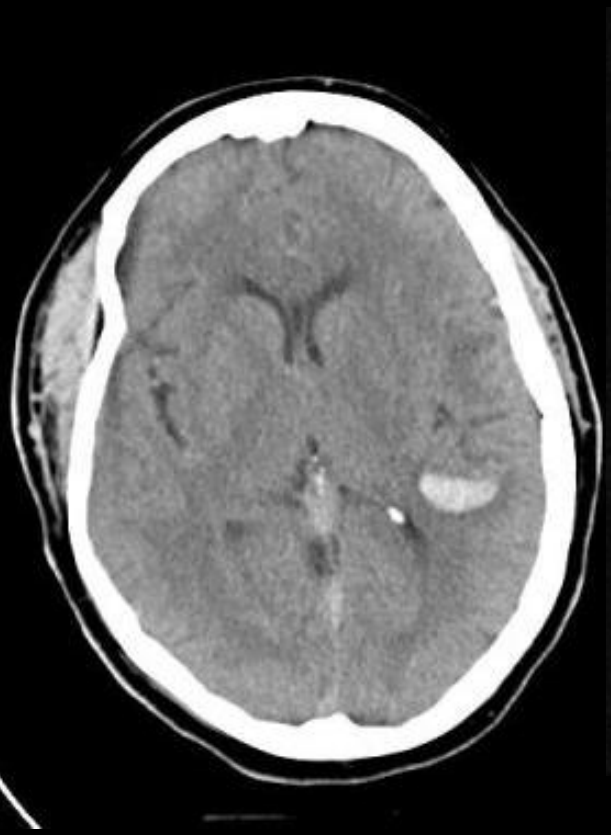
T1-Weighted Image



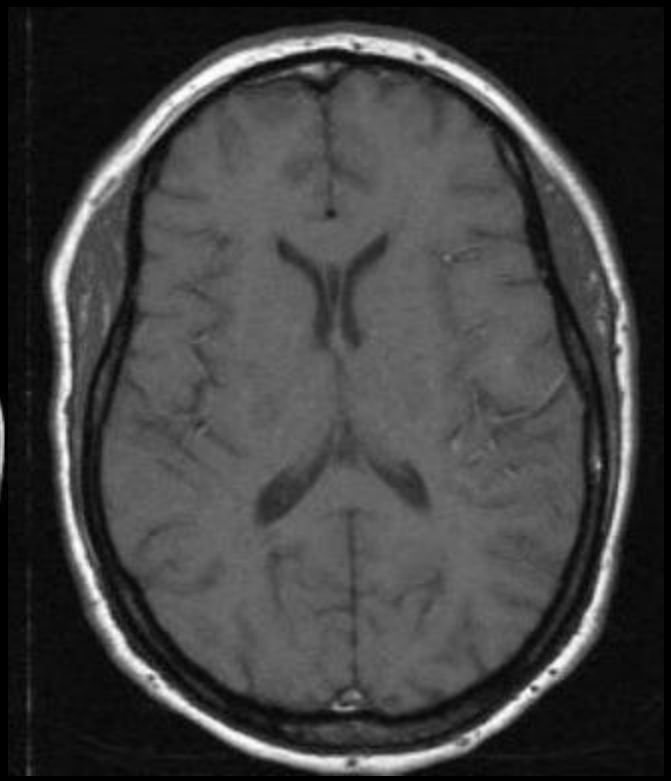
- Purposes
  - Useful for anatomy
  - Not very sensitive to lesions
  - Pre-contrast image



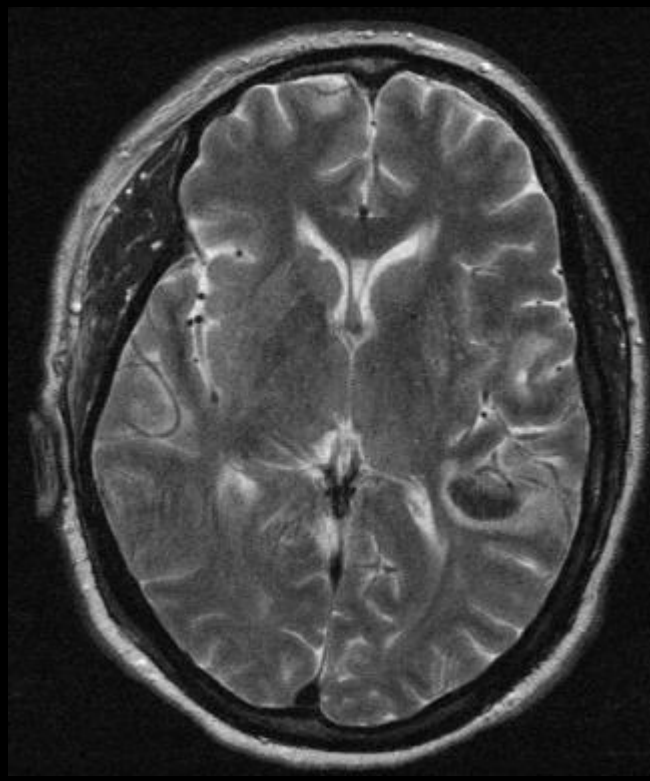
T1-Weighted Image - hemorrhage



CT (day 1)



T1 (day 2)

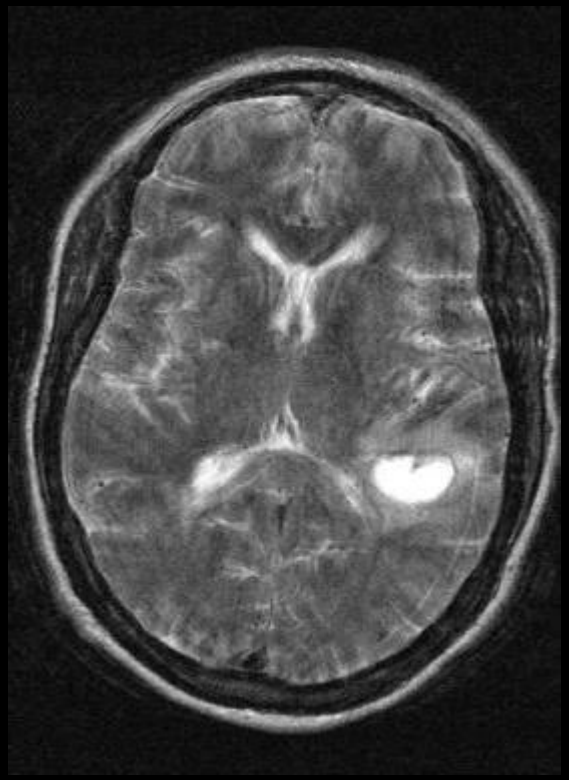


T2 (day 2)

T1-Weighted Image - hemorrhage

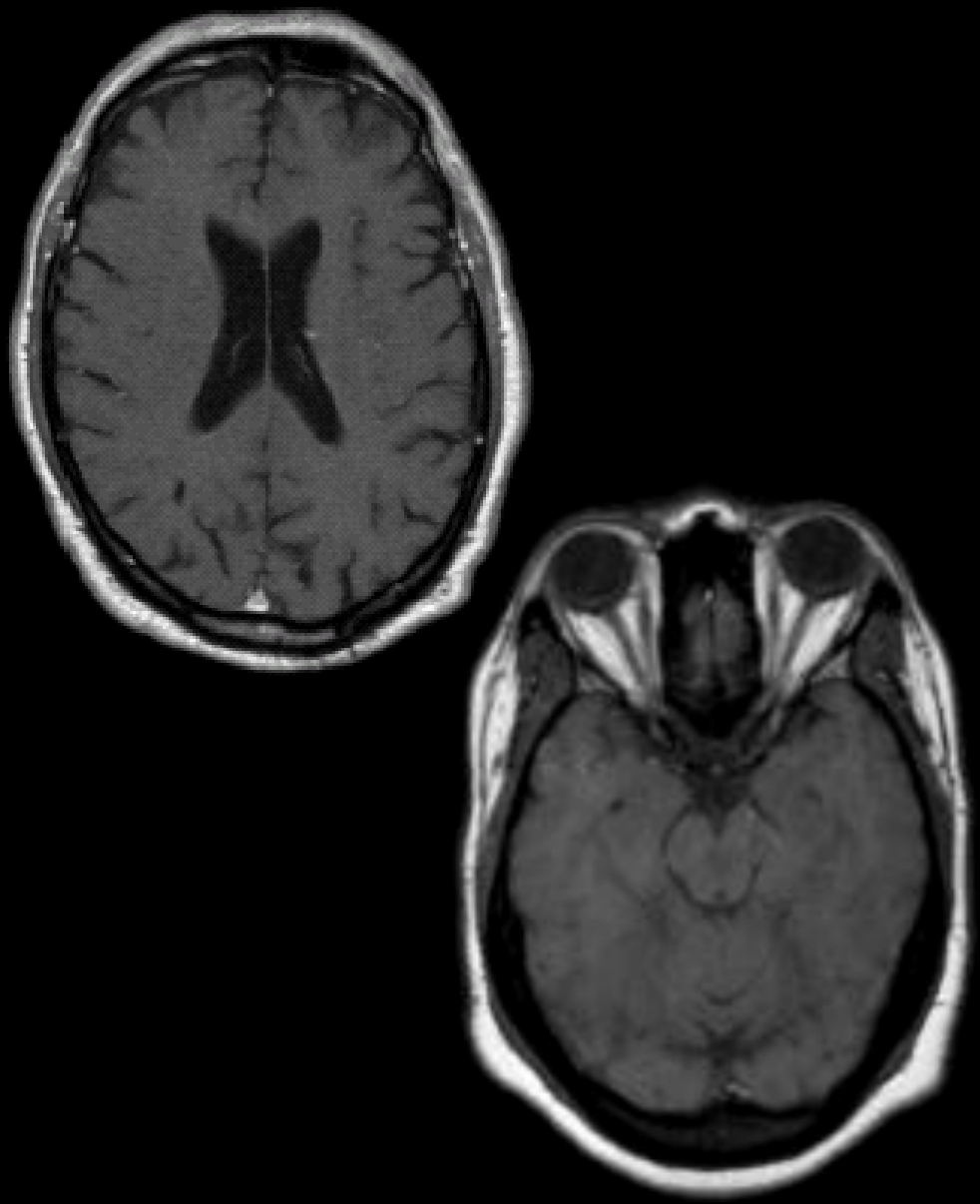
CT (day 16)

T1 (day 20)



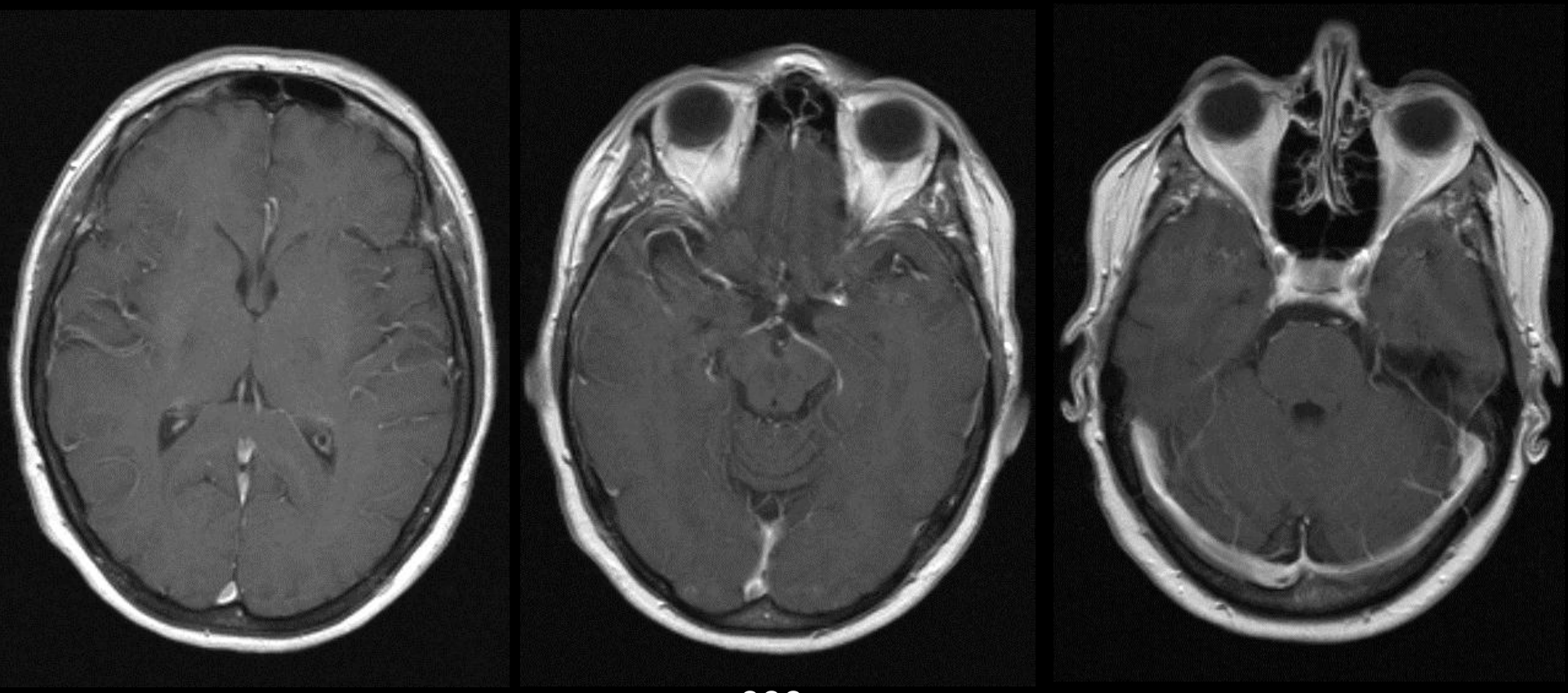
T2 (day 20)

T1 Image – Recognition



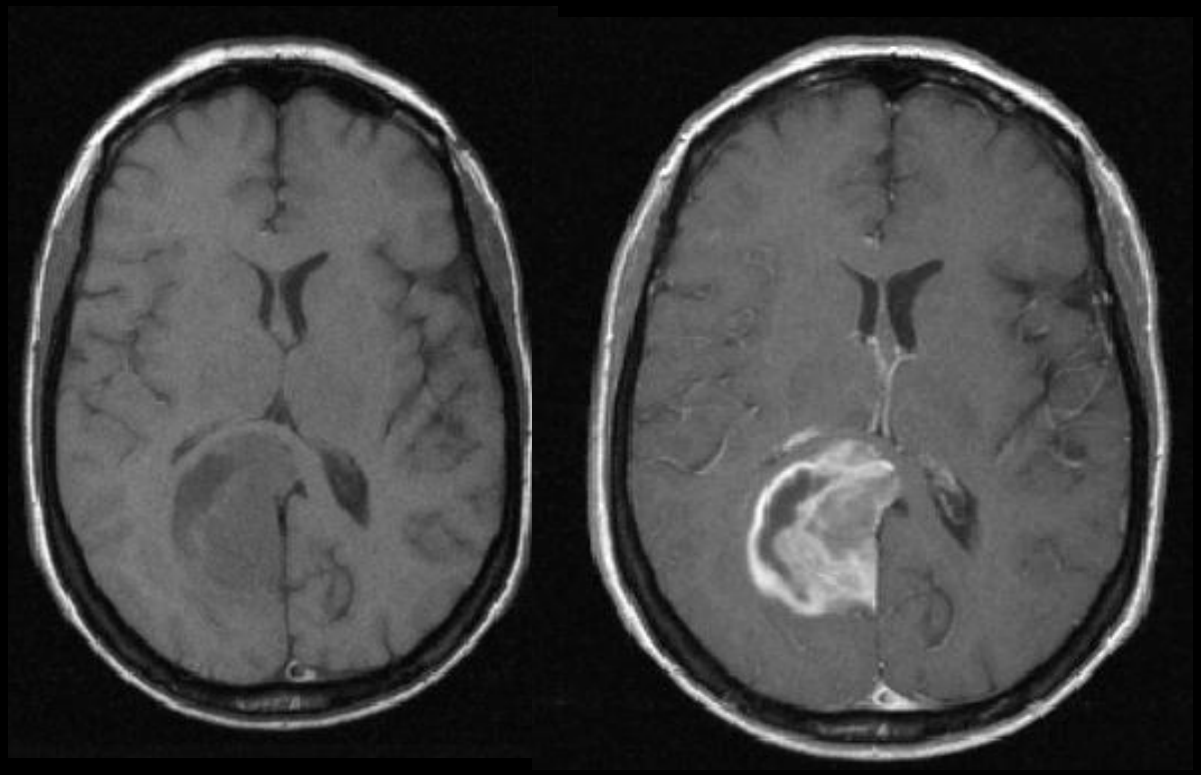
- Multiple orientations
- Looks like CT
- CSF black
- Cranium bright
- Orbits bright / globe black
- Distinguish from T1 with contrast (Gd)

T1-Weighted Image with Contrast



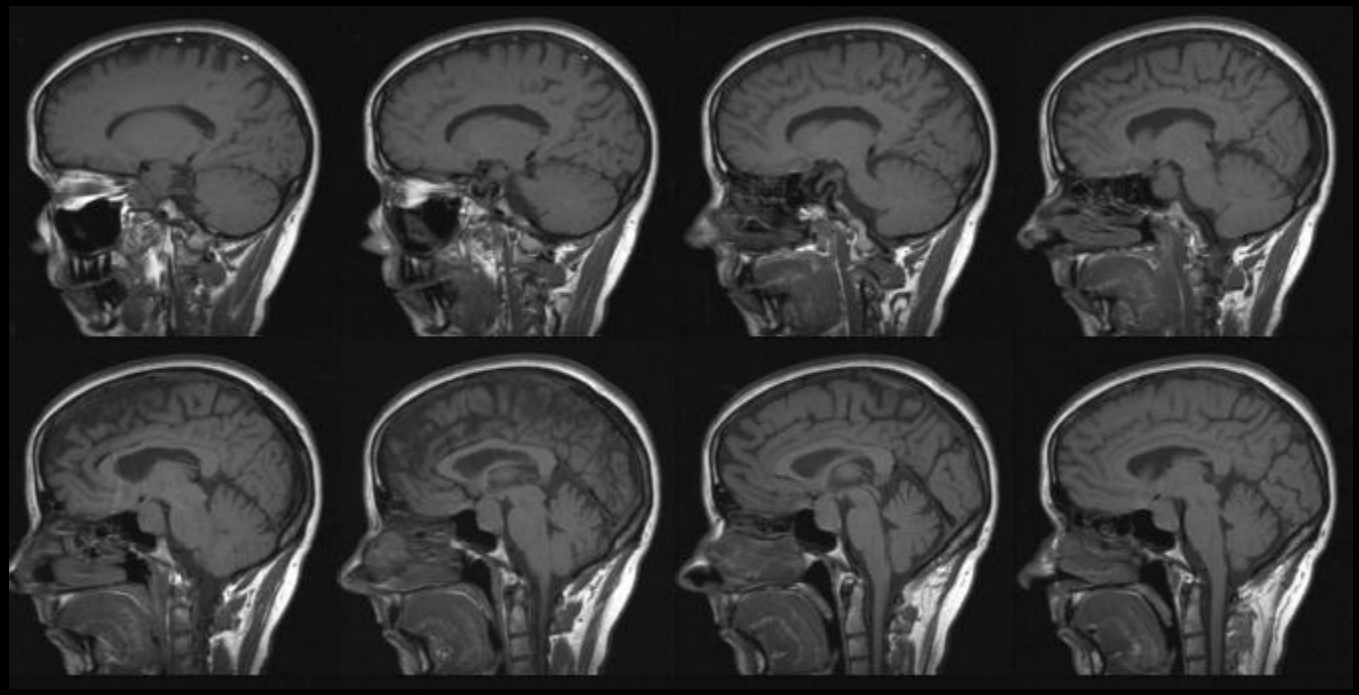
666

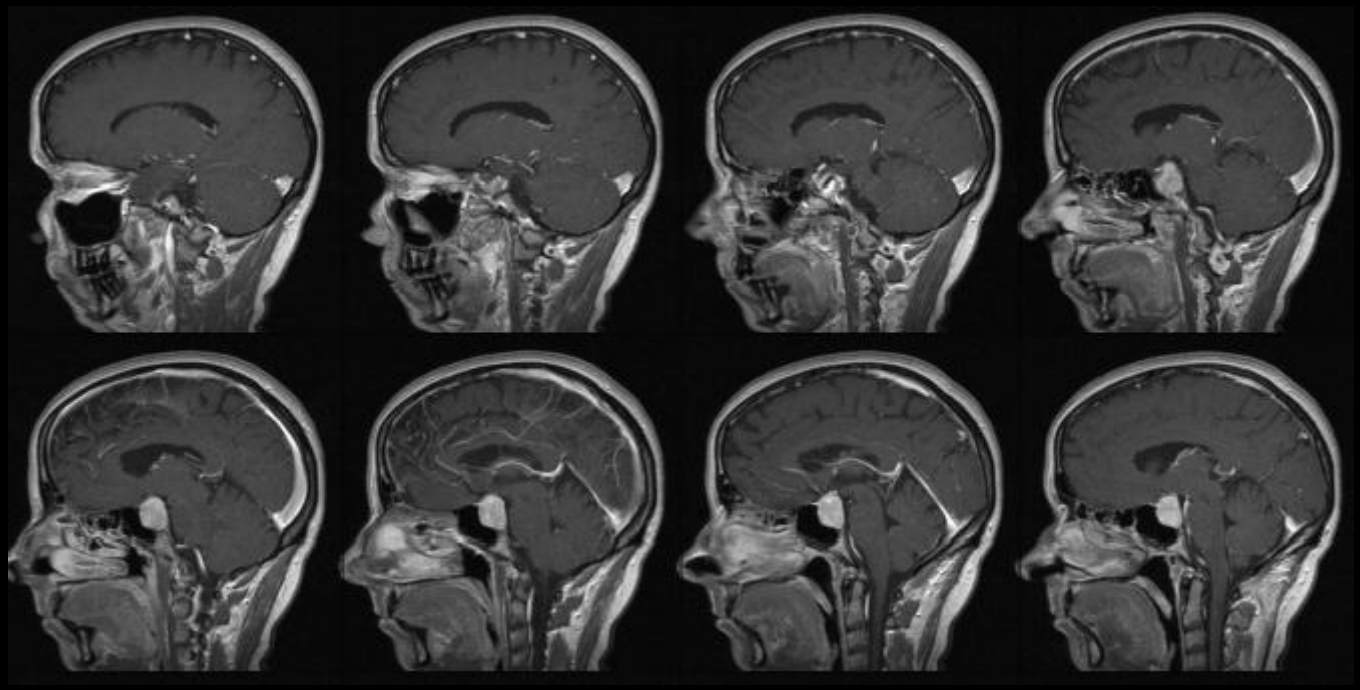
T1-Weighted Image with Contrast

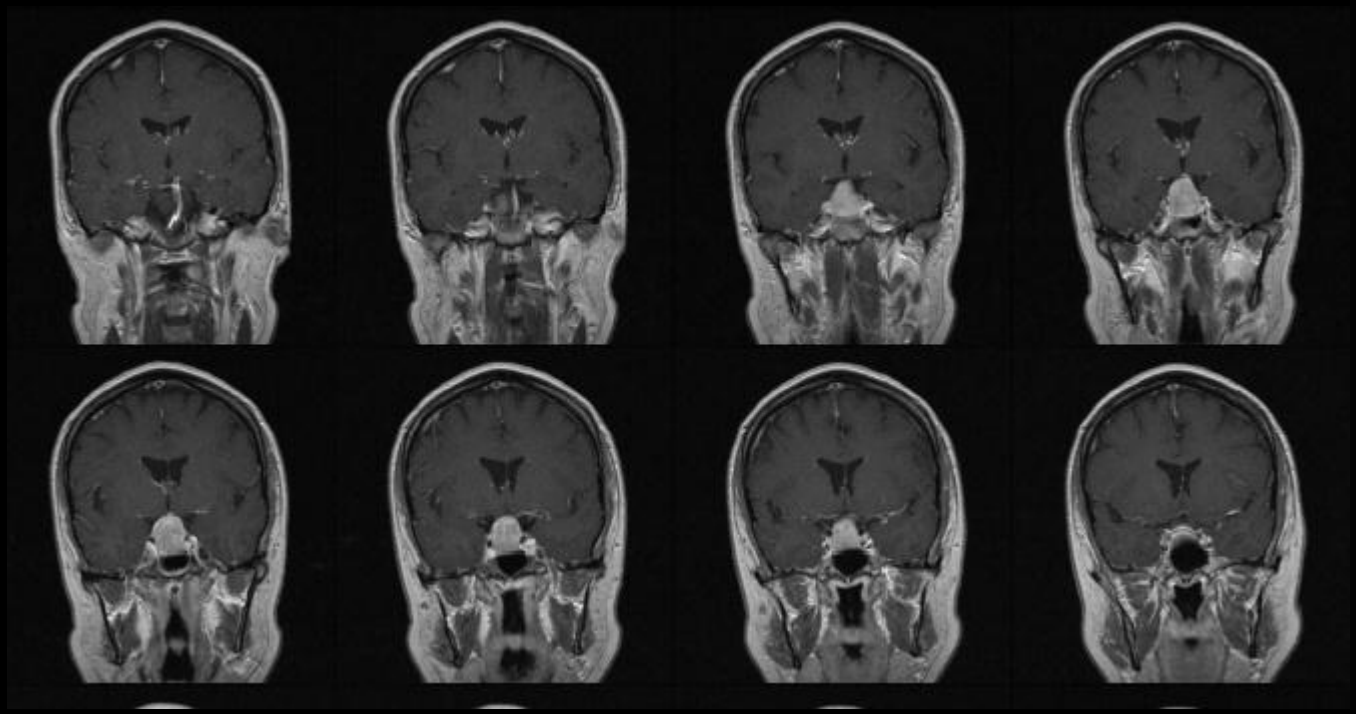


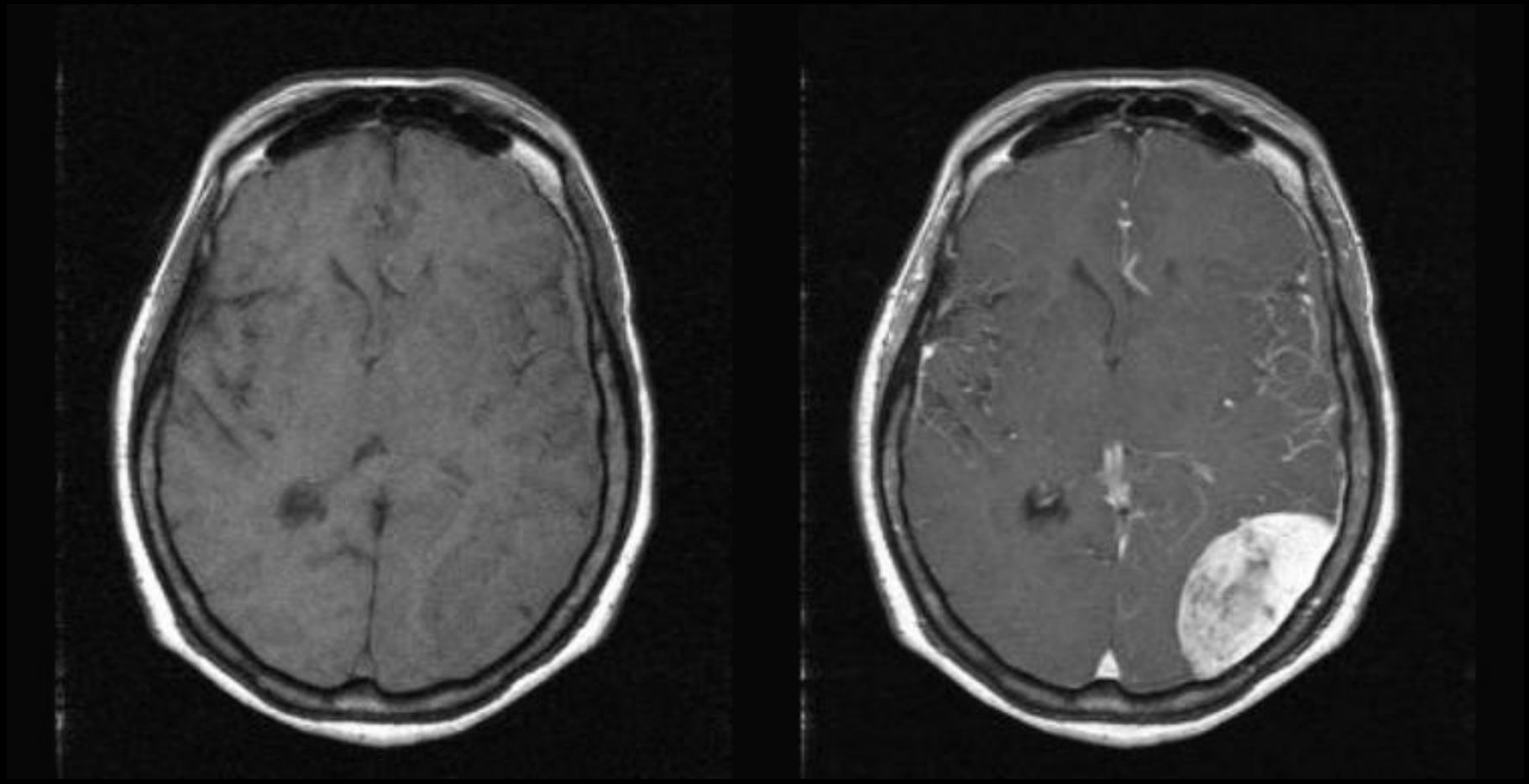
Visualization of Blood Vessels

Enhancement of lesions with BBB breakdown, esp. tumors



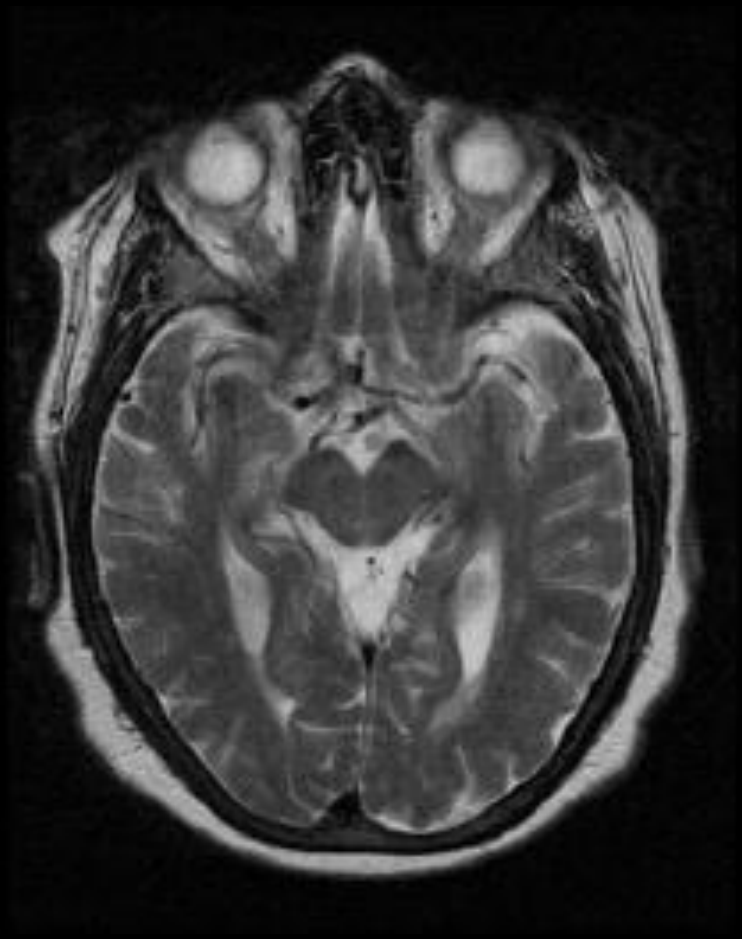






1570

T2-Weighted Image



Black on T2
(Low proton signal)

- Bone
- Calcium
- Air
- Flow

Grey on T2
(Short T2)

- Brain
- Fat

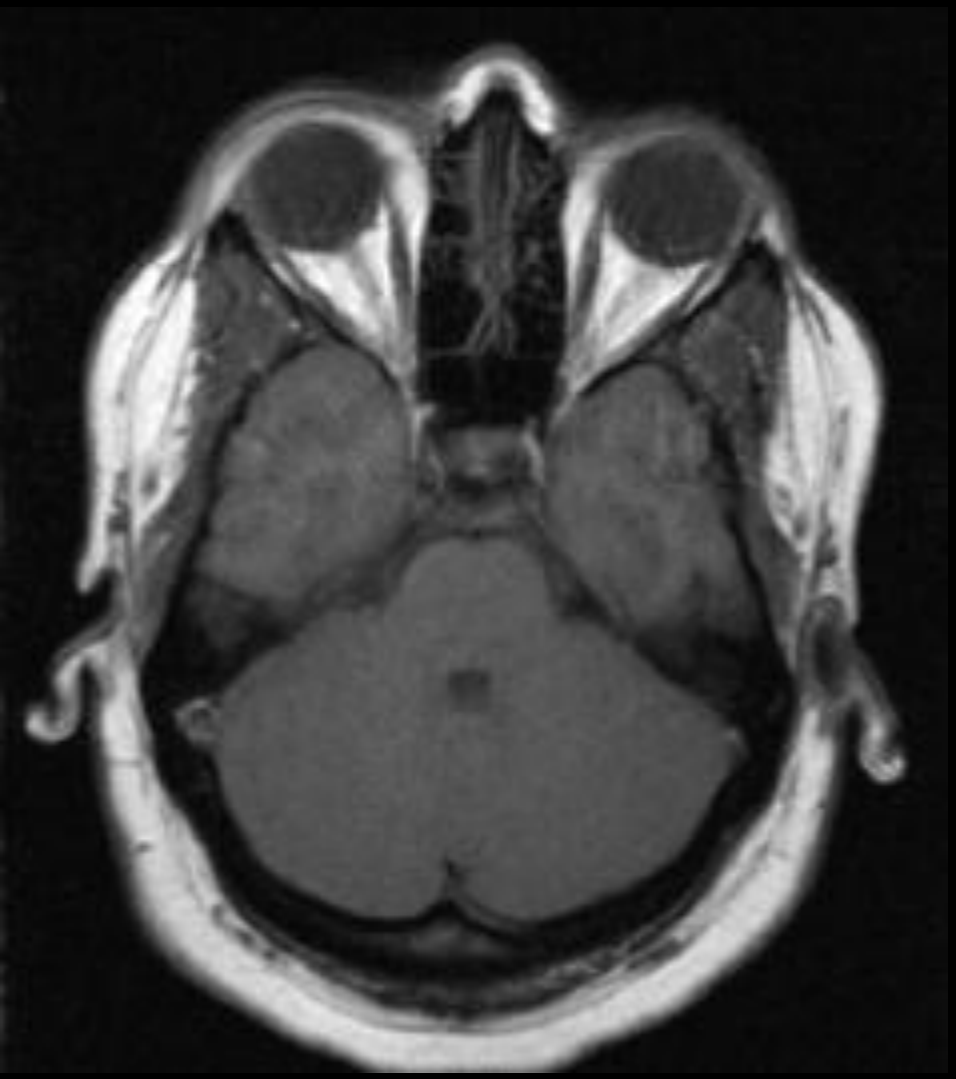
Bright on T2
(Long T2 – footnote 1)

- Edema
- Most lesions
- CSF

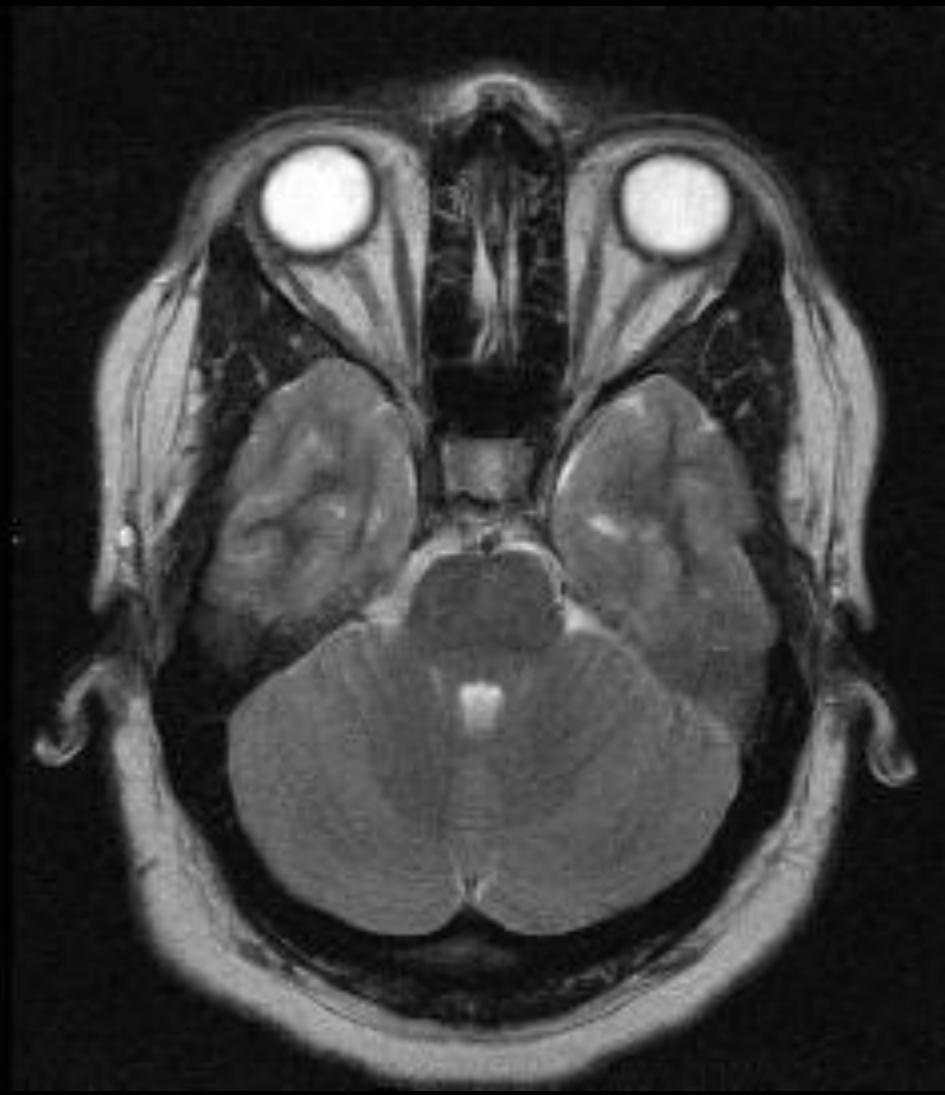
T2-Weighted Image

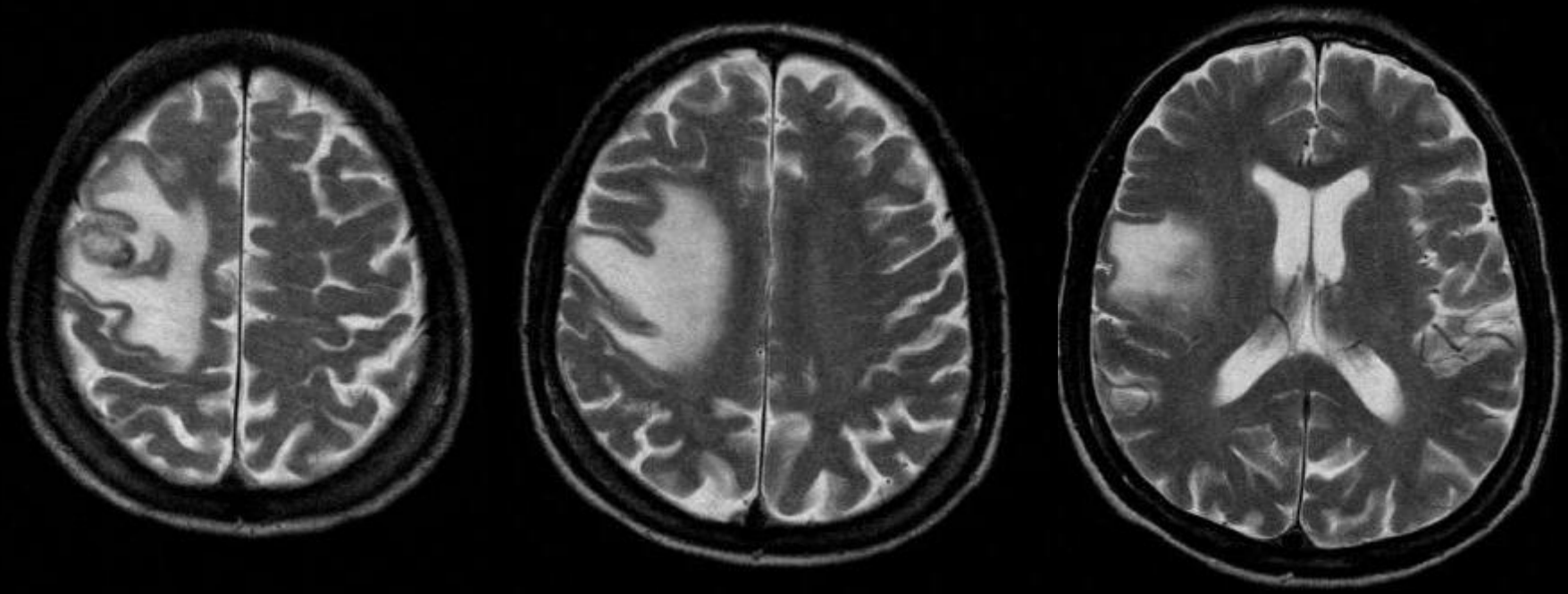
- Purposes
  - Pathologic evaluation
  - Very sensitive for edema
  - Can’t distinguish CSF
- Recognition
  - CSF / sulci - bright
  - Cranium, fat - bright
  - Eyes - bright
  - Brain tissue - neutral gray
  - Abnormal tissue - bright
- Appearance of Blood
  - Hyperacute - bright
  - Acute - very dark
  - Subacute - bright
  - Chronic - dark

T1-Weighted Image

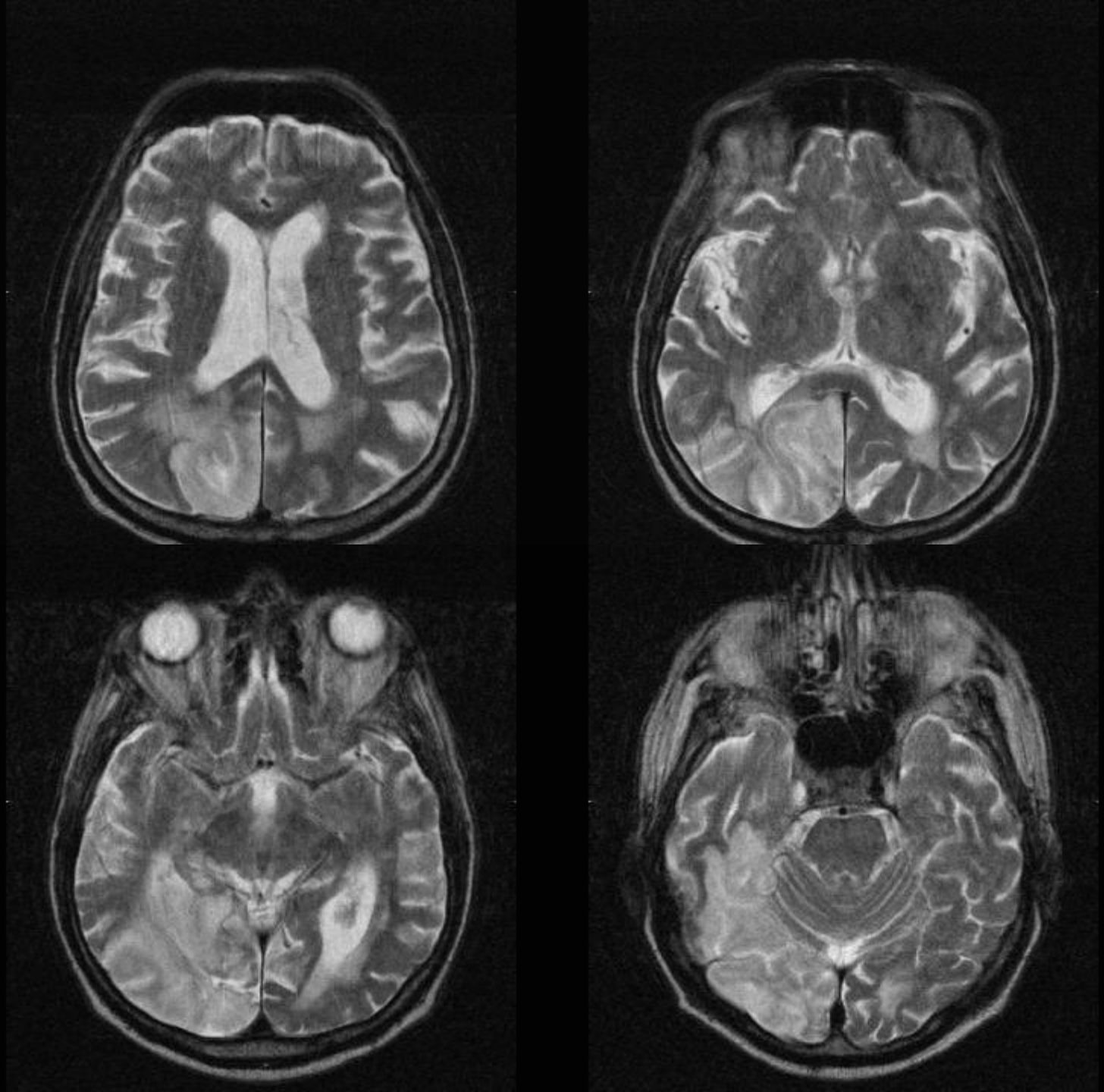


T2-Weighted Image



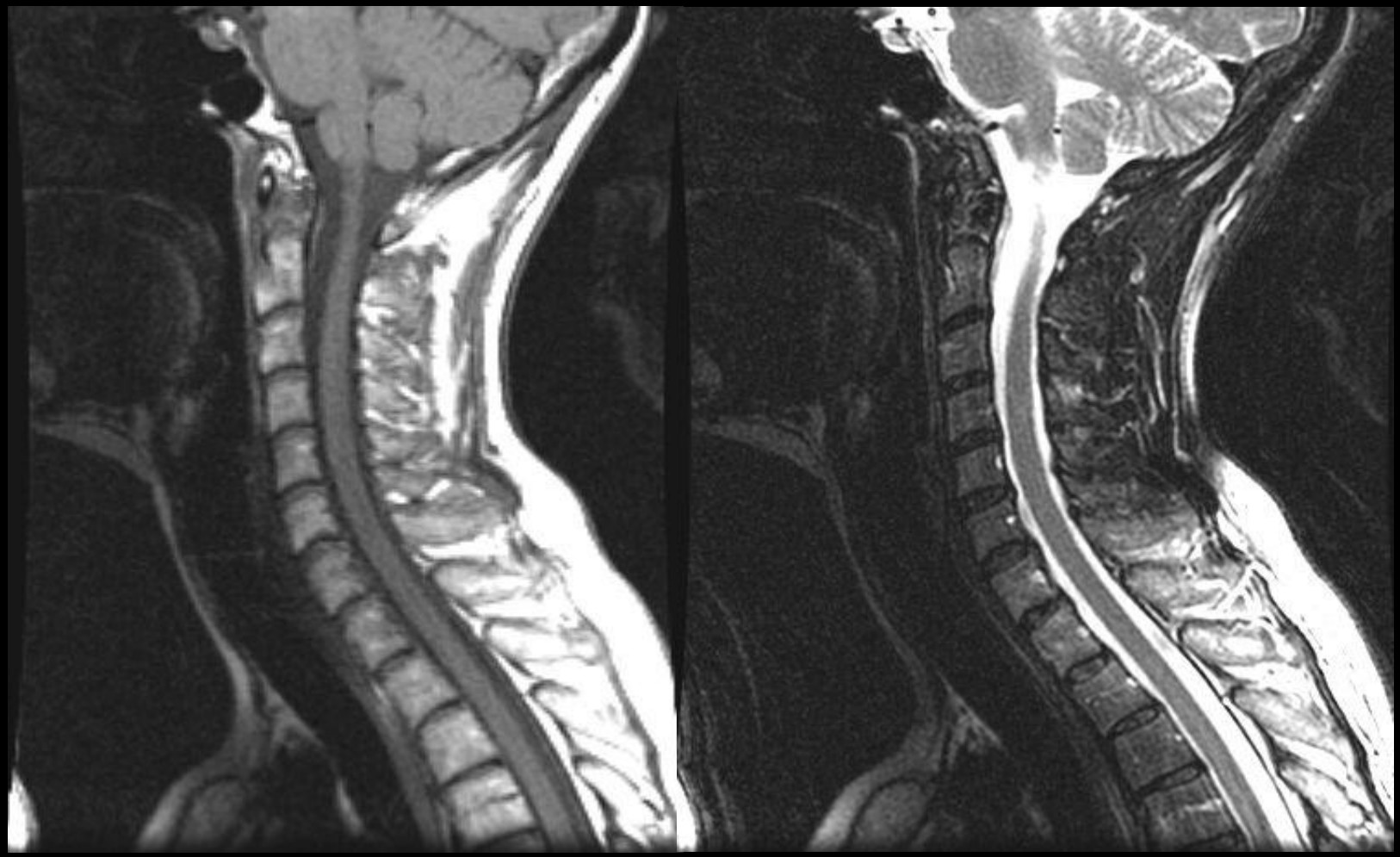


Ghostoid appearance
Rebecca Chancey sez
Northern Lights – J. Sanchez



11783

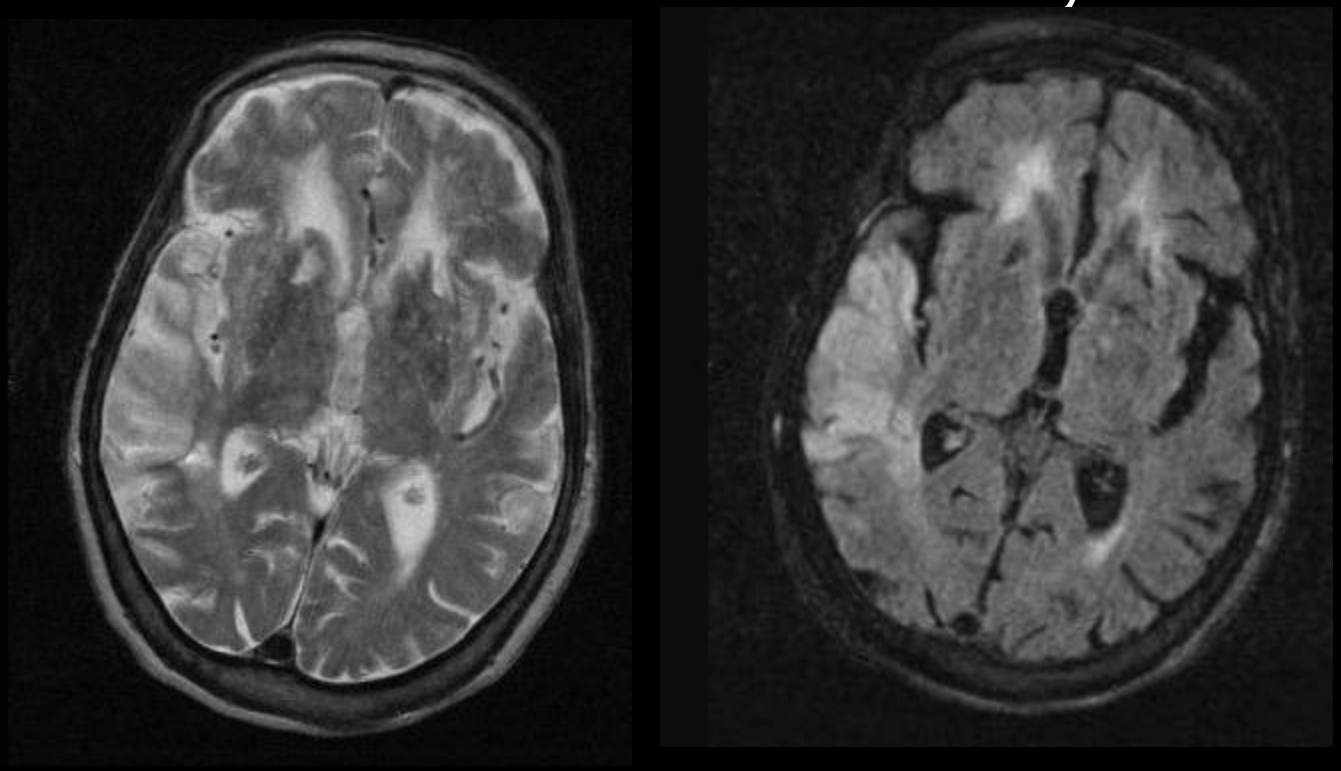
C-Spine MRI



2
3
4
5

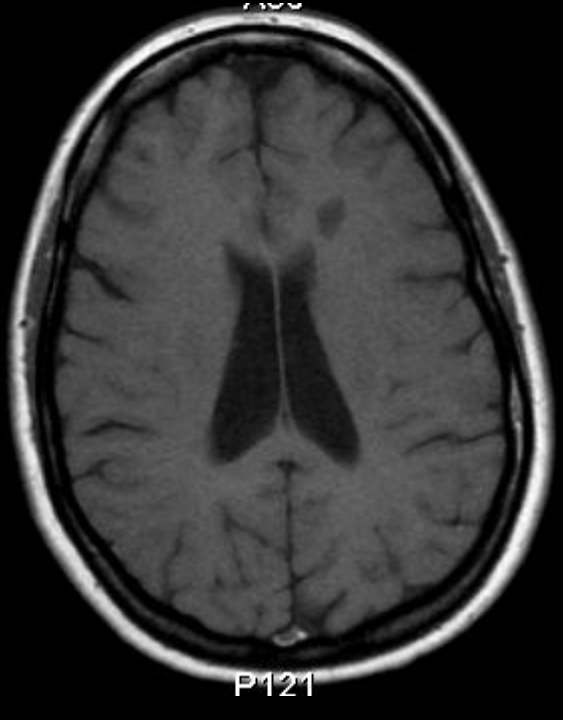
5 cm

FLAIR
FLuid Attenuated Inversion Recovery



T2 FLAIR

- Form of T2-weighted image, with free water suppressed
- Pathologic evaluation
  - Non-hemorrhagic, vasogenic or cytotoxic edema
- Sometimes improves gray/white distinction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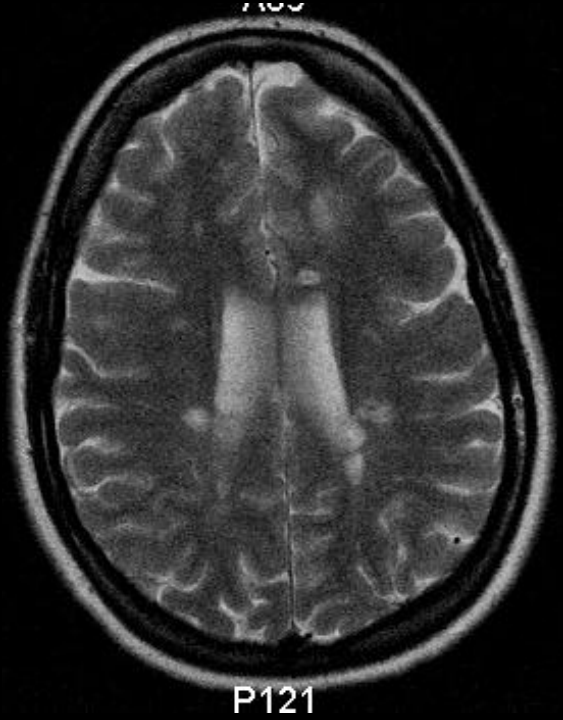
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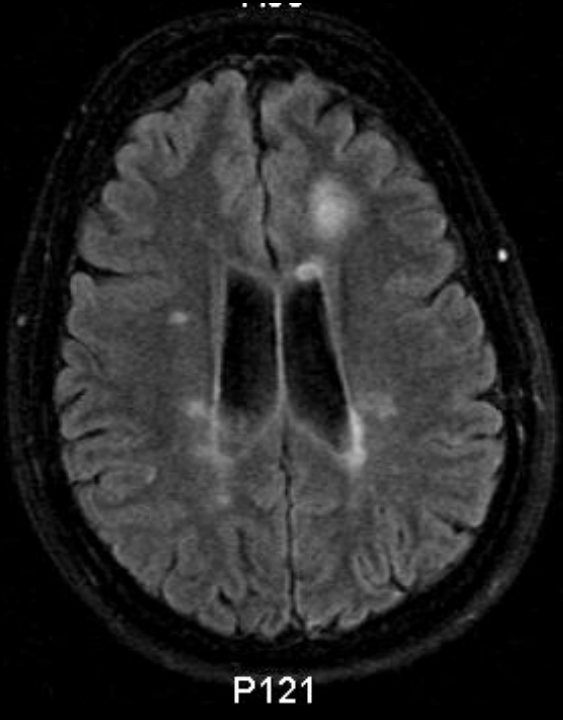
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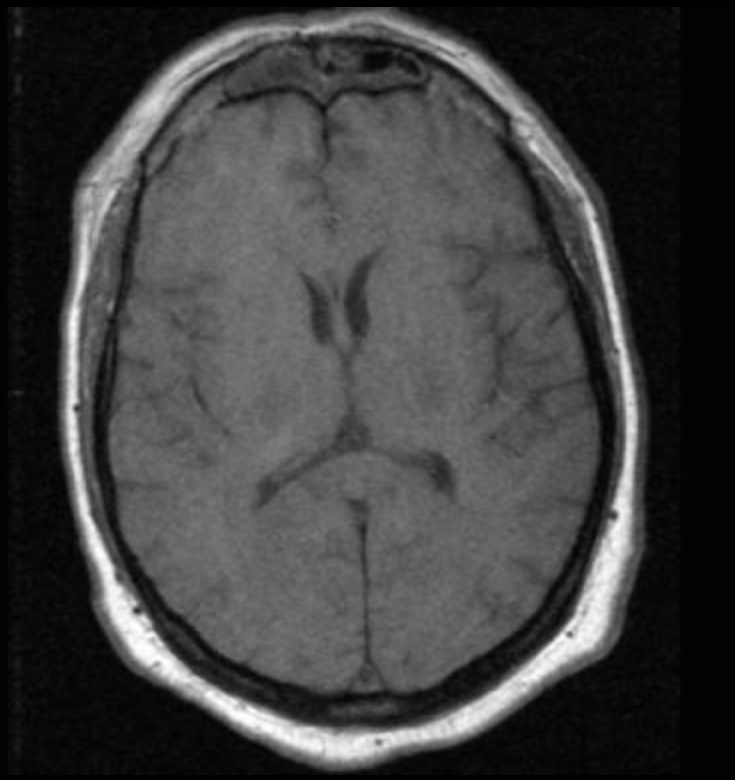
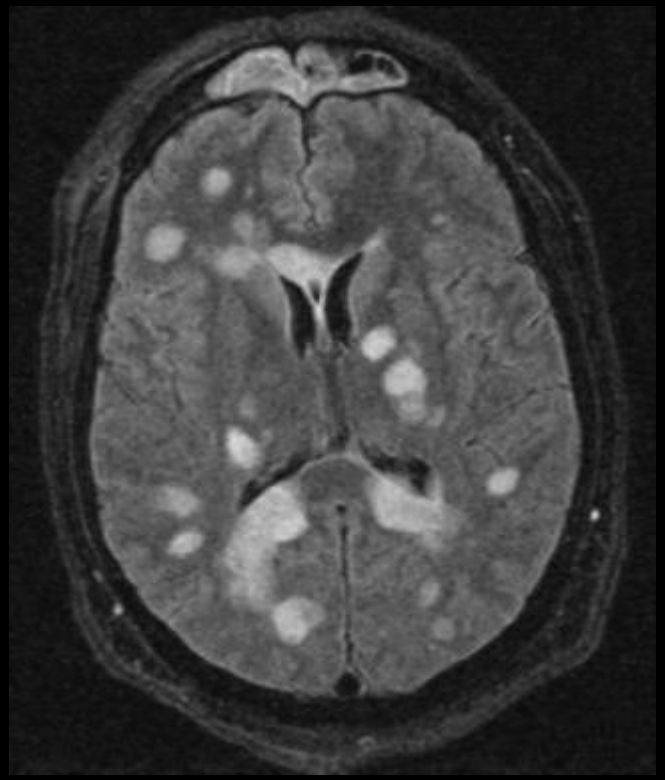
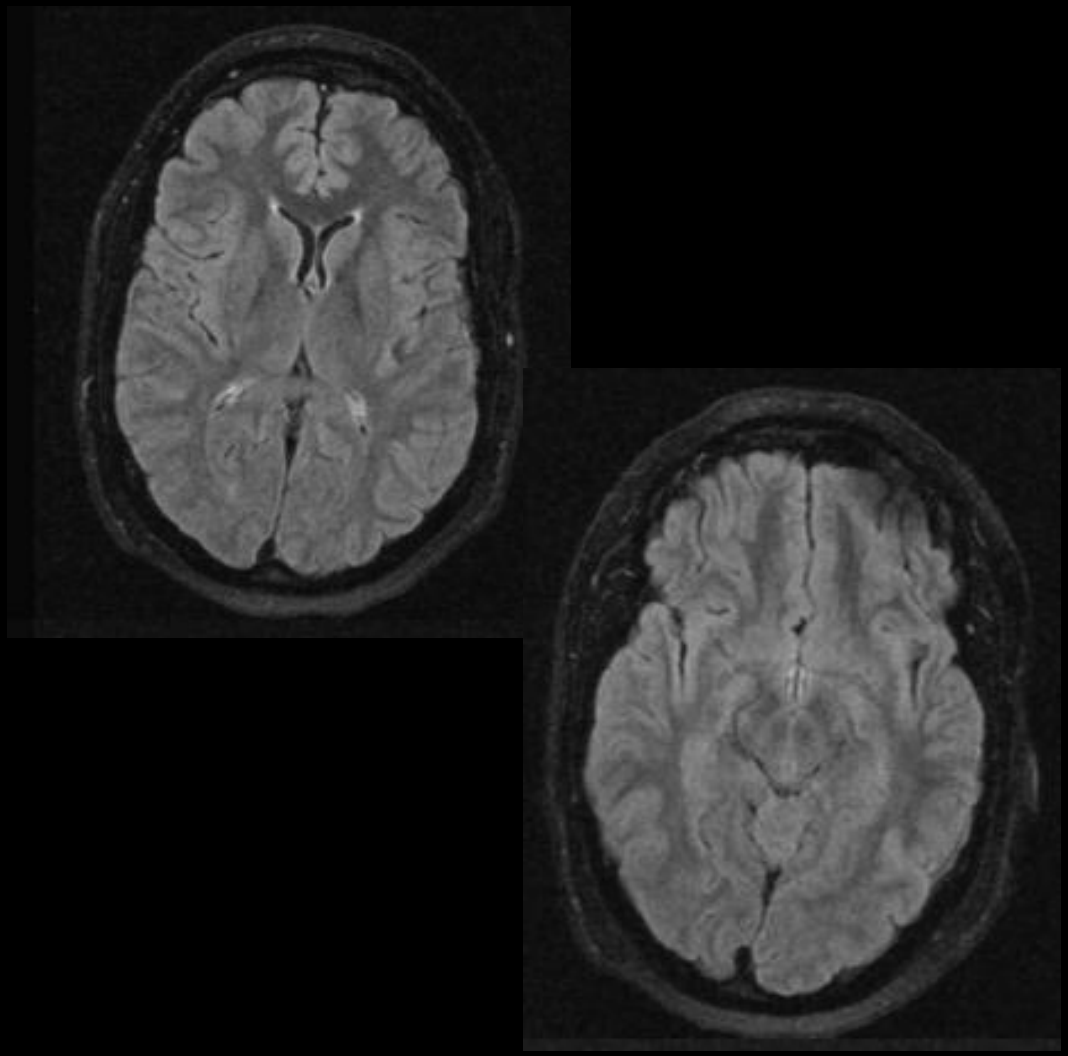




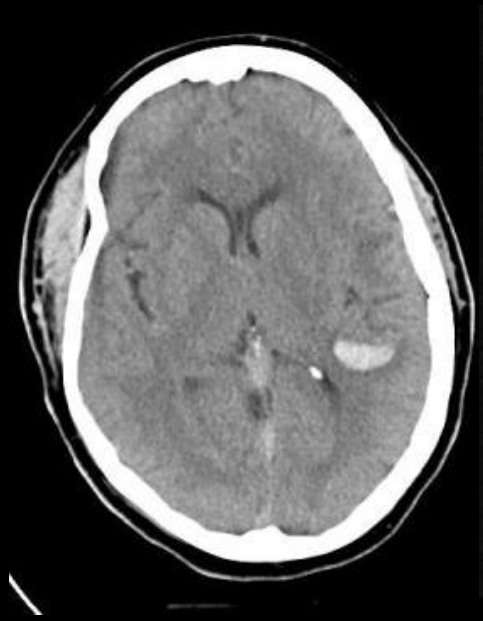
FLAIR - Recognition

FLuid Attenuated Inversion Recovery

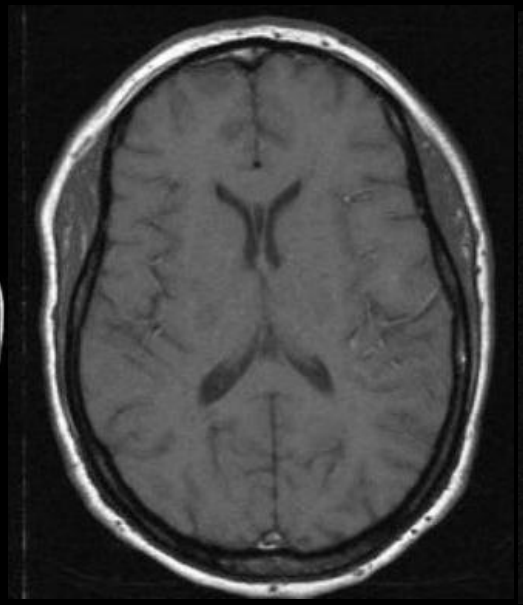


- Cranium barely visible
- CSF suppressed - dark
- Pathology – bright
- Often bright around lateral ventricles

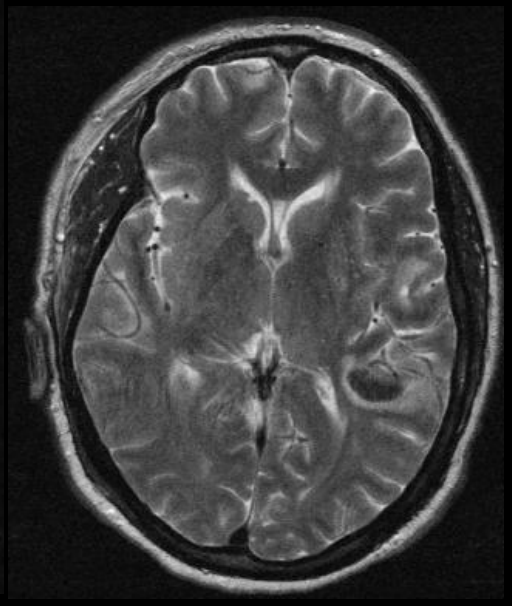
Hemorrhage



CT (day 1)

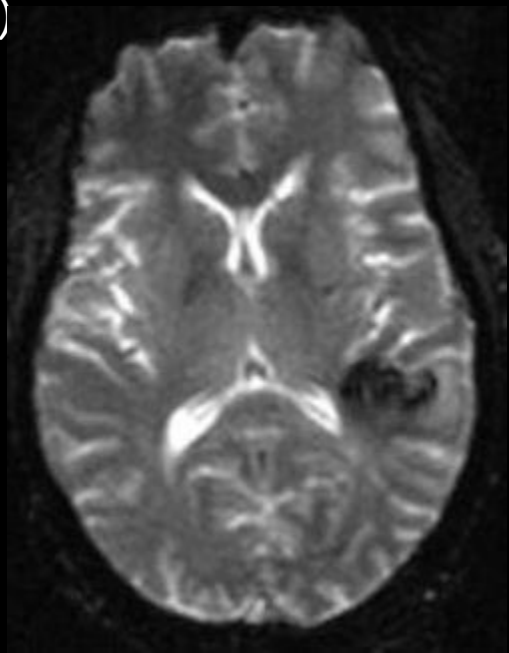


T1 (day 2)



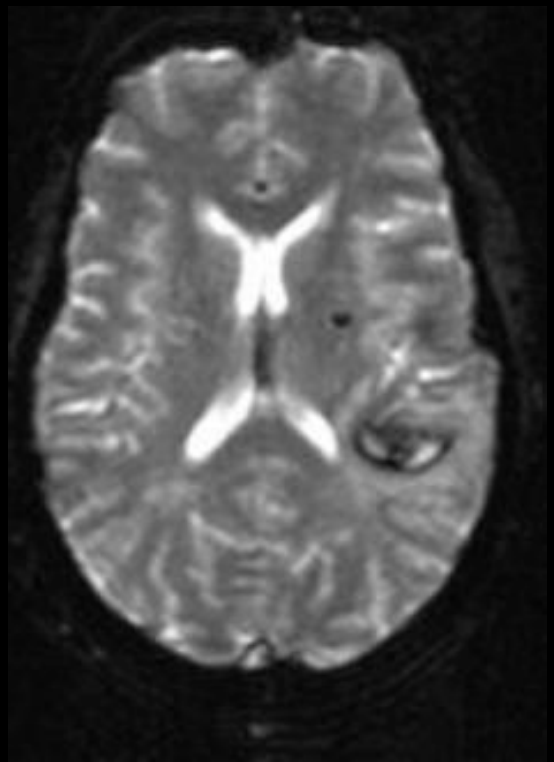
T2 (day 2)

T2* (T2-star)



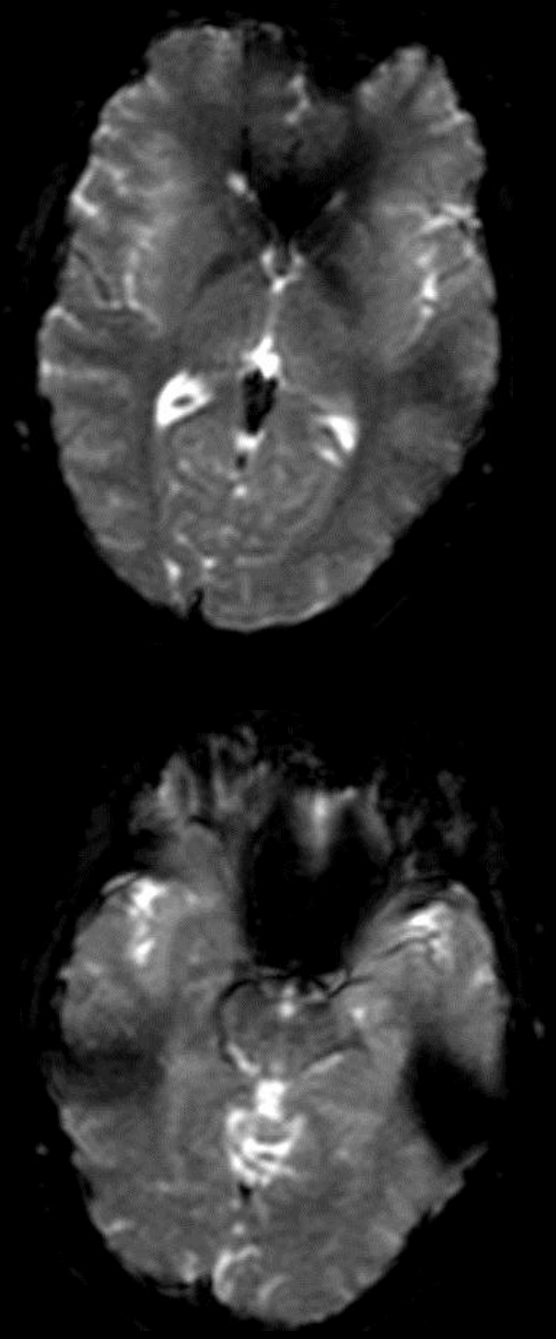
T2* Sequence (“T2-star”)

- Susceptible to iron and calcium (*decreased* signal)
- Purpose
  - Evaluation of acute or chronic hemorrhage

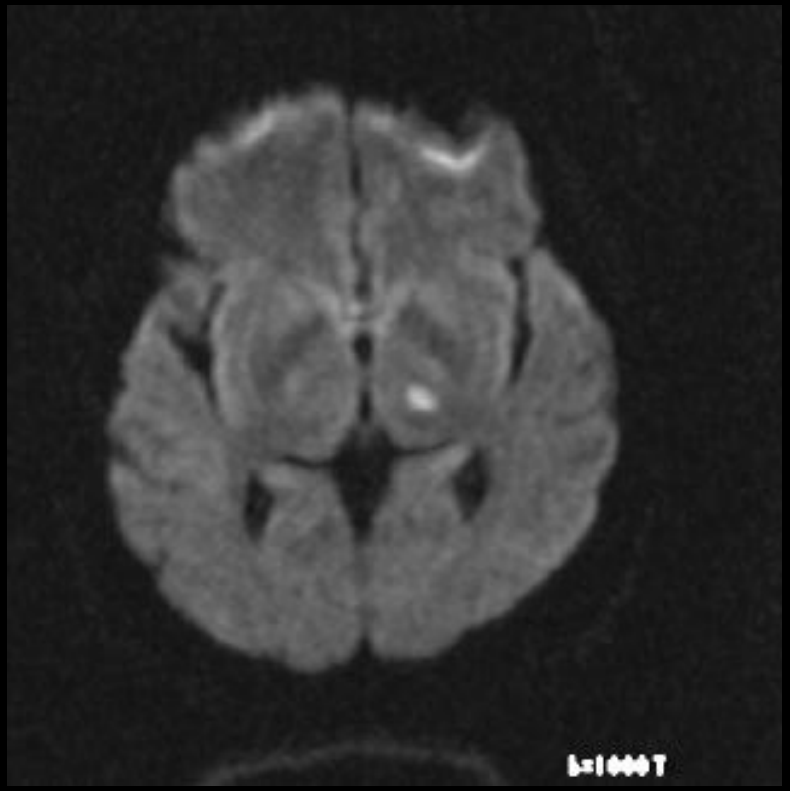


T2* Recognition

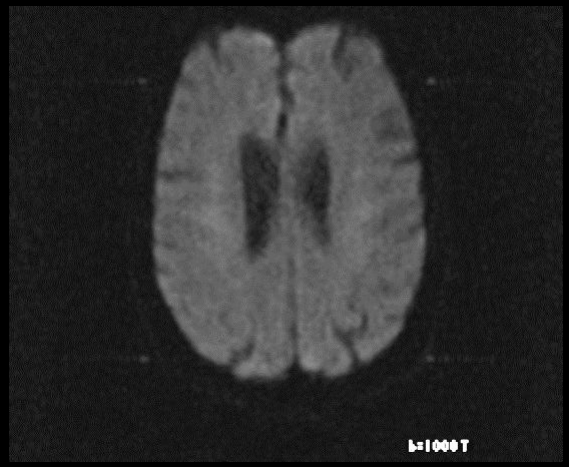
- Like T2:
  - CSF bright; brain gray
- No cranium
- Susceptibility artifacts – dark near frontal, temporal bones
- Dark near blood or calcium



Diffusion-weighted imaging (DWI)



- Bright signal = restricted diffusion
- Specific Features
  - Random motion / CSF
    - Dark
  - Restricted motion
    - Bright
- Uses
  - Early recognition of ischemia
  - May also show abscess
- Recognition
  - Look for “DWI”, “b=1000T” or “b=900T” at bottom
  - Sometimes grouped with other images (such as b=1000P)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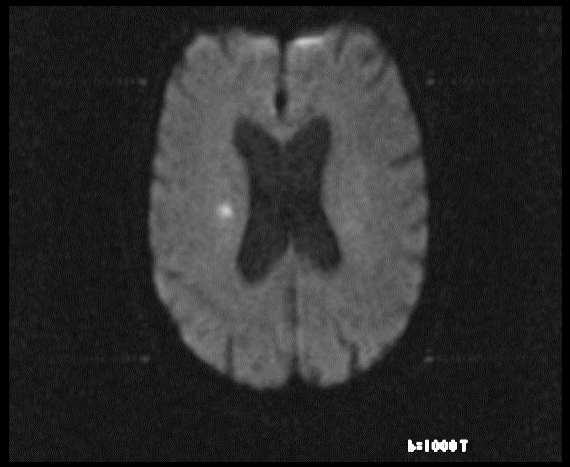
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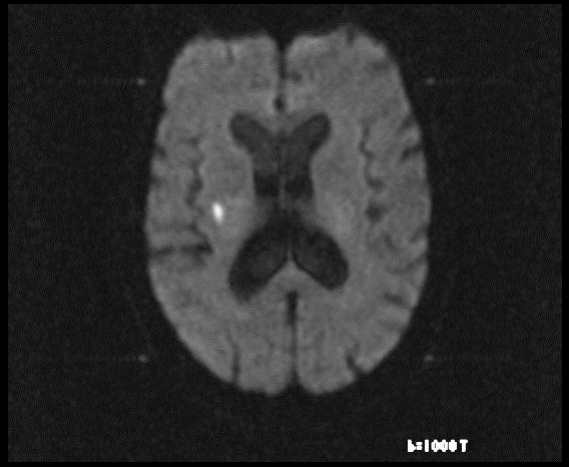
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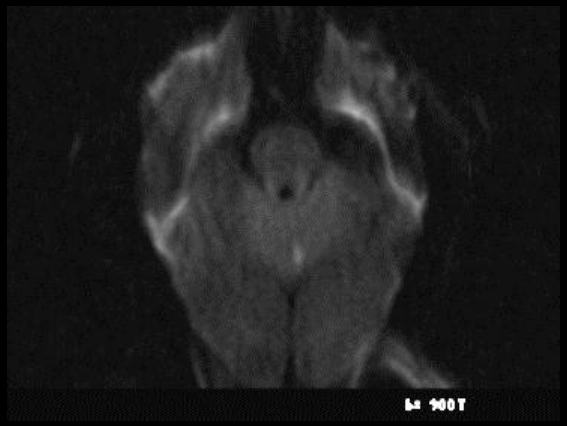
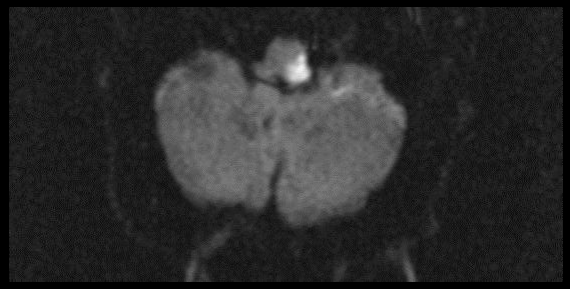
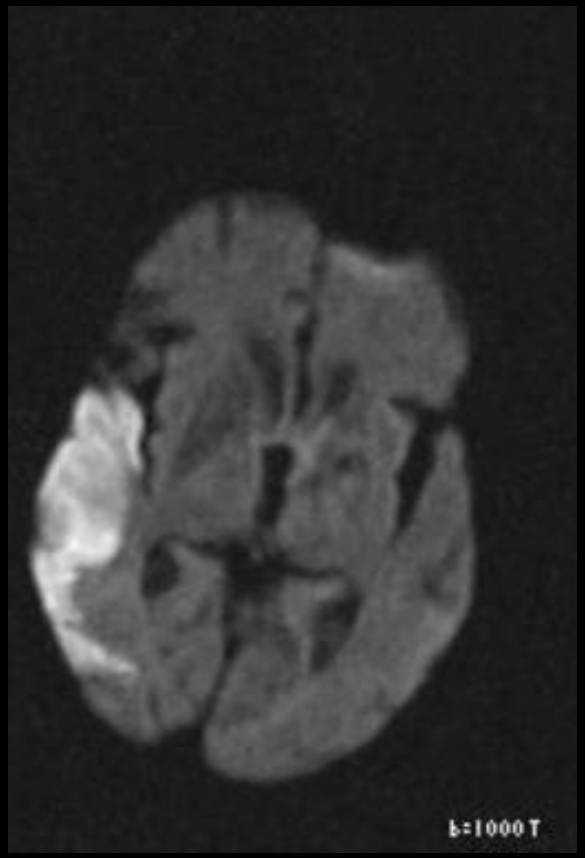

b= 900T

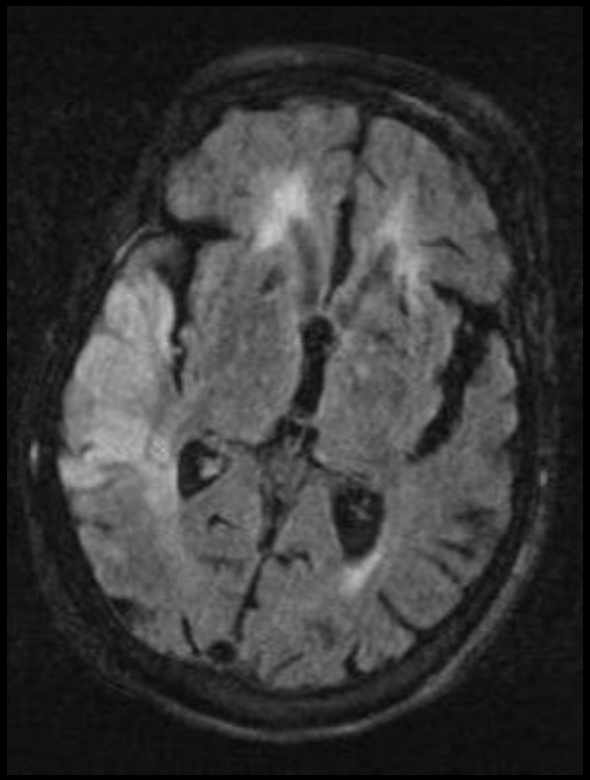
b= 900T

b= 900T

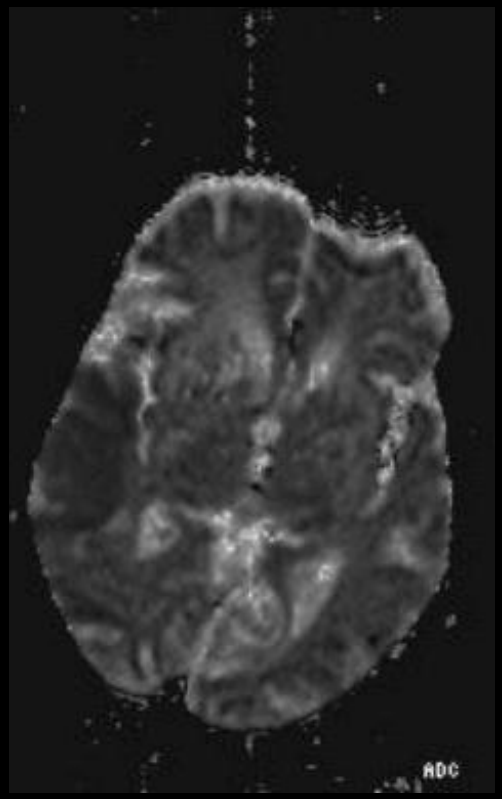




DWI

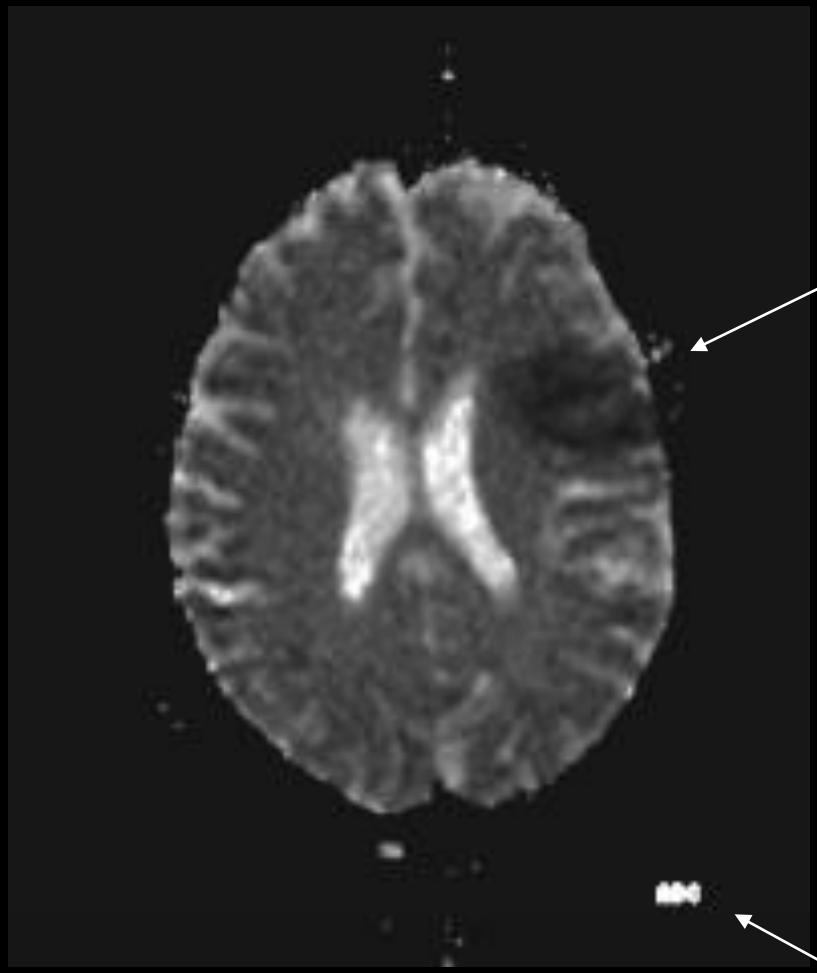


FLAIR



ADC MAP

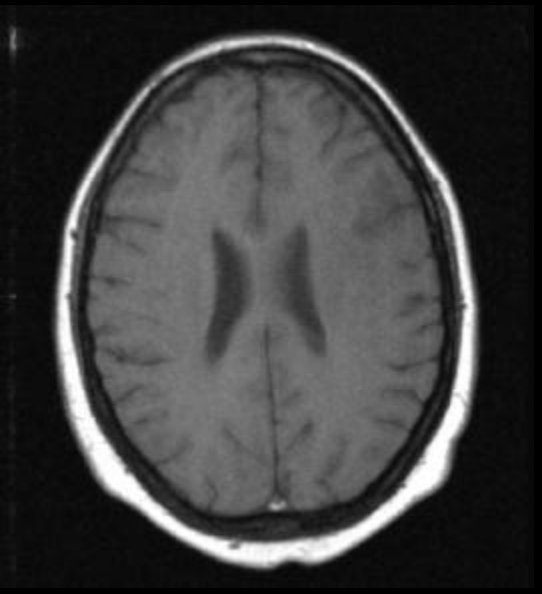
ADC map (apparent diffusion coefficient)

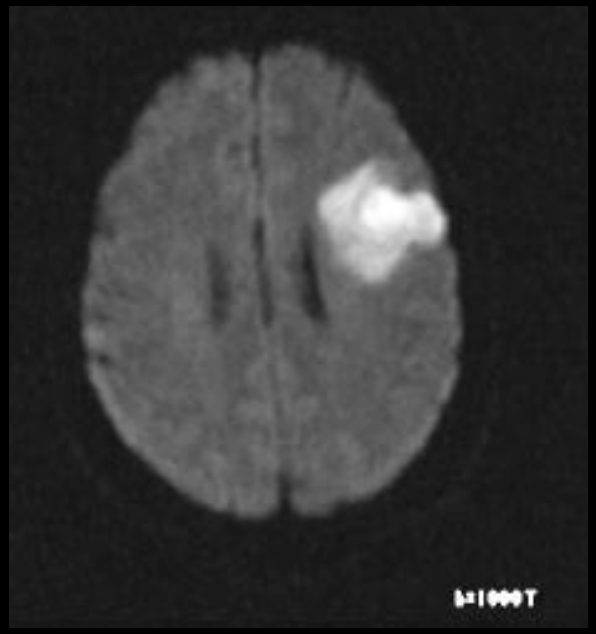


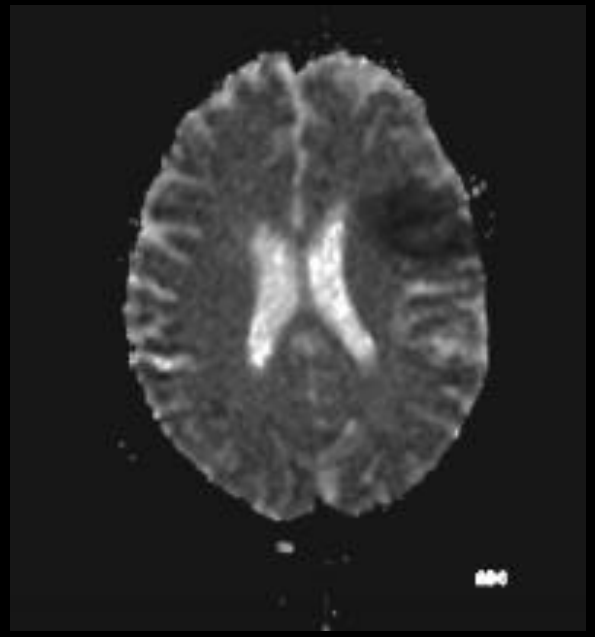
Restricted diffusion = abnormal = black

Use *only* to verify DWI results

ADC

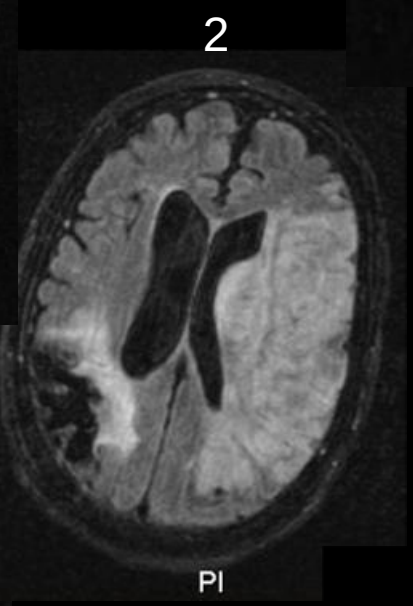


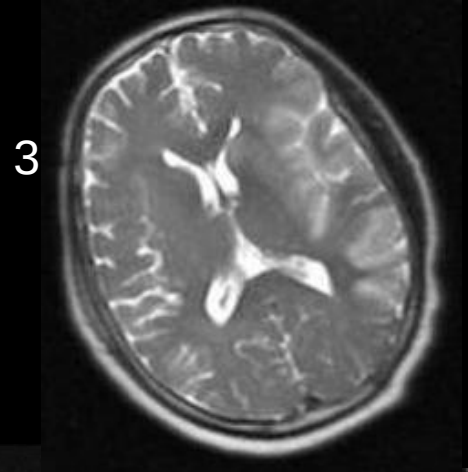




Johnson, Donna

1
PI


2
PI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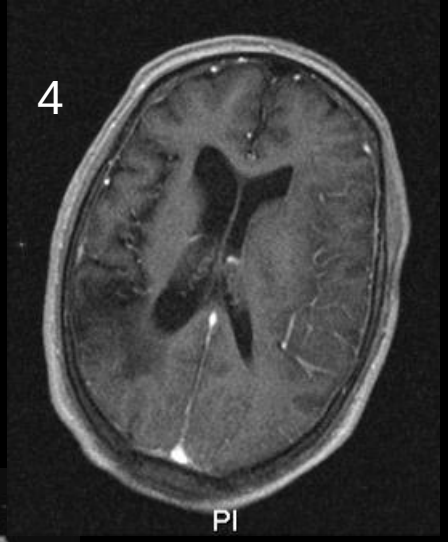
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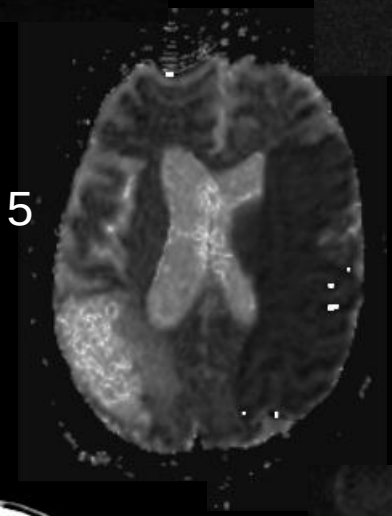
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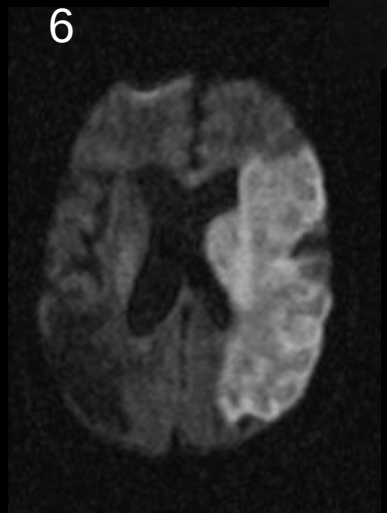
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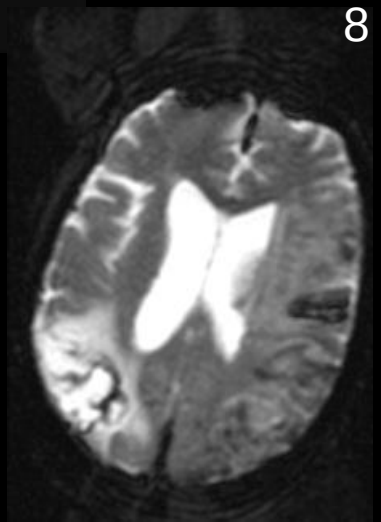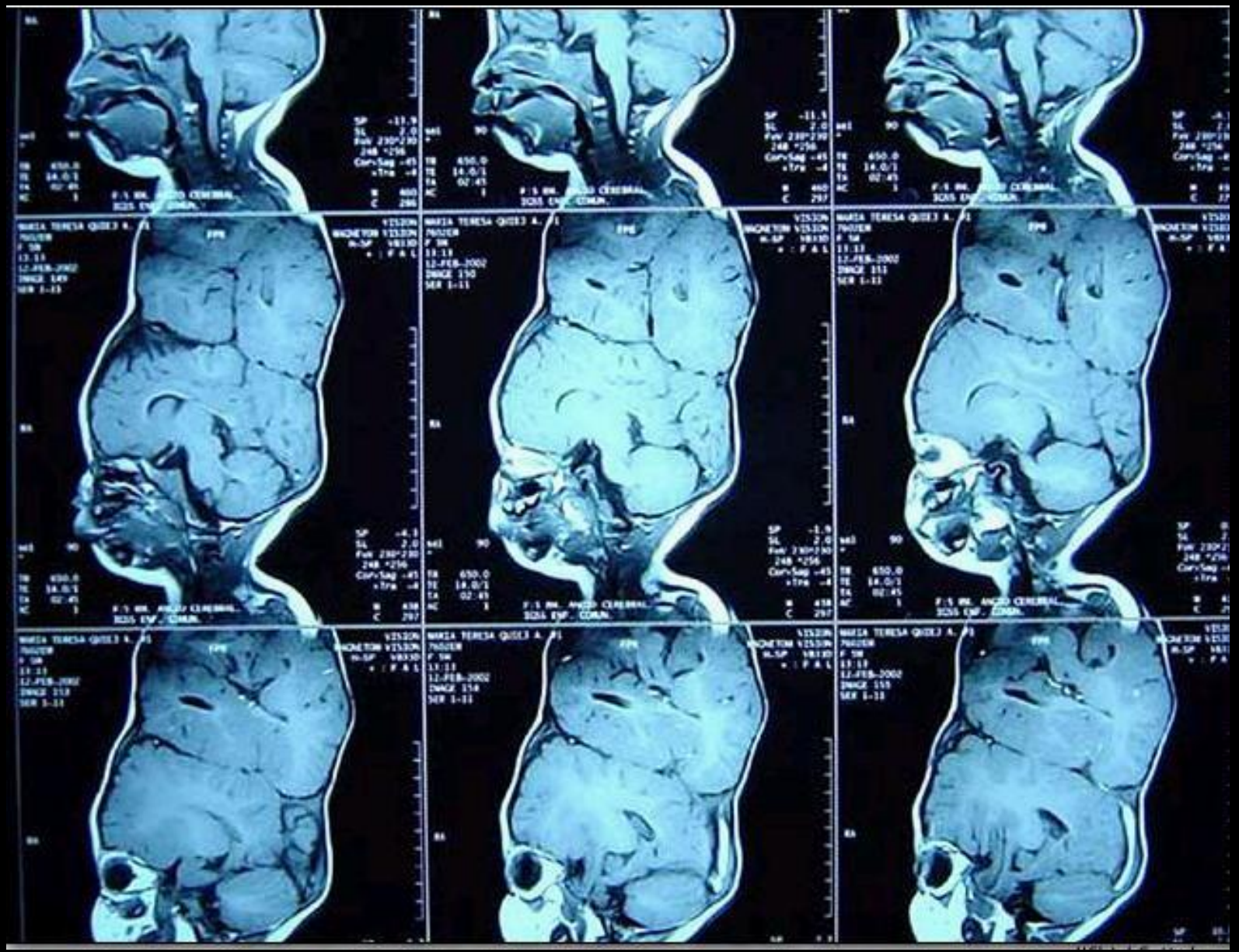
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