

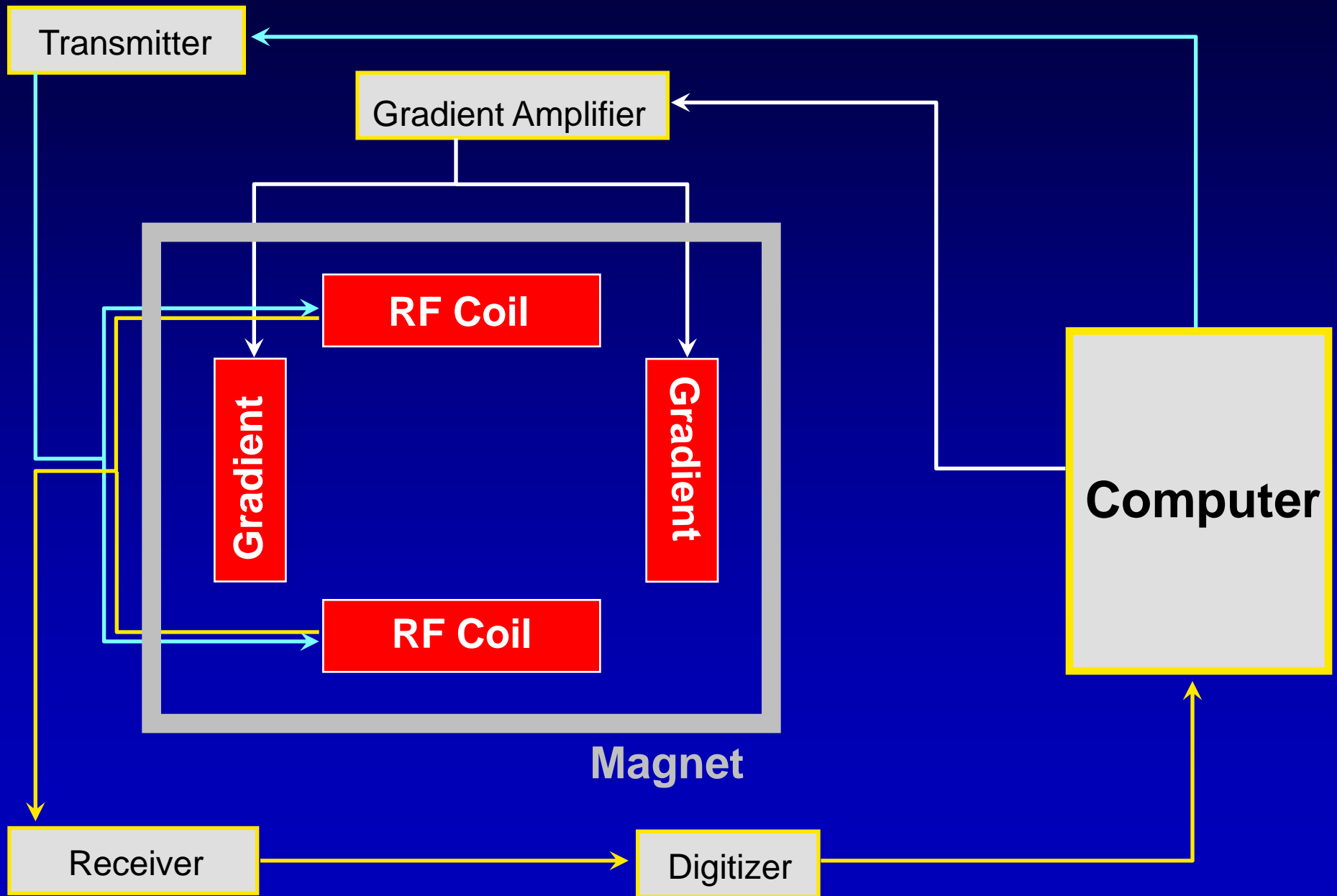
Department of Radiology
University of California
San Diego

MR Imaging of the Brain



John R. Hesselink, M.D.

MR System Components



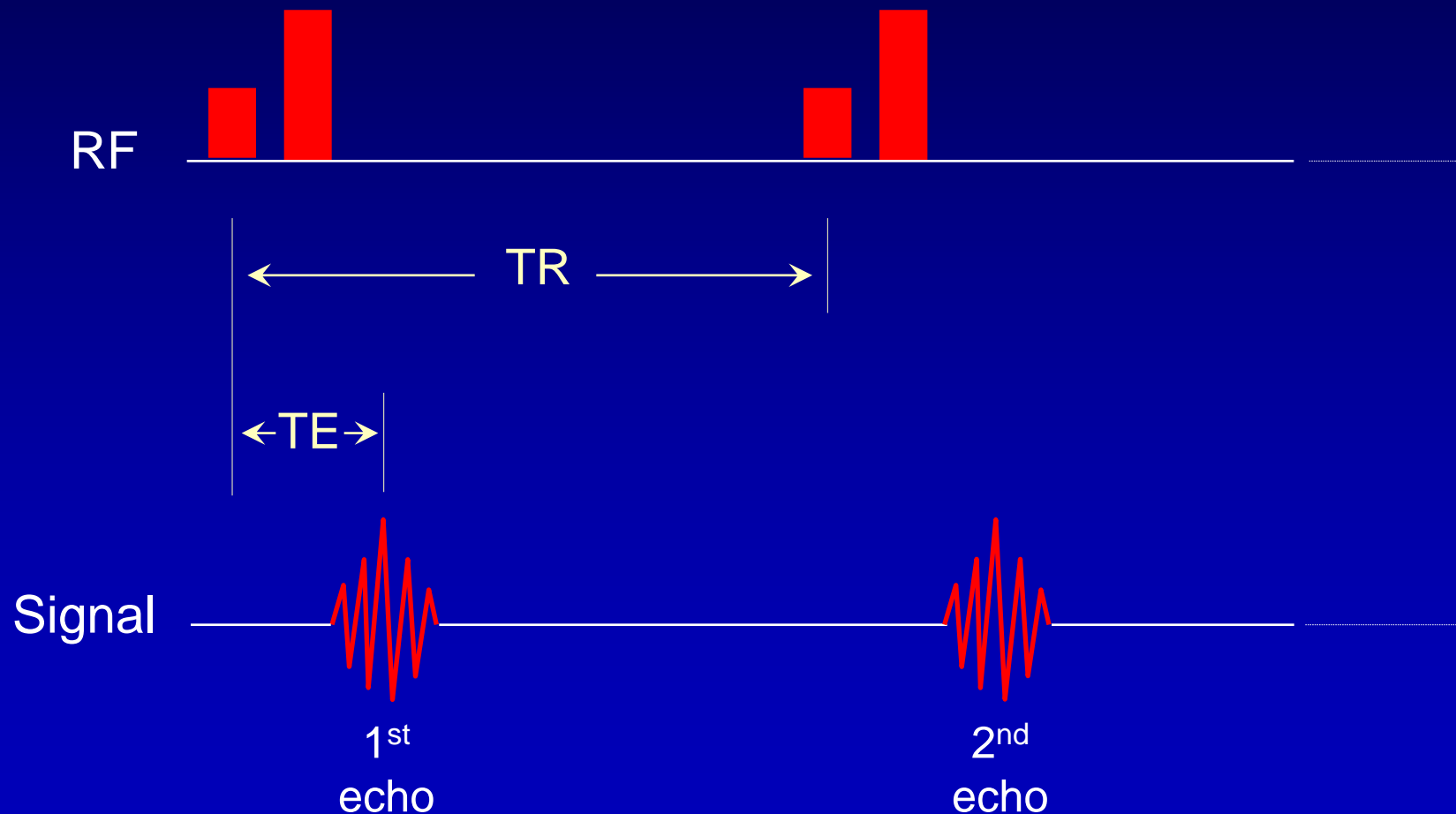
MR Imaging

Source of Signal and Contrast

- Proton density
- T1 relaxation time
- T2 relaxation time
- Flow effects

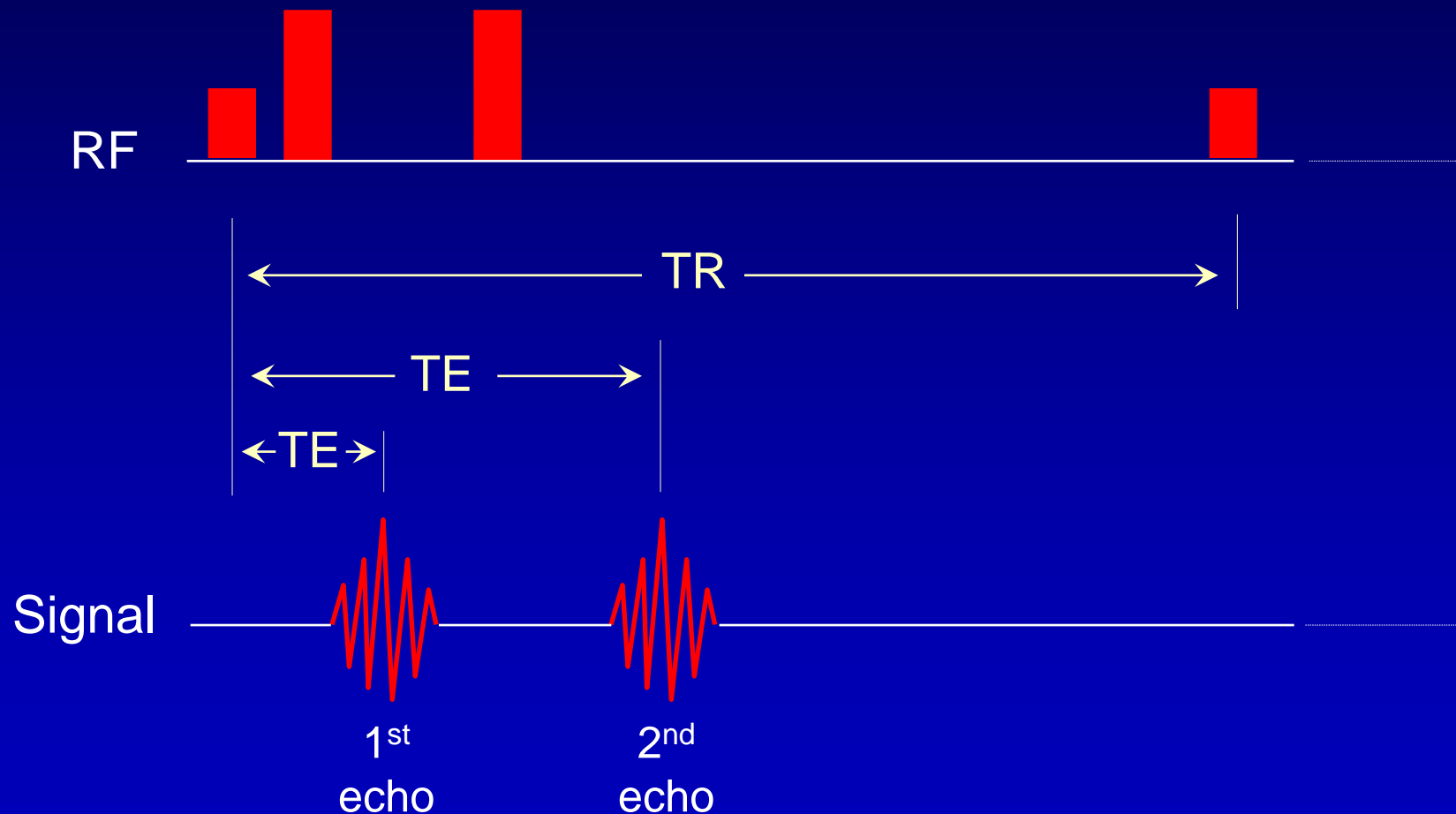
Spin-echo Pulse Sequence

Single Echo T1-weighted

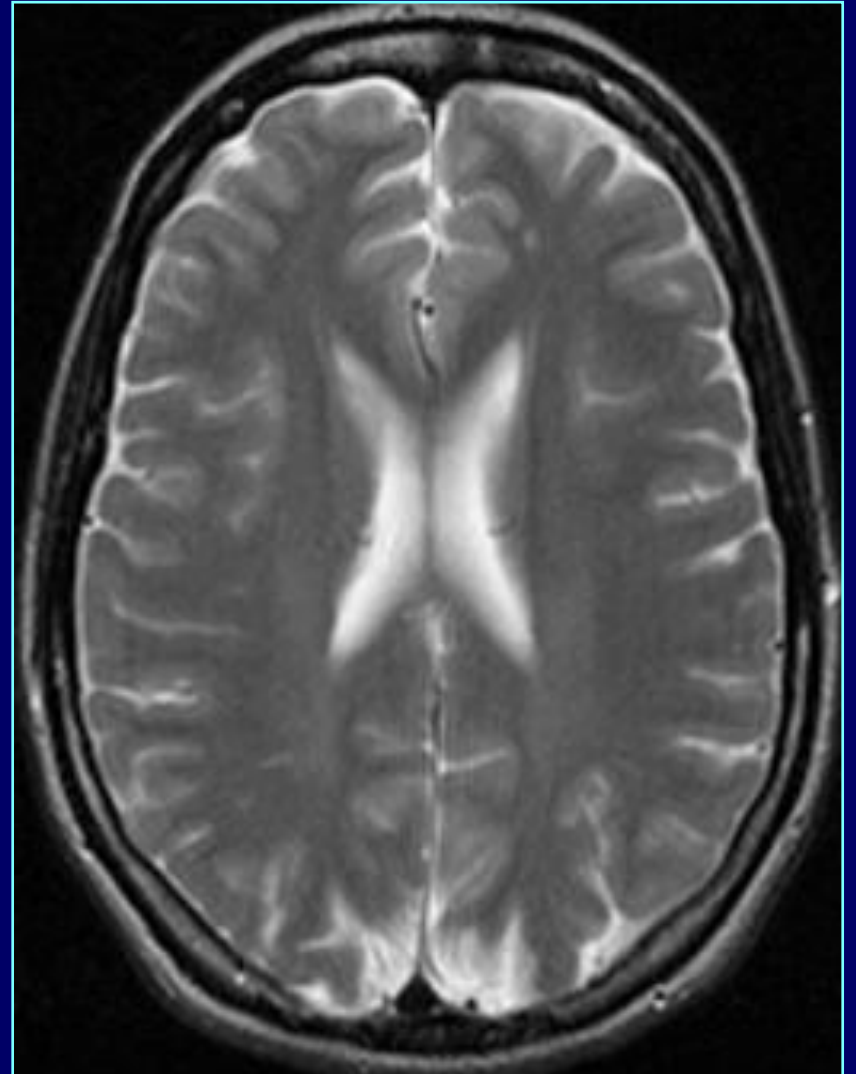
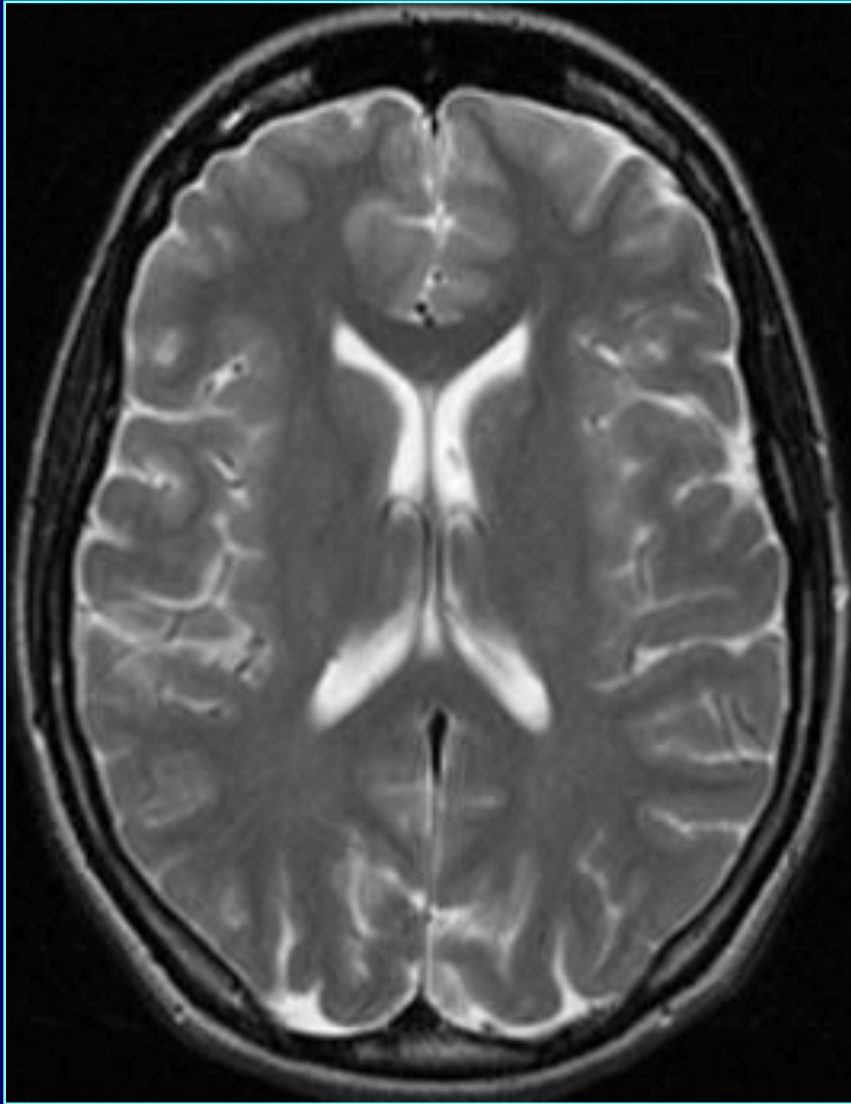


Spin-echo Pulse Sequence

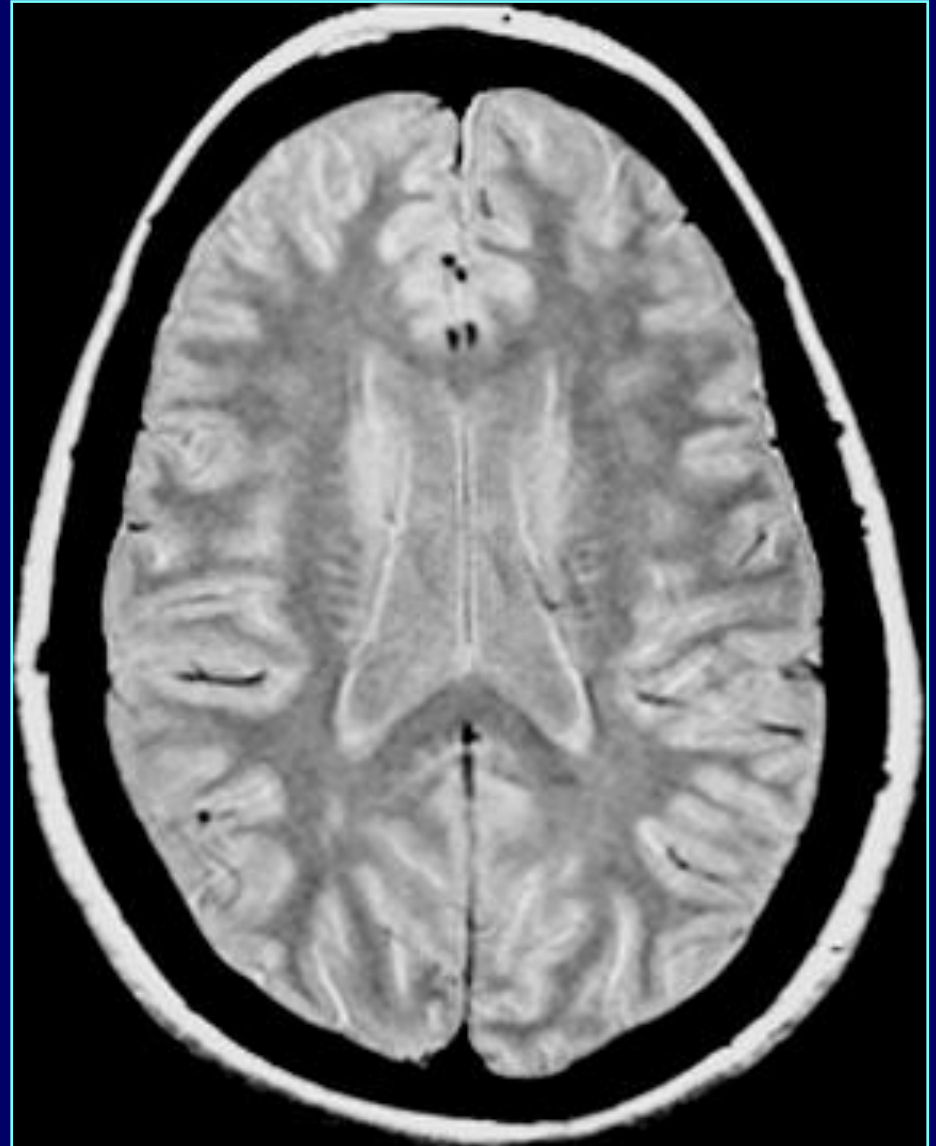
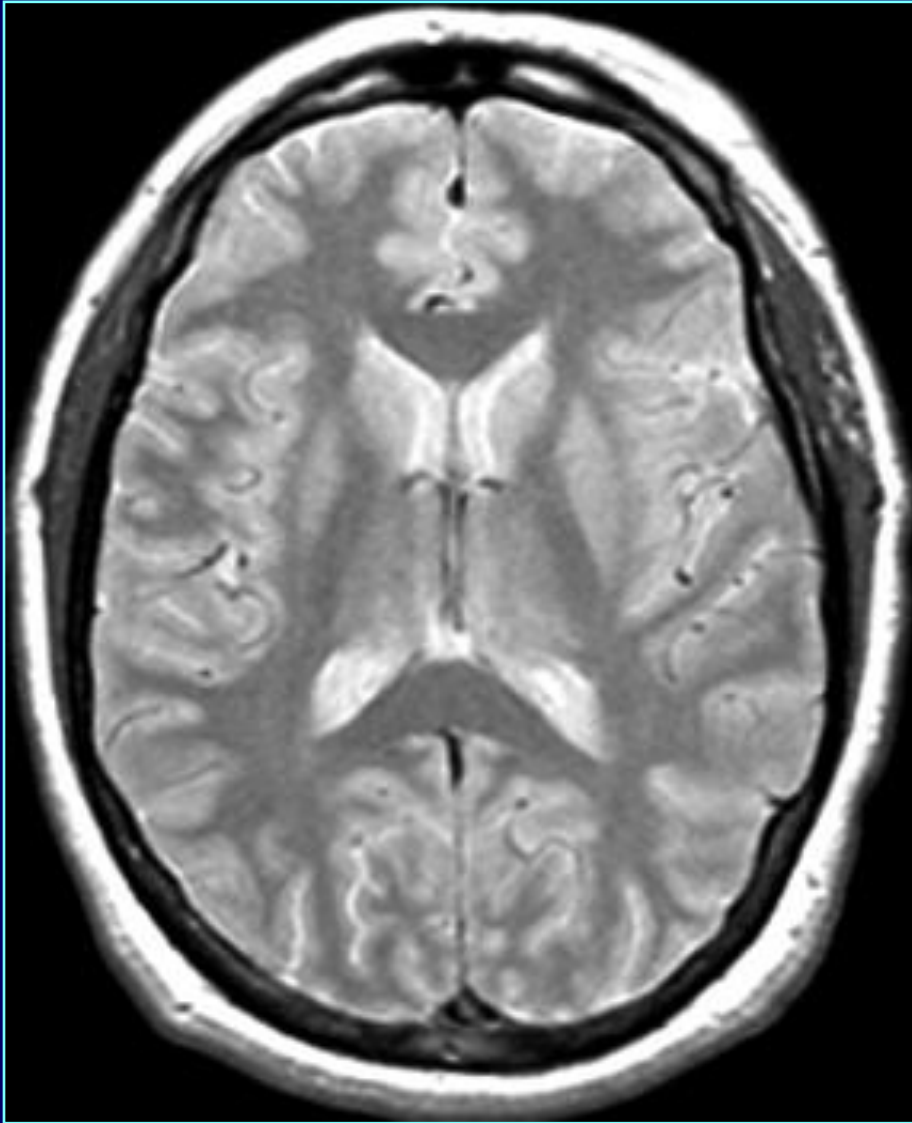
Dual Echo T2-weighted



T2-Weighted Images

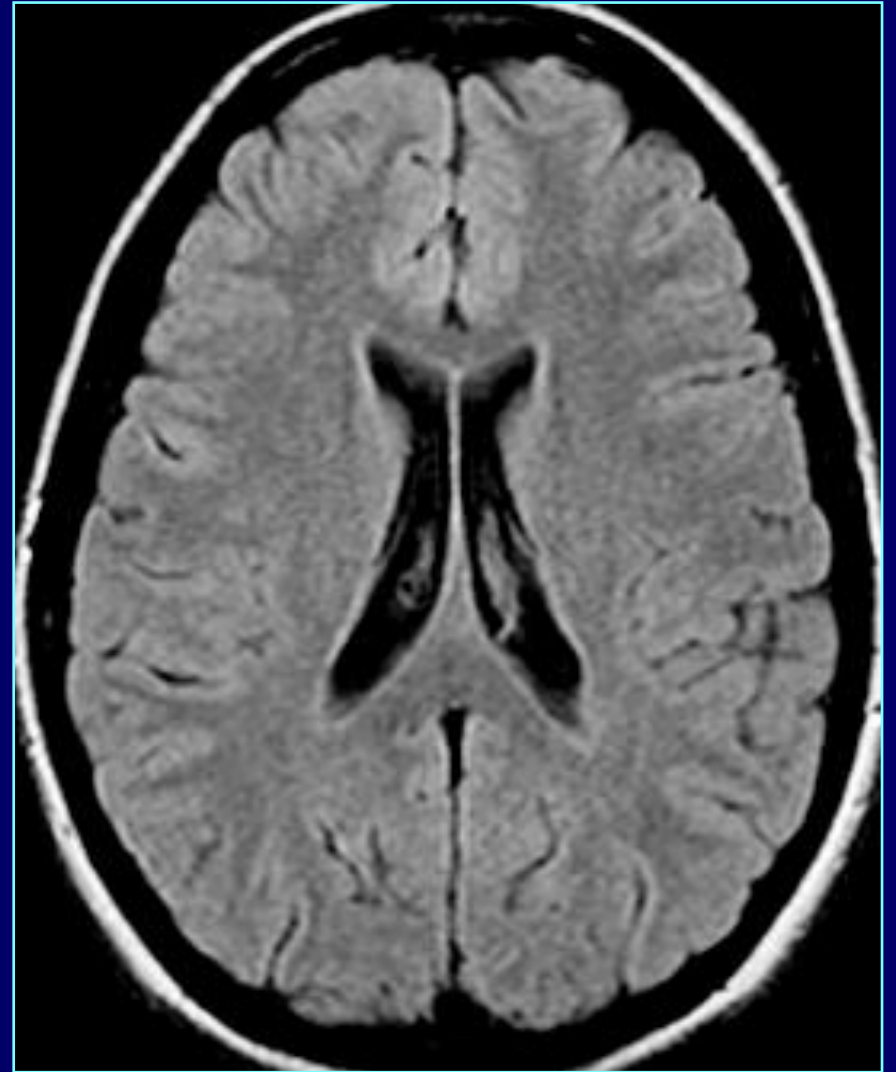
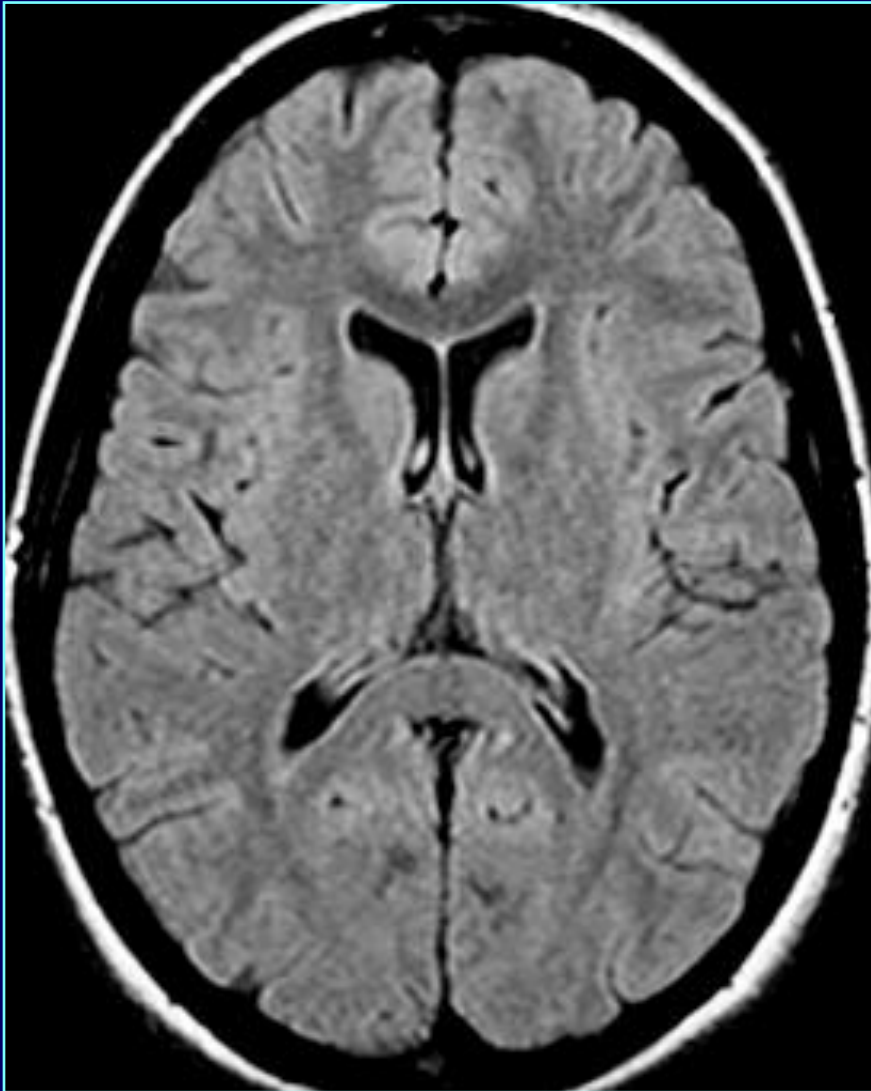


Proton Density Weighted Images

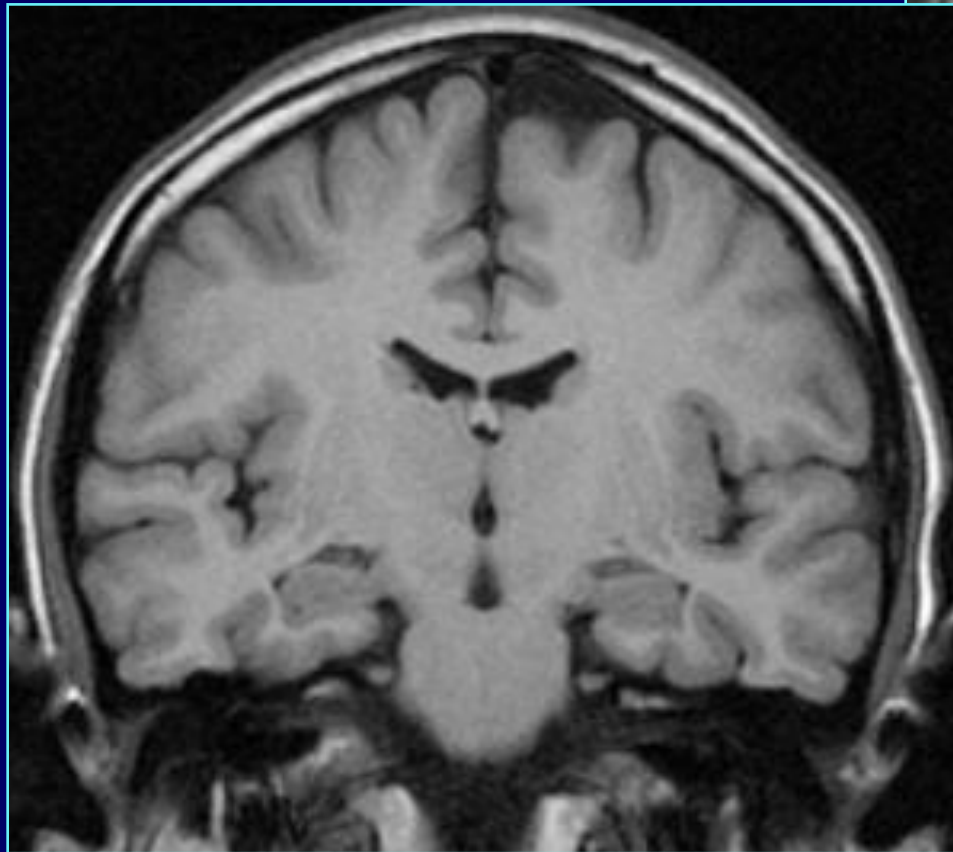
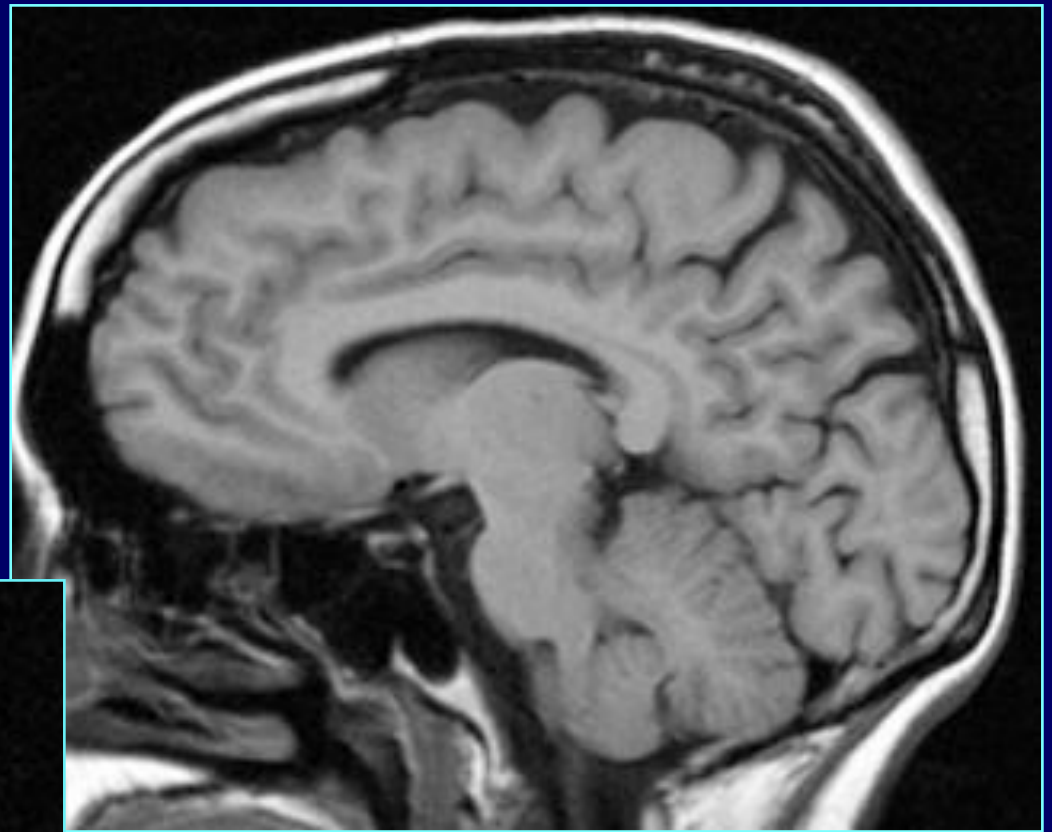


Normal FLAIR Images

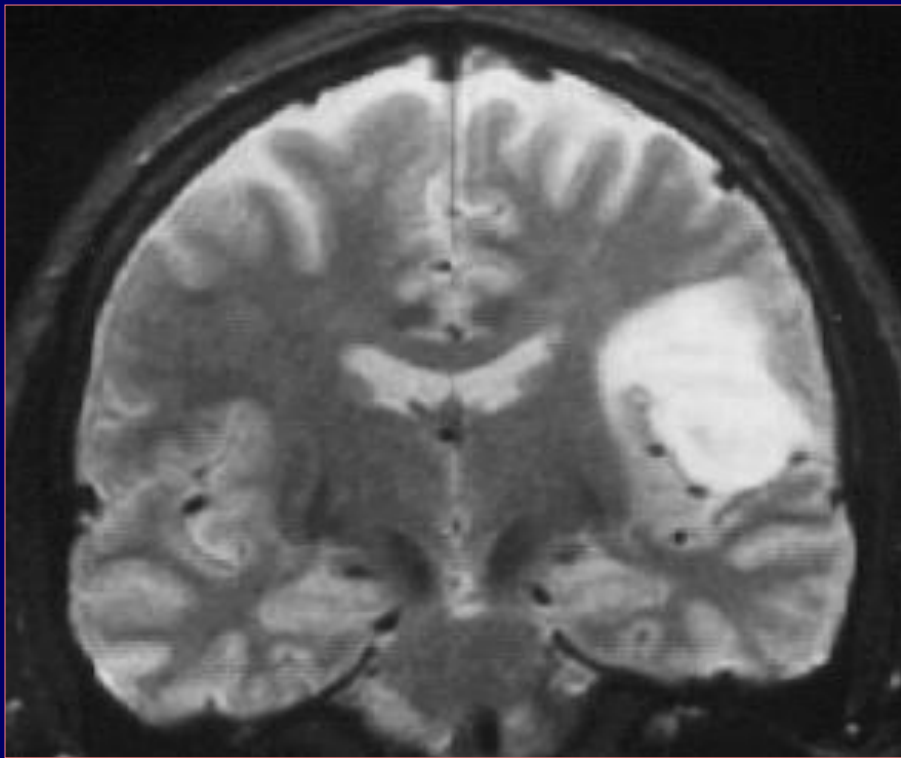
TR = 6000 msec, TI = 2000 msec, TE = 102 msec



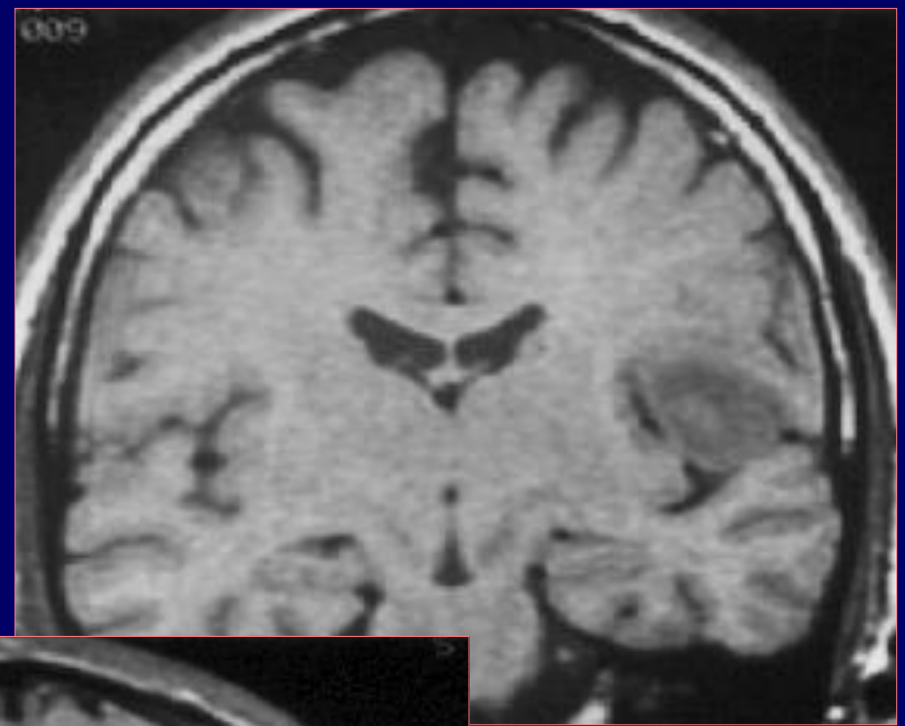
T1-Weighted Images



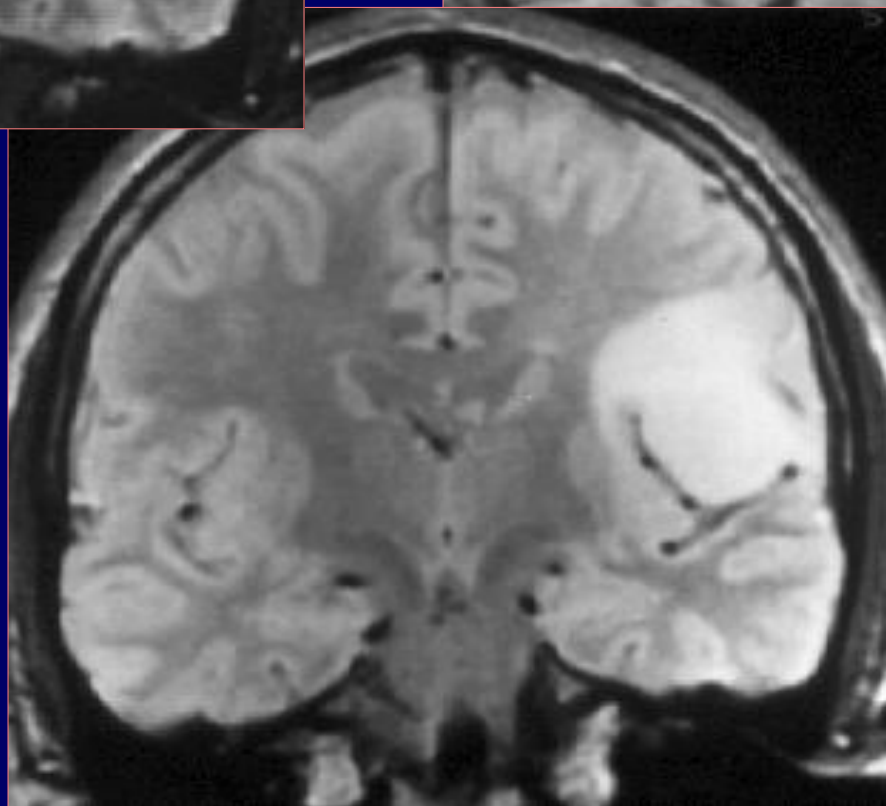
MR Signal of Brain Lesions



T2W



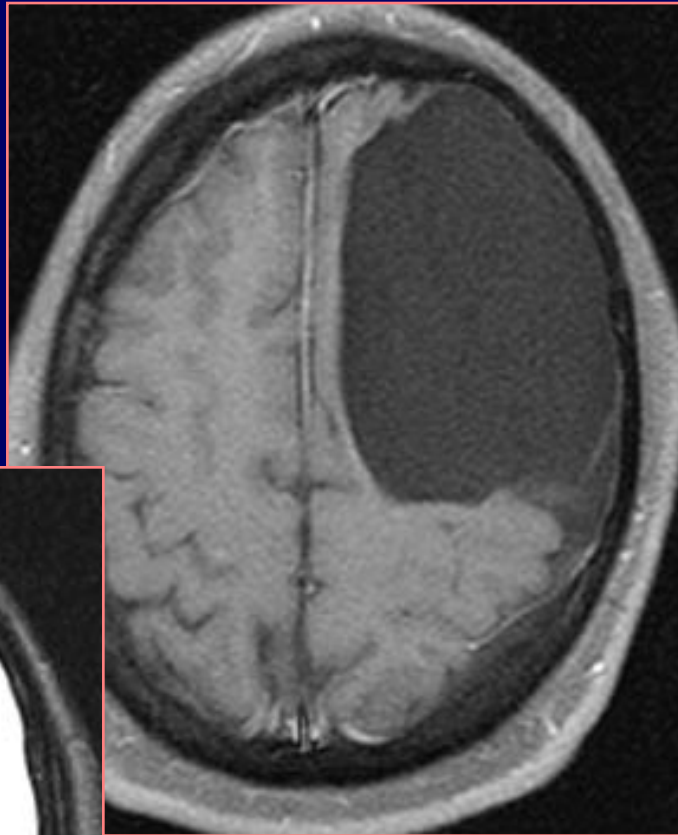
T1W



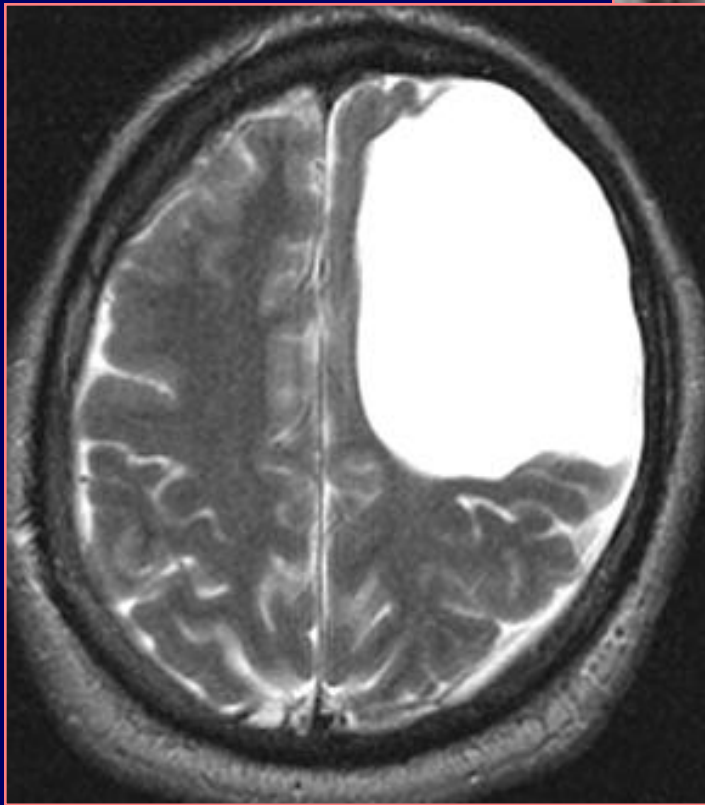
PDW

**Solid
Brain
Lesion**

Cystic Lesion

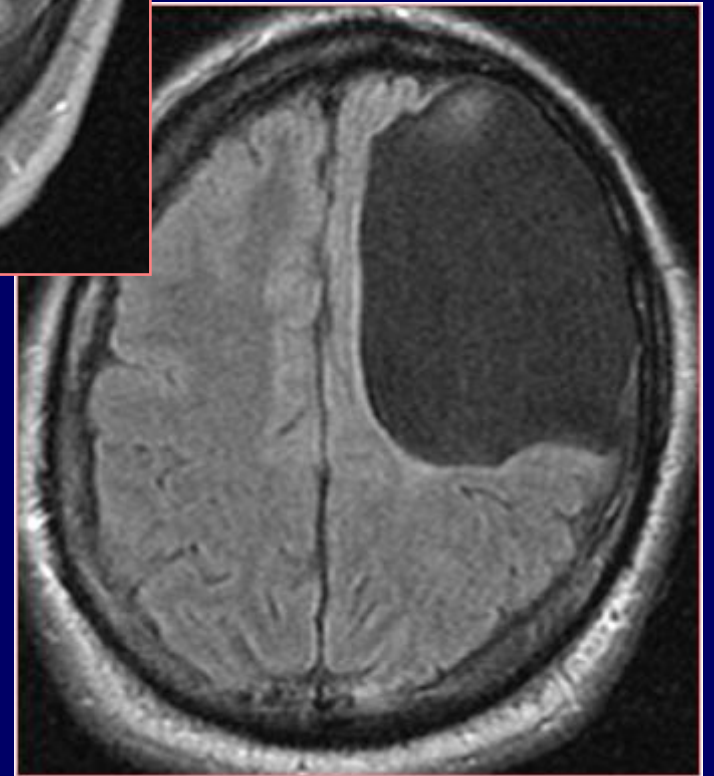


T1W

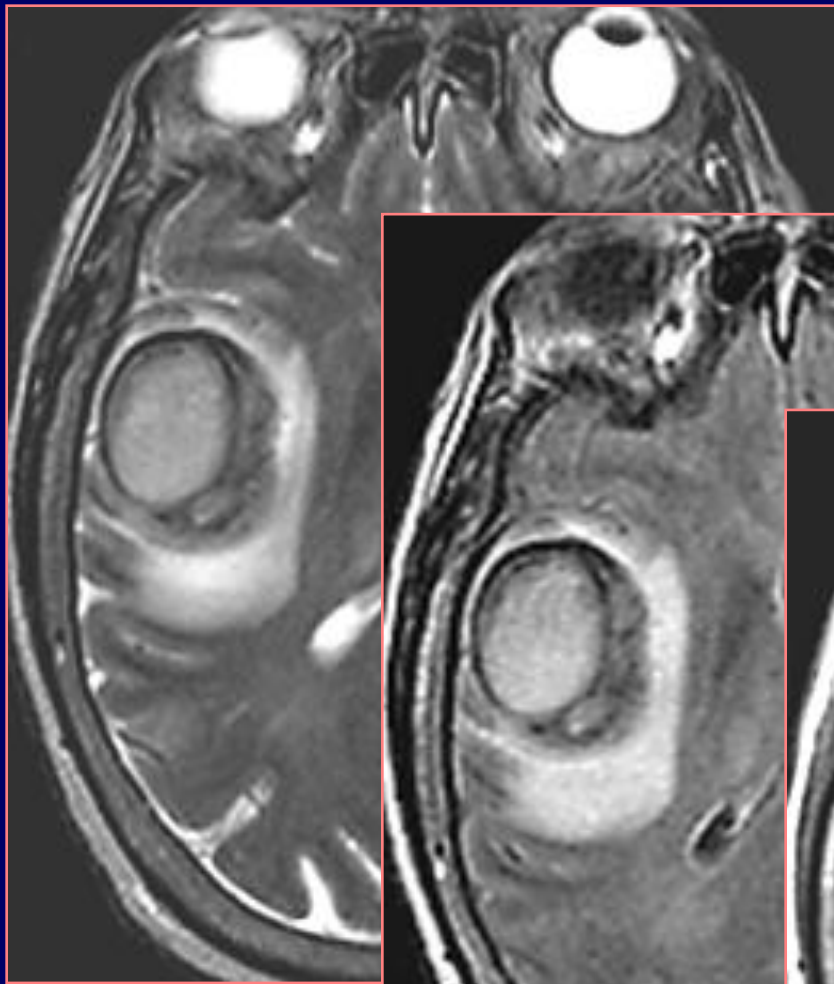


T2W

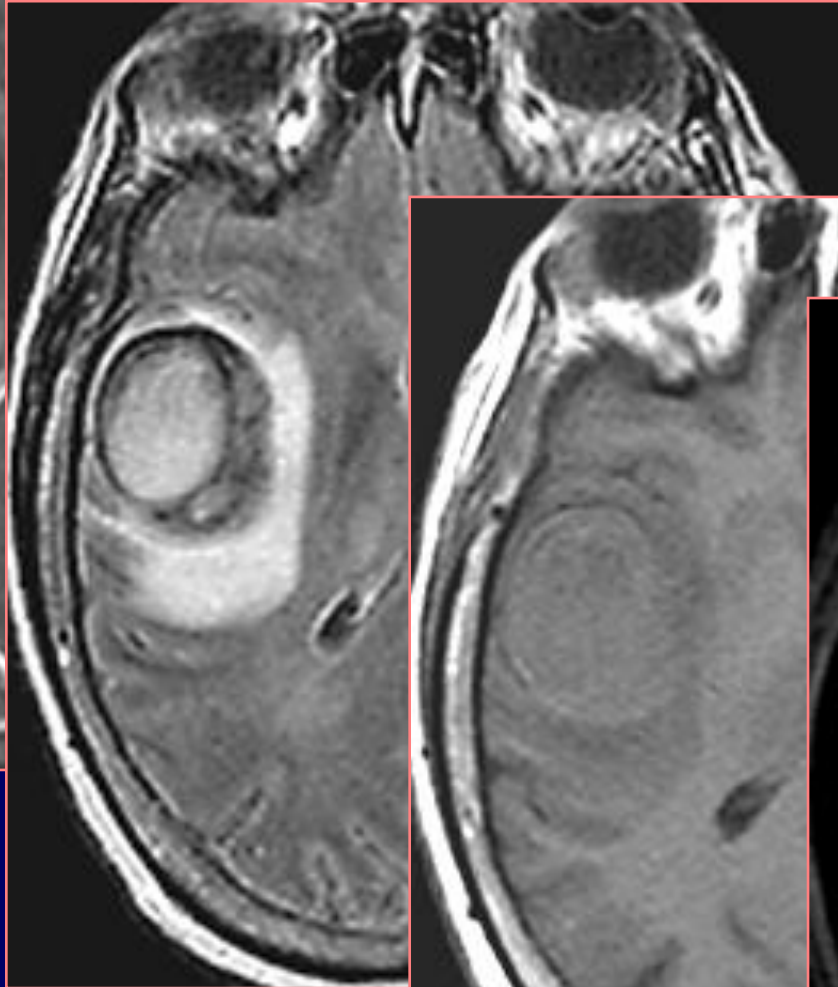
FLAIR



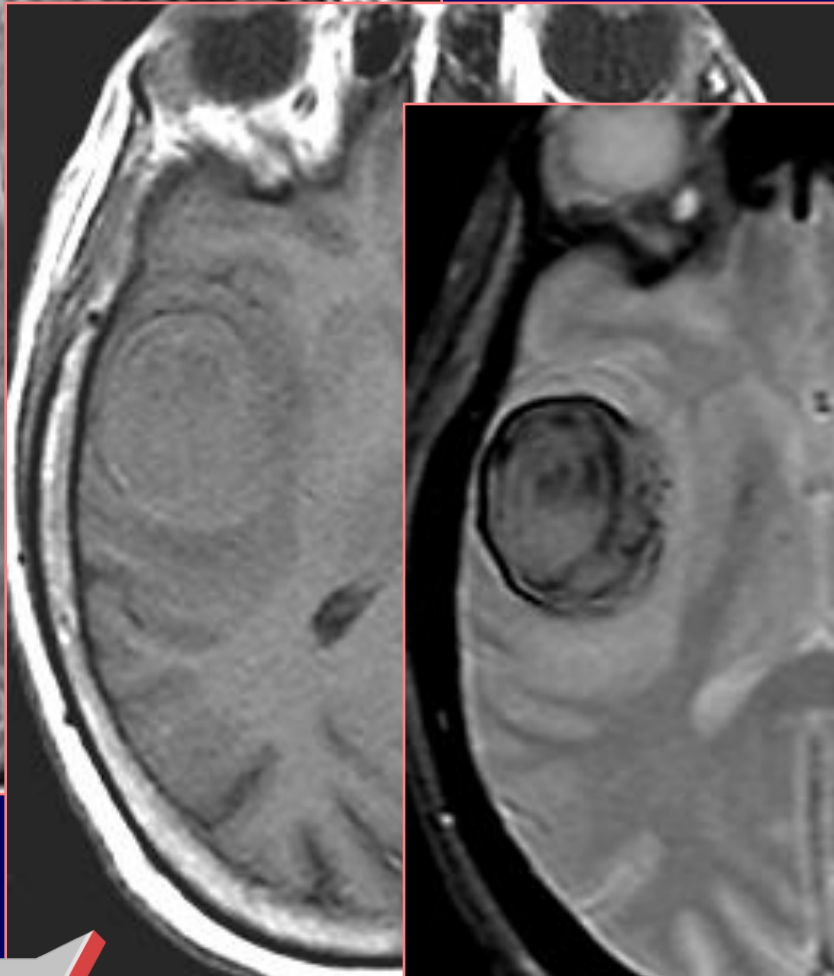
Acute Hemorrhage



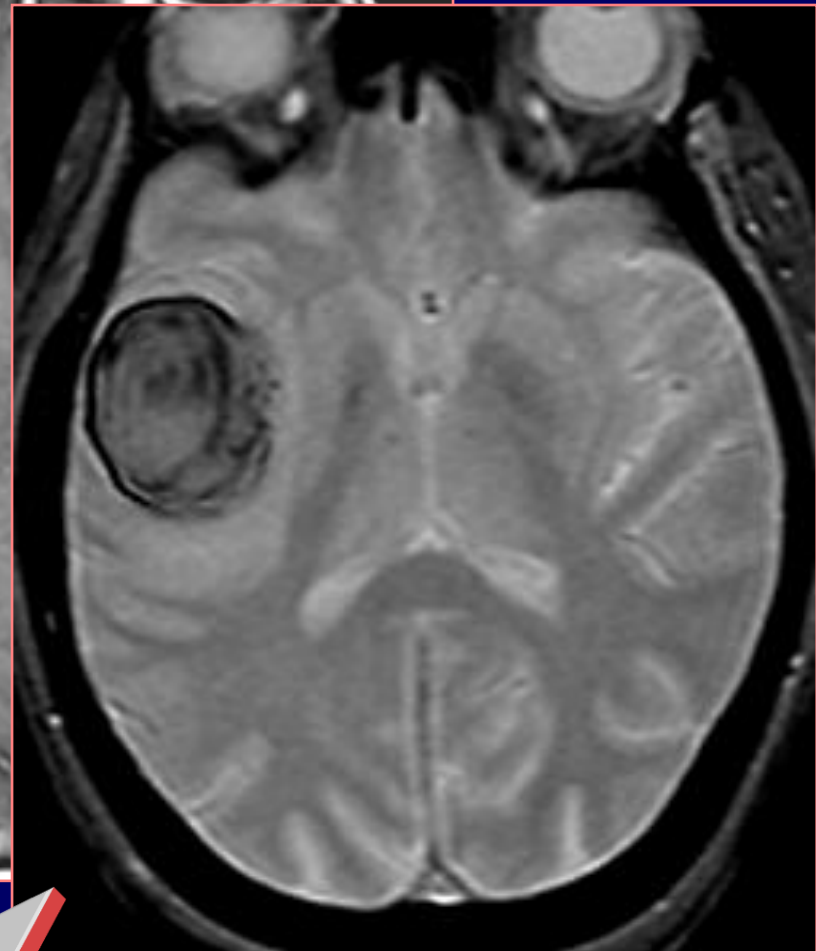
T2W



FLAIR

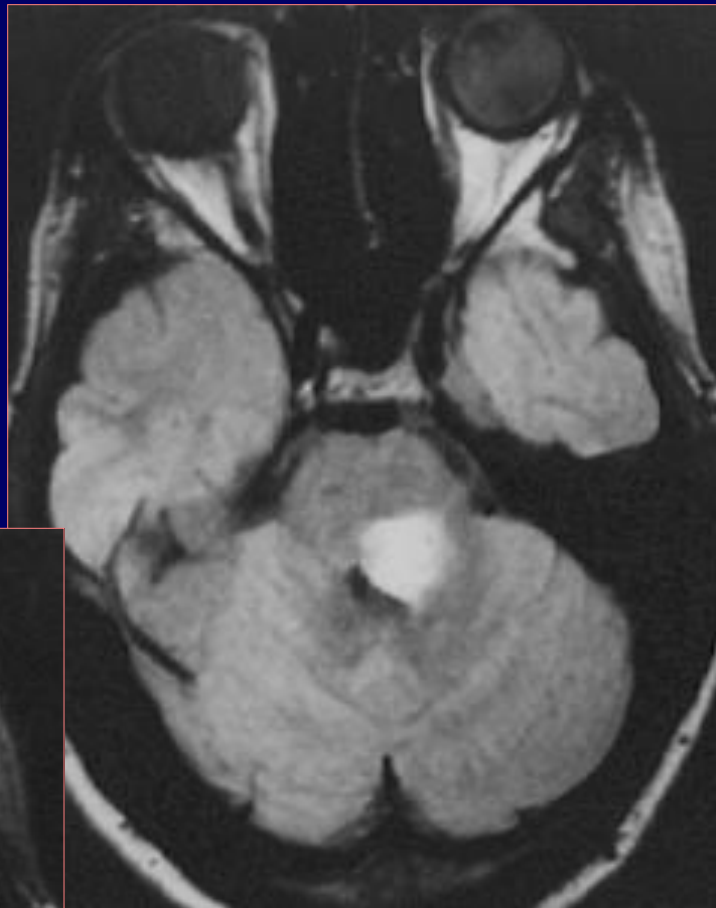


T1W

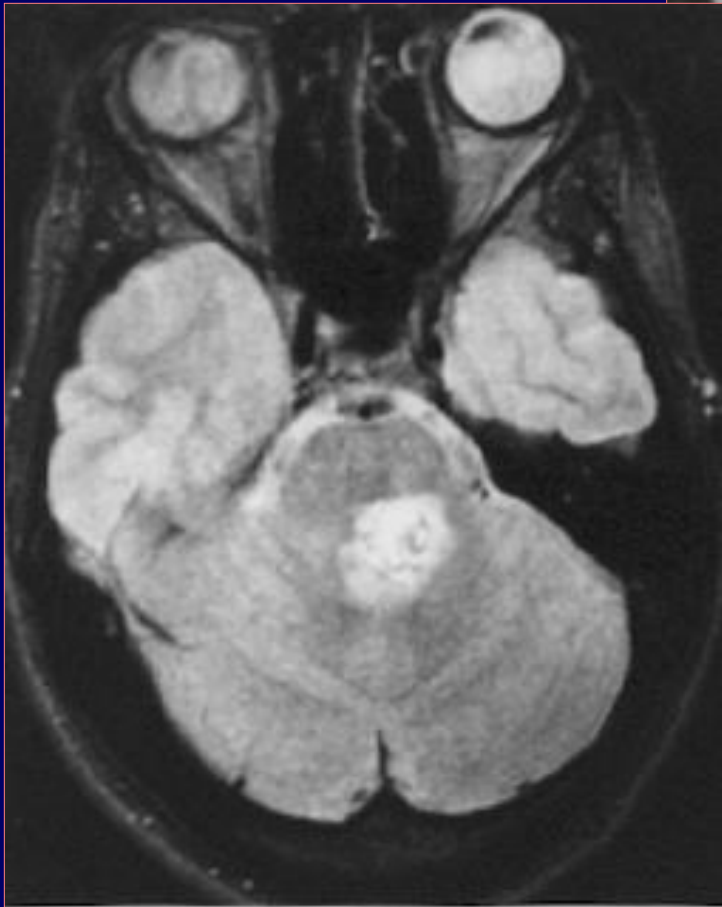


GRE

Subacute Hemorrhage

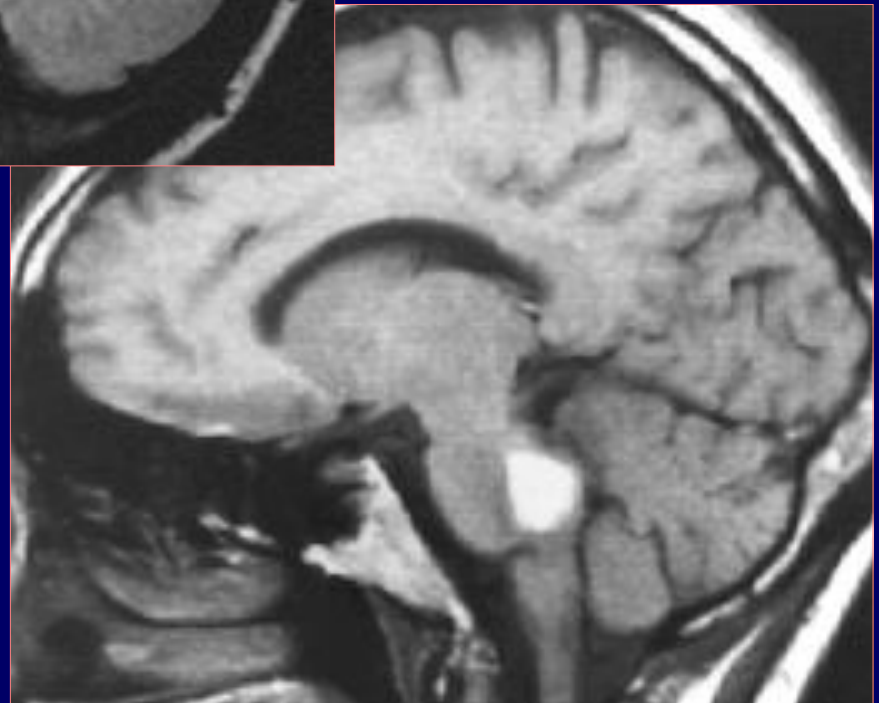


PDW

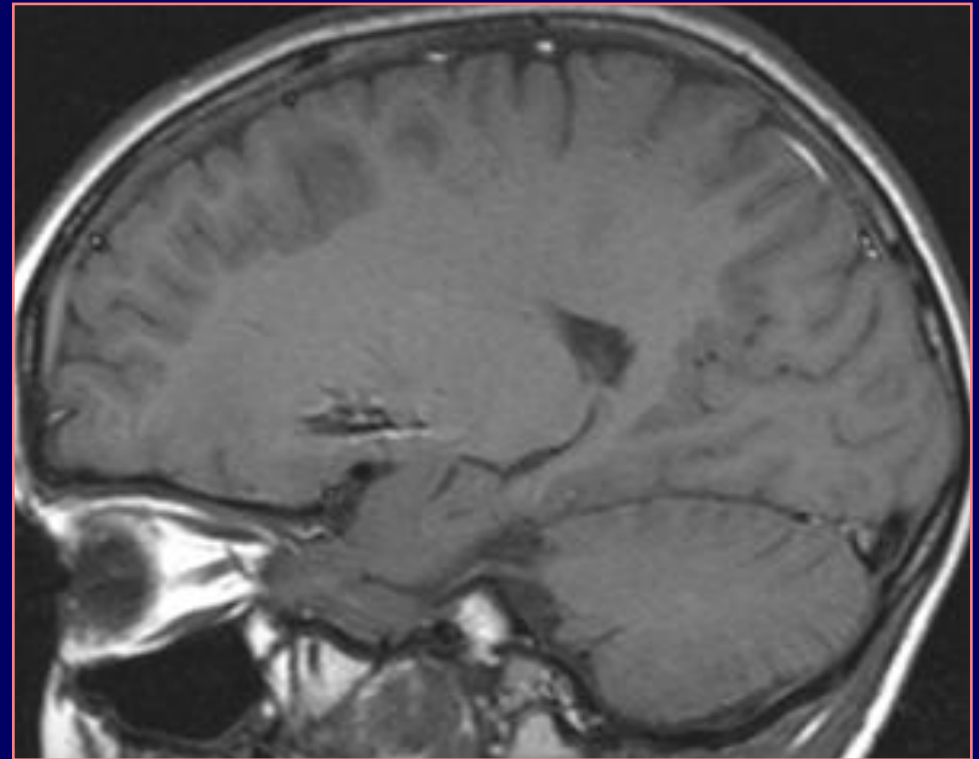
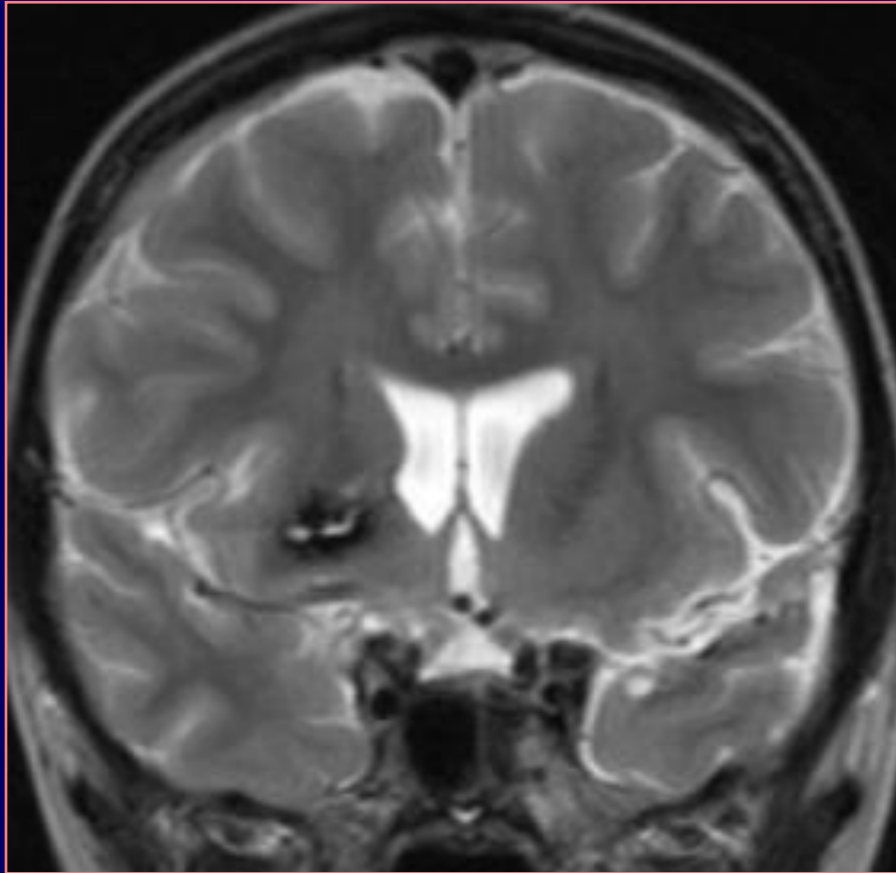


T2W

T1W

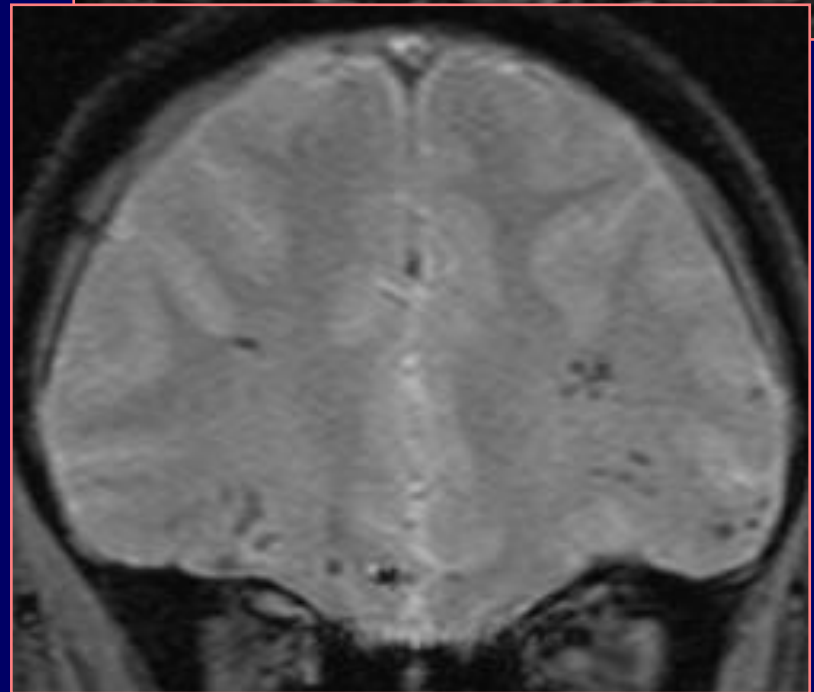
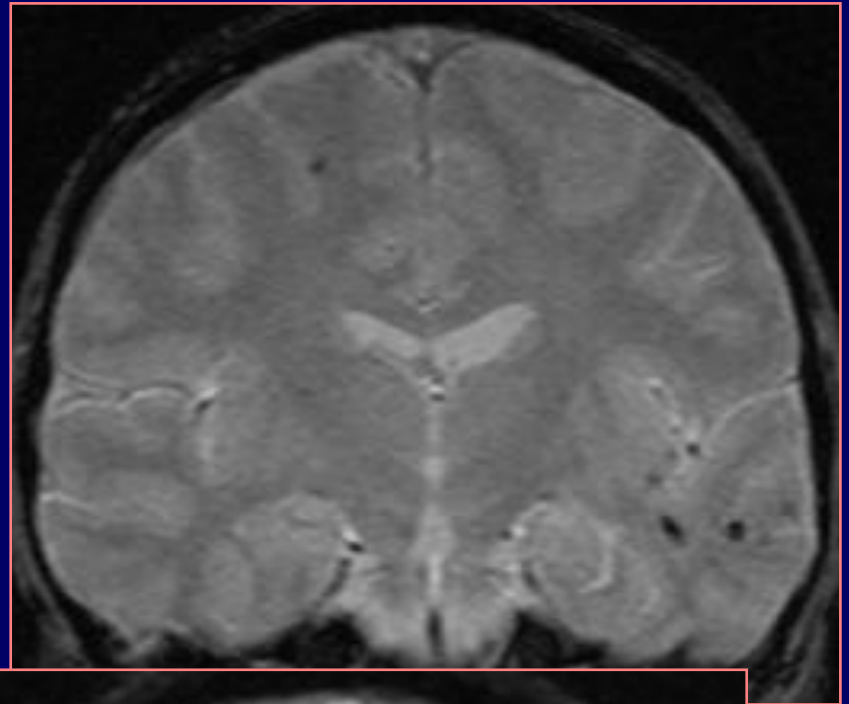
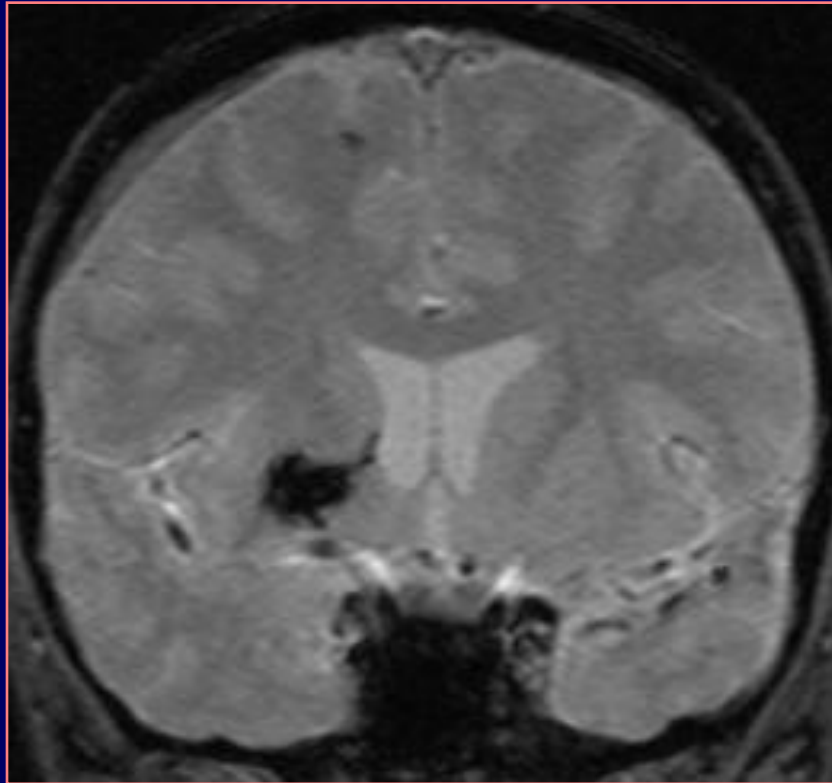


History: 9 y/o boy with prior head trauma

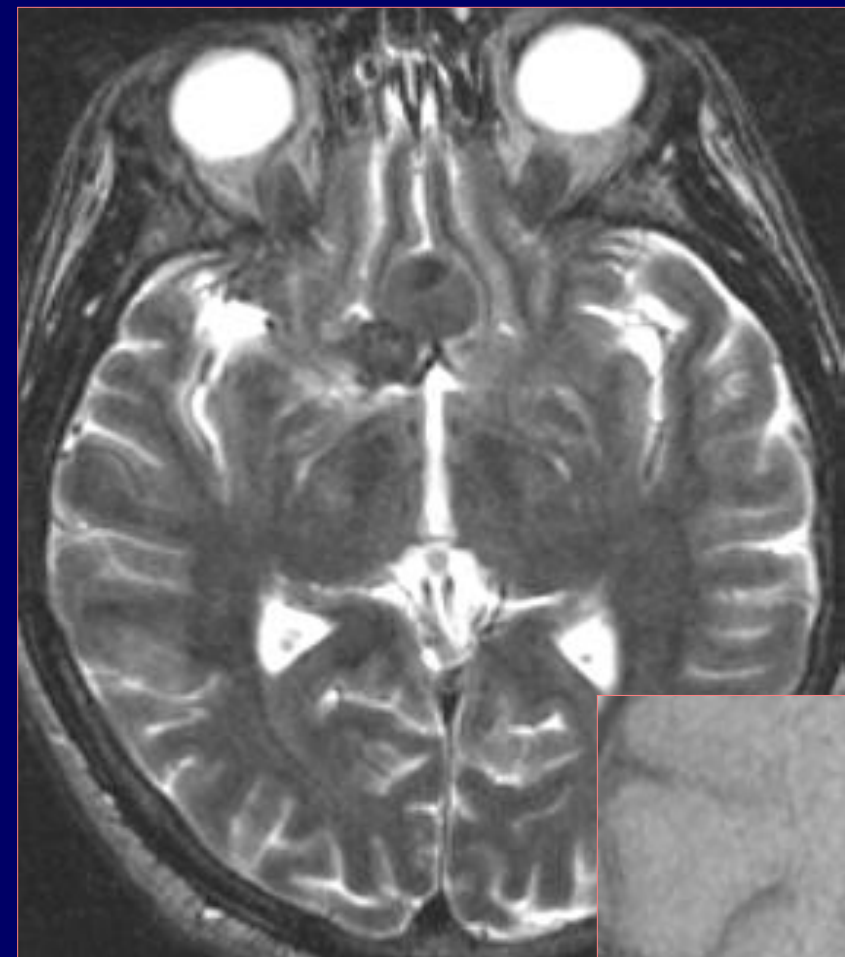


Hemorrhage Sequence

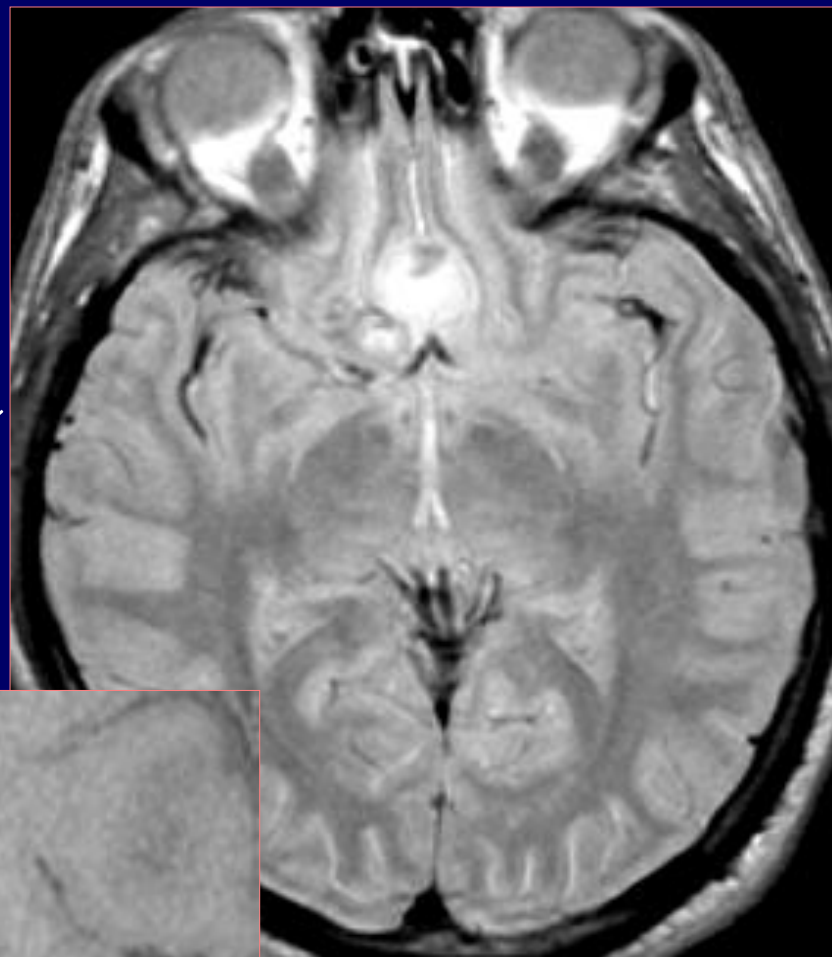
Gradient-echo



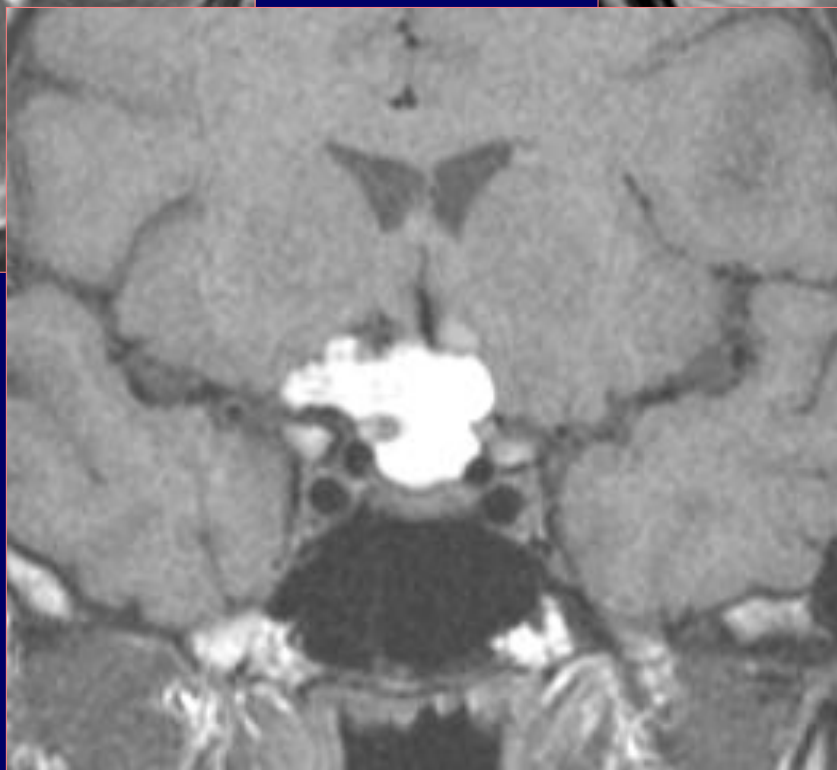
Fat or Lipoma



T2W



PDW



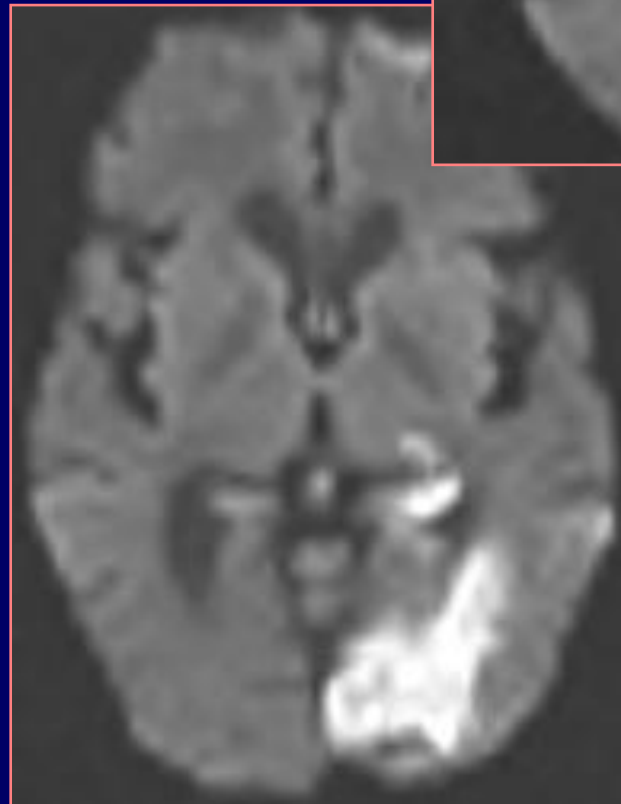
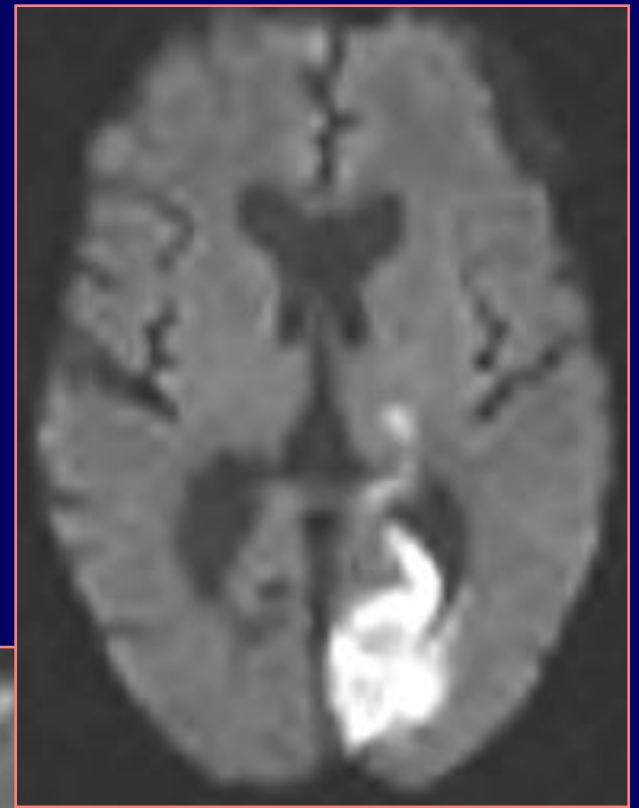
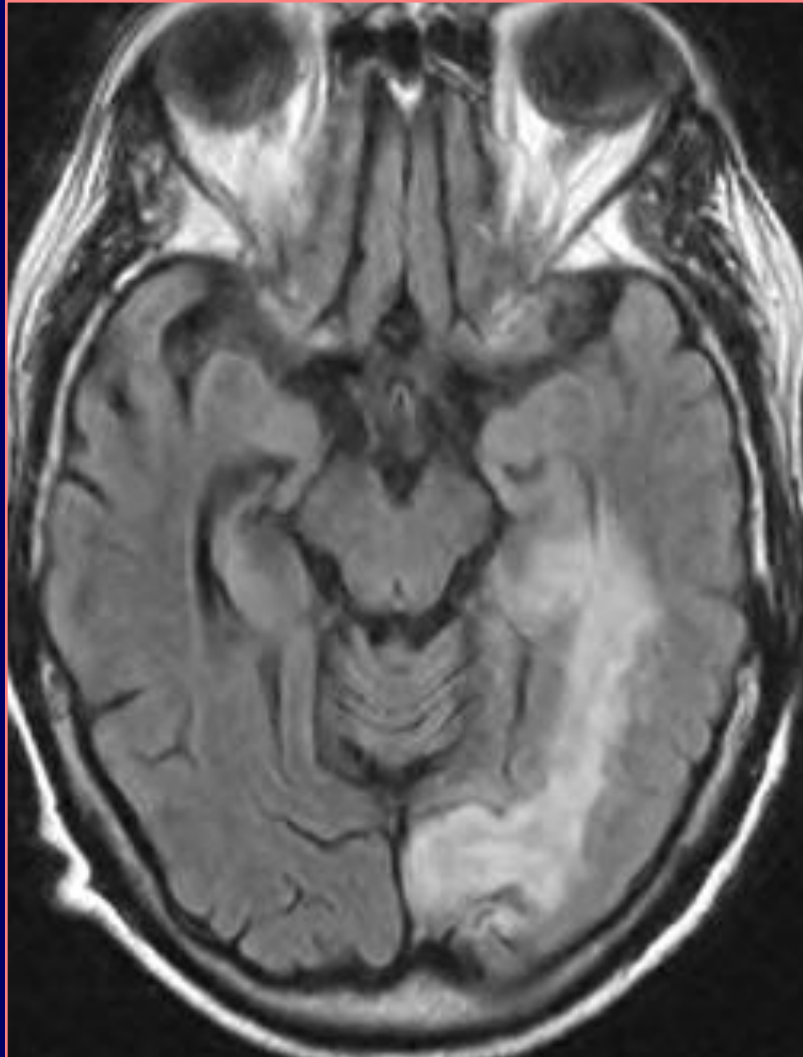
T1W

MR Signal Intensities

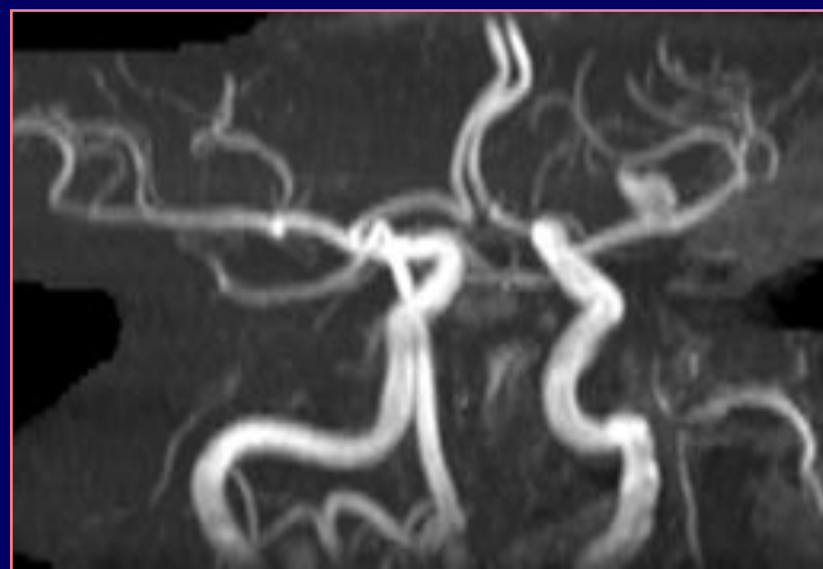
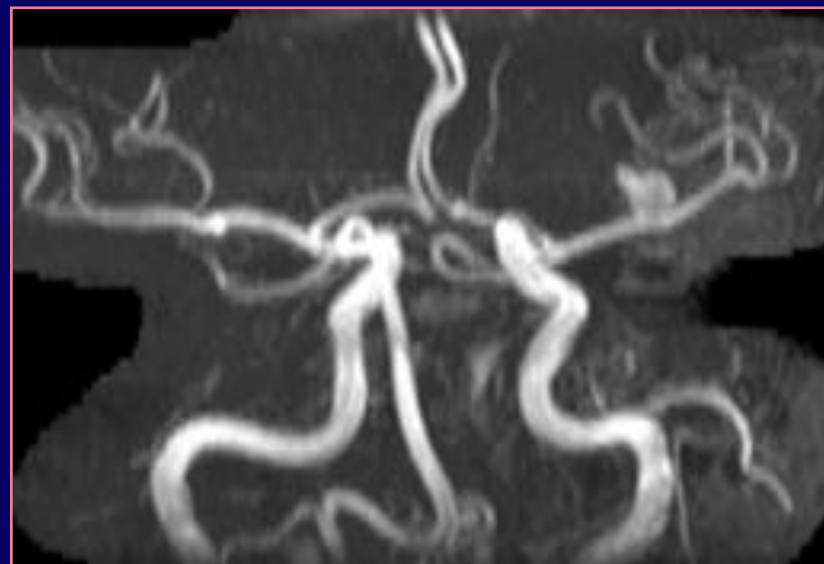
| | T2WI | PD/FLAIR | T1WI |
|----------------------------------|---------------|---------------|---------------|
| Solid mass | Bright | Bright | Dark |
| Cyst | Bright | Dark | Dark |
| Subacute blood | Bright | Bright | Bright |
| Acute & chronic blood | Dark | Dark | Gray |
| Fat | Dark | Bright | Bright |

Acute Stroke Sequence

Diffusion Weighted Imaging

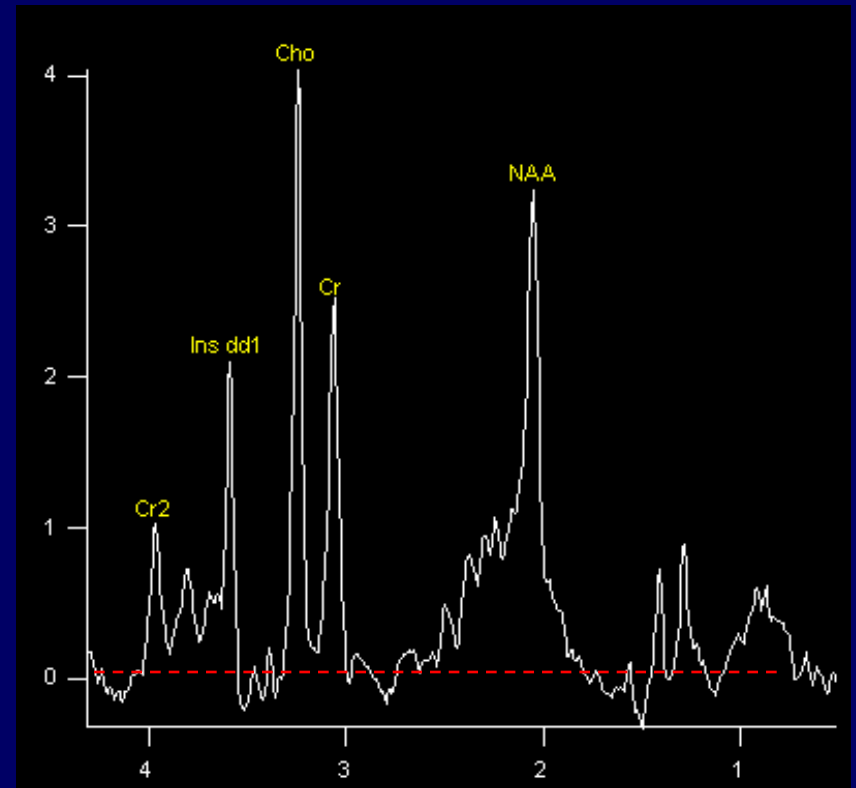
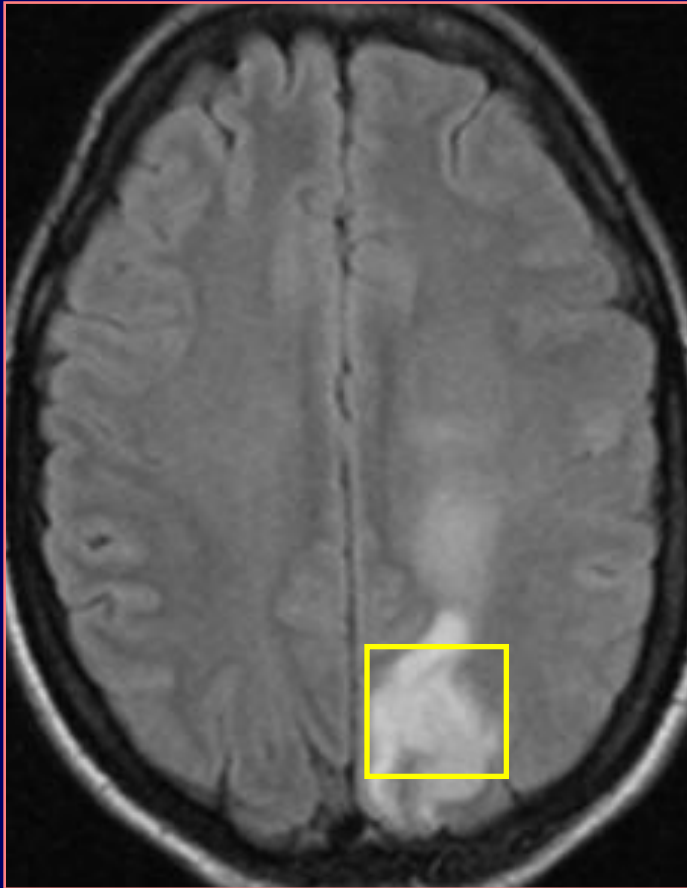


MR Angiography



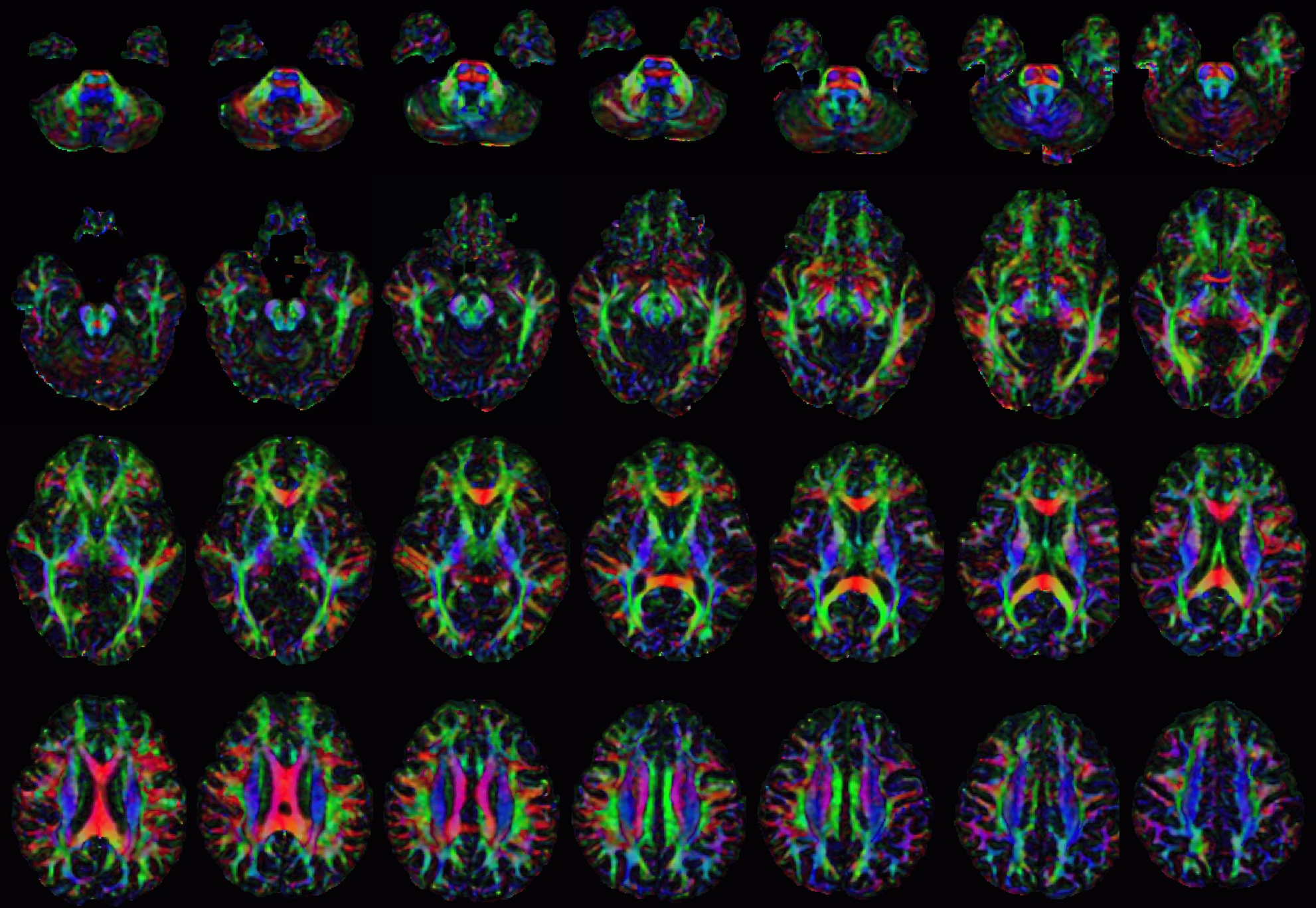
MR Spectroscopy

A Measure of Metabolism

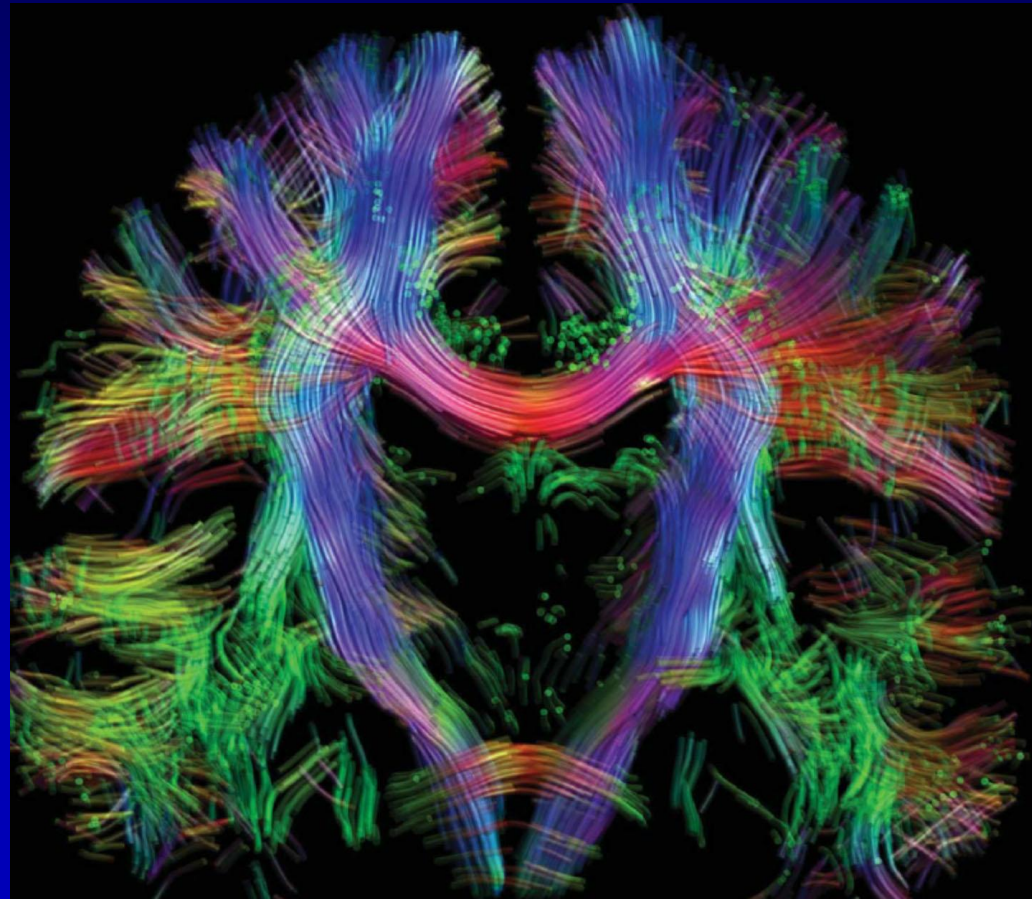
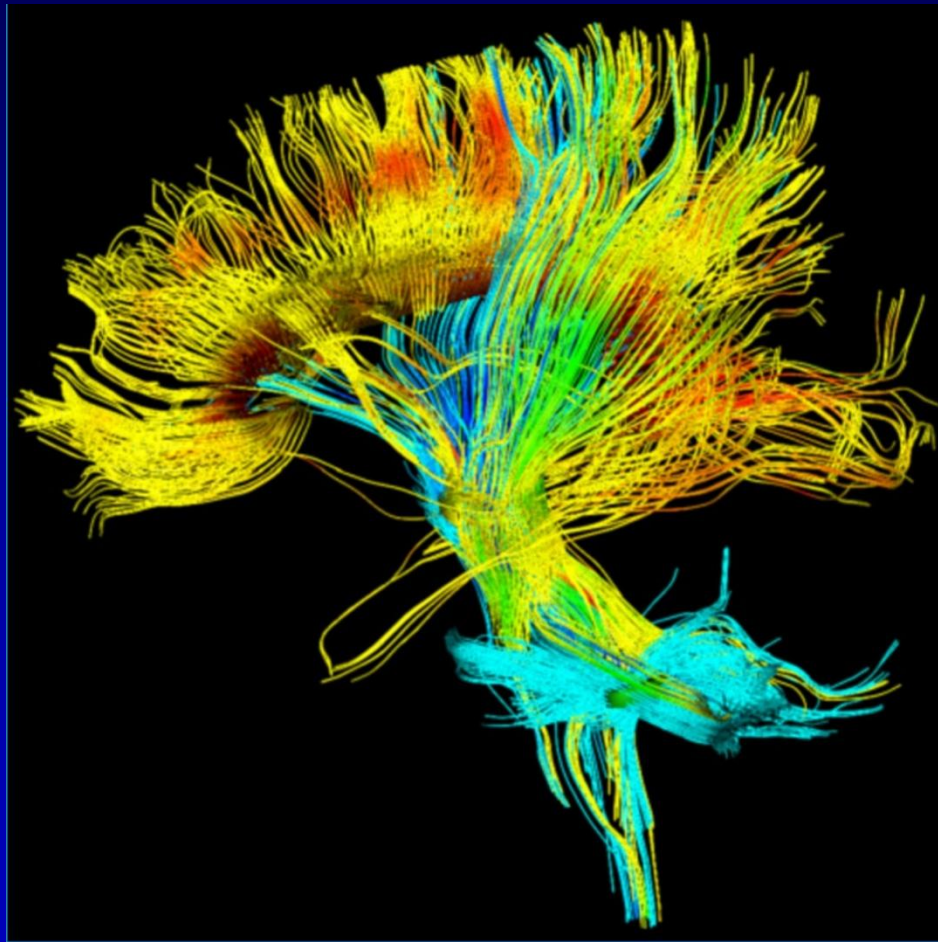


Dx:

Diffusion Tensor Imaging (DTI)



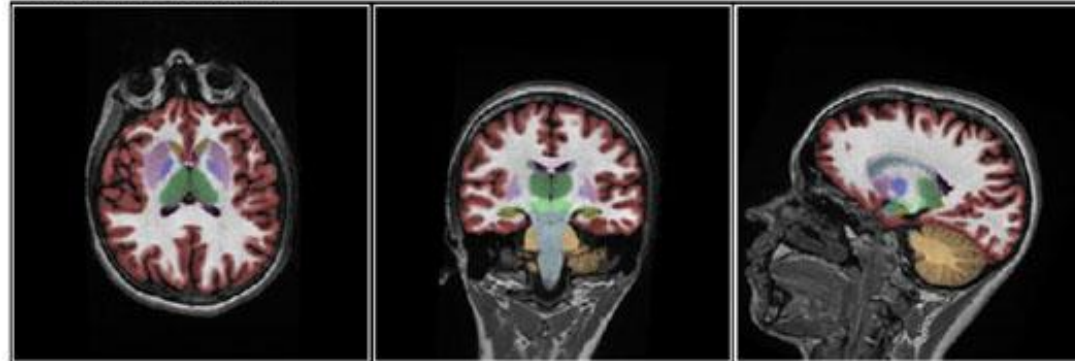
DTI Tractography / Fibertracking



PATIENT INFORMATION

| | | | |
|--------------------------------------|----------------------------------------------|---------------------------------------------|-------------------|
| Patient ID: 30000140812 | Patient Name: GODINEZ, VERONICA | Sex: F | Age: 25 |
| Accession Number: 00642317 | Referring Physician: MD YOO, KEVIN | Exam Date: 2016/06/21 10:55:08 AM | |

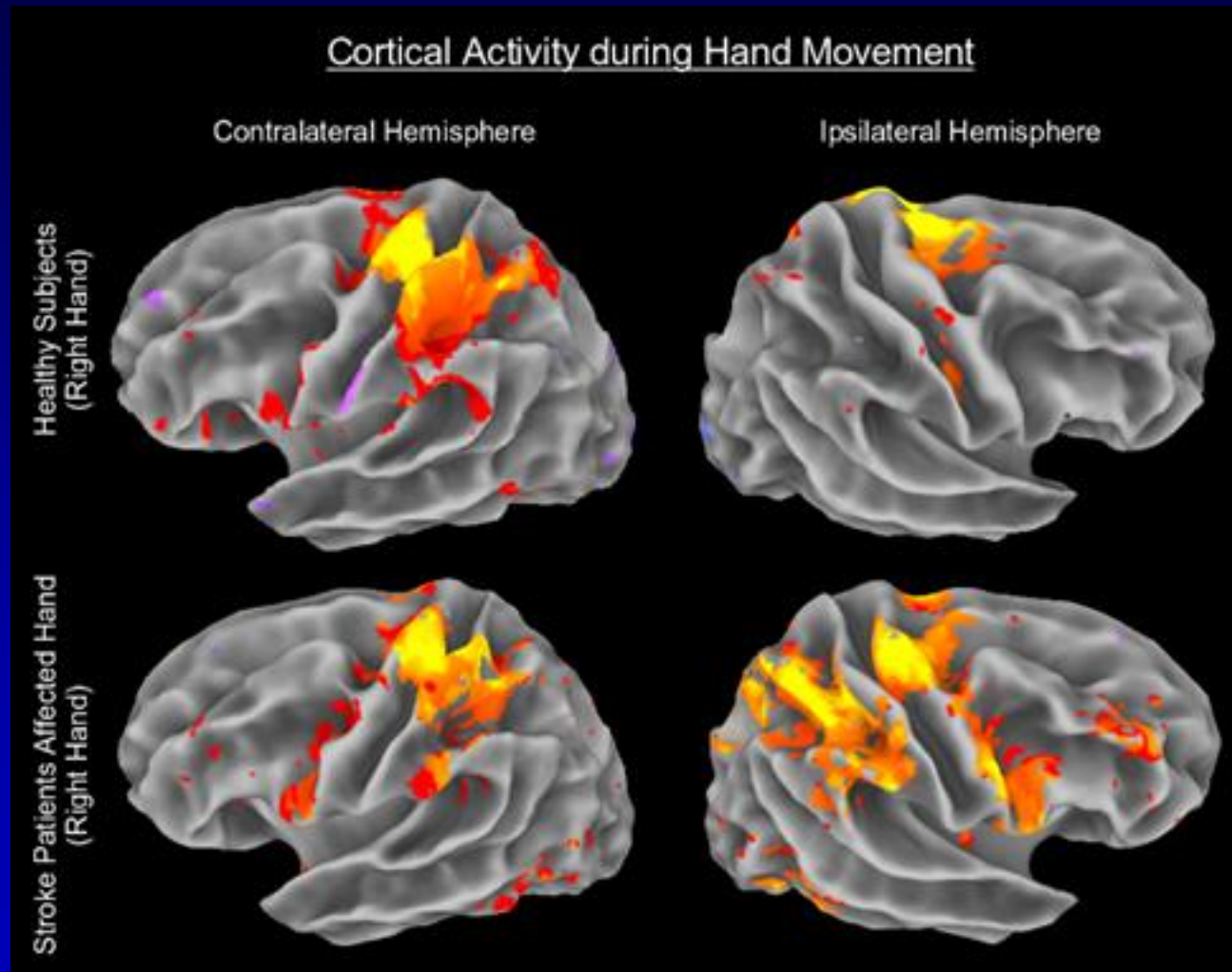
MORPHOMETRY RESULTS



| Intracranial Volume (ICV) (cm ³) | ICV Z-score | ICV Percentile | | Cortical Brain Regions | | LH Z-score | LH % | RH Z-score | RH % |
|----------------------------------------------|-------------------|----------------|-------------------|------------------------|------------------------------------|------------|------|------------|------|
| 1492.74 | -0.42 | 34 | | Frontal Lobe | | | | | |
| Brain Structure | LH Z-score | LH % | RH Z-score | RH % | Precentral | 0.05 | 52 | -0.54 | 30 |
| Total Cerebral White Matter ¹ | 0.66 | 75 | 1.04 | 85 | Premotor | 0.24 | 59 | -0.08 | 47 |
| Total Cerebral Grey Matter ² | -0.32 | 38 | -0.34 | 37 | Superior Frontal | -1.53 | 6 | -0.81 | 21 |
| Total Ventricle ³ | 0.08 | 53 | -0.09 | 47 | Anterior Middle Frontal | -1.31 | 9 | -0.67 | 25 |
| Cerebellar White Matter | -0.36 | 36 | -0.05 | 48 | Parstriangularis | 0.26 | 60 | -0.26 | 40 |
| Cerebellar Gray Matter | -0.48 | 32 | -0.34 | 37 | Lateral Orbito Frontal | 0.16 | 57 | 0.75 | 77 |
| Brainstem | 0.32 | 62 | 0.36 | 64 | Pars Orbitale | -0.05 | 48 | -1.01 | 16 |
| Thalamus | 0.46 | 68 | 1.39 | 92 | Parietal Lobe | | | | |
| Ventral Diencephalon | 0.25 | 60 | 0.76 | 78 | Inferior Parietal | > 1.65 | 97 | 0.29 | 62 |
| Hippocampus | 0.83 | 80 | 0.33 | 63 | Superior Parietal | -0.04 | 48 | 0.76 | 78 |
| Amygdala | 0.46 | 68 | 0.39 | 65 | Medial Parietal | 0.83 | 80 | 1.16 | 88 |
| Basal Ganglia | | | | | Supra Marginal | -0.54 | 29 | 1.21 | 89 |
| Putamen | 0.51 | 70 | > 1.65 | 97 | Primary Sensory | 0.37 | 64 | 0.43 | 67 |
| Caudate | 0.51 | 69 | 1.25 | 89 | Primary Motor | -1.42 | 8 | < -1.65 | 2 |
| Nucleus Accumbens | 0.02 | 51 | 0.65 | 74 | Occipital Lobe | | | | |
| Pallidum | -0.21 | 41 | 1.35 | 91 | Medial Occipital | 0.11 | 54 | 0.09 | 54 |
| | | | | | Lateral Occipital | 1.23 | 89 | 0.06 | 52 |
| | | | | | Temporal Lobe | | | | |
| | | | | | Fusiform | 1.49 | 93 | -0.35 | 36 |
| | | | | | Anterior Medial Temporal | -0.40 | 34 | 0.94 | 83 |
| | | | | | Posterior Medial Temporal | 0.78 | 78 | 0.64 | 74 |
| | | | | | Temporal Pole | -1.09 | 14 | -0.65 | 26 |
| | | | | | Transverse + Superior Temporal | < -1.65 | 3 | -1.48 | 7 |
| | | | | | Posterior Superior Temporal Sulcus | < -1.65 | < 1 | 0.29 | 61 |
| | | | | | Middle Temporal | -1.40 | 8 | 0.12 | 55 |
| | | | | | Inferior Temporal | -0.90 | 38 | 0.32 | 63 |
| | | | | | Limbic Lobe | | | | |
| | | | | | Caudal + Rostral Ant Cingulate | > 1.65 | 97 | -0.39 | 35 |
| | | | | | Isthmus + Post Cingulate | -0.10 | 46 | 0.73 | 77 |

1) Total White Matter excludes Cerebellum
 2) Total Grey Matter excludes Cerebellum
 3) Total Ventricle includes Lateral Ventricle, 3rd Ventricle and 4th Ventricle
 4) Medial Occipital includes Cuneus, Lingual, and Pericalcarine
 ** Normative values are for reference purposes.

fMRI (BOLD) Technique

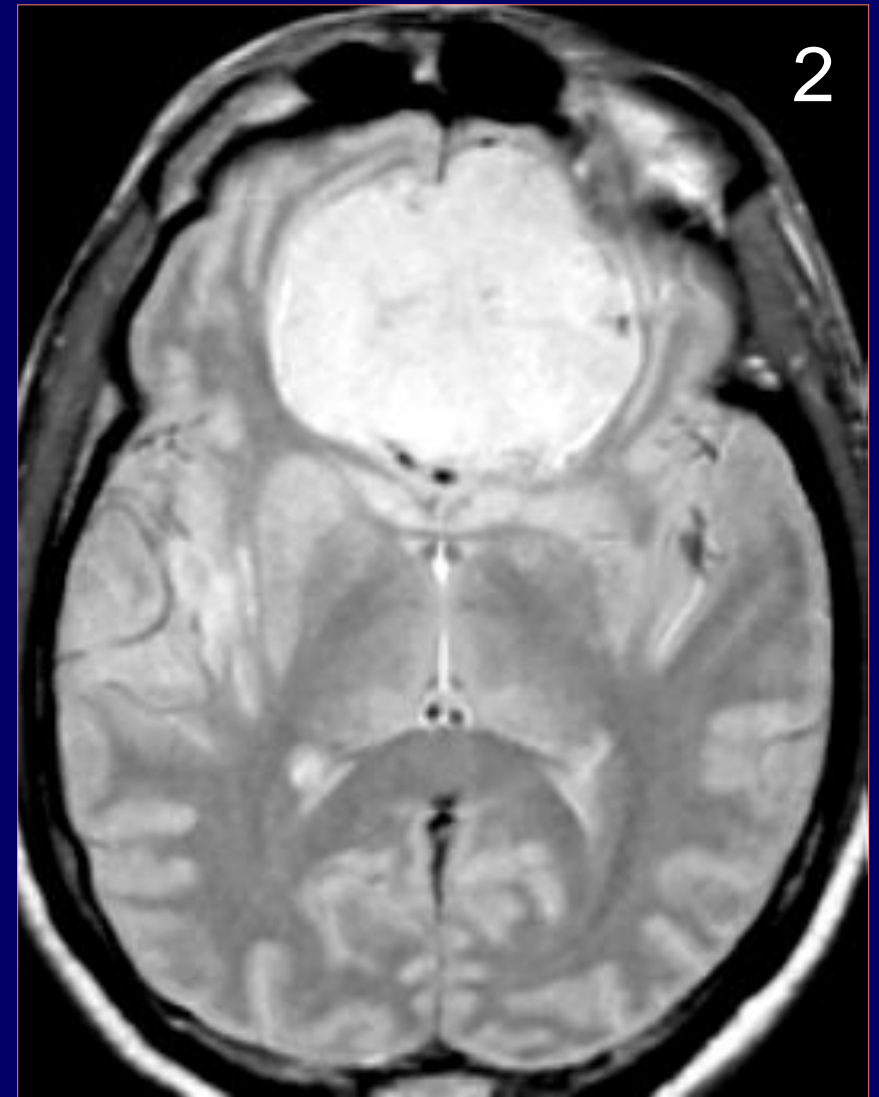
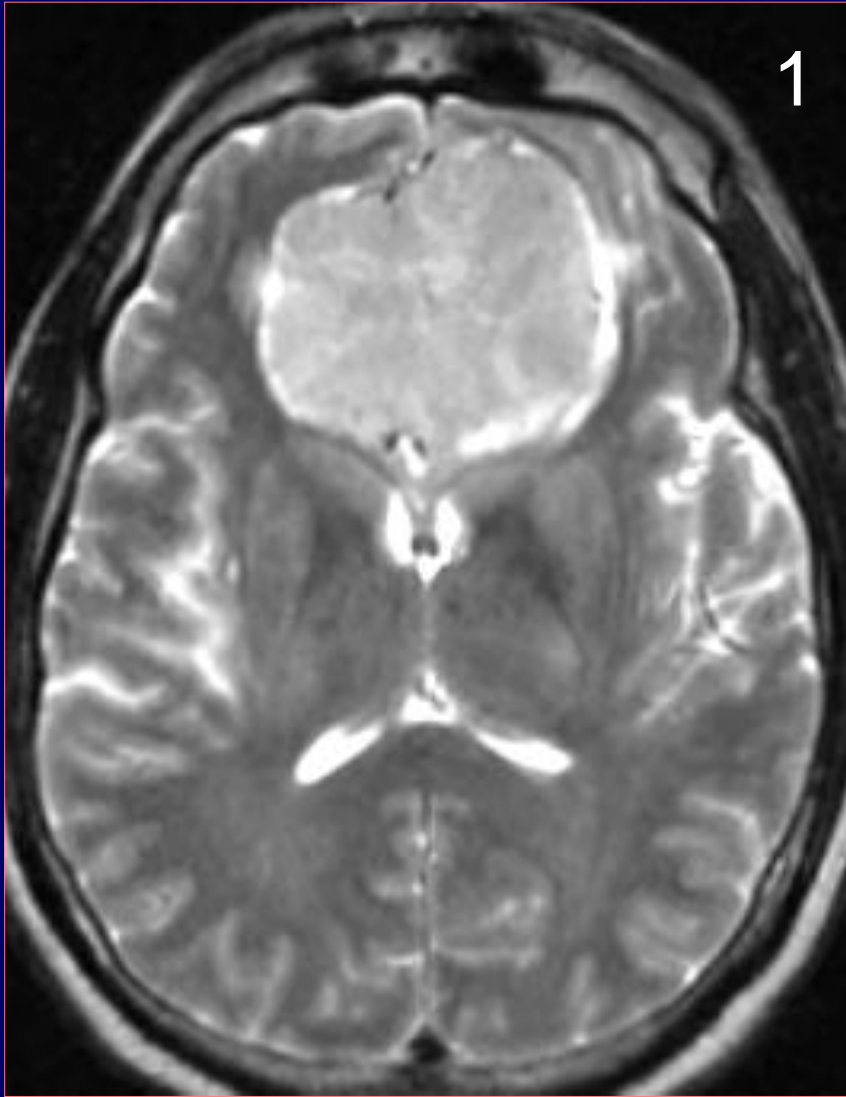


Brain Screening Protocol



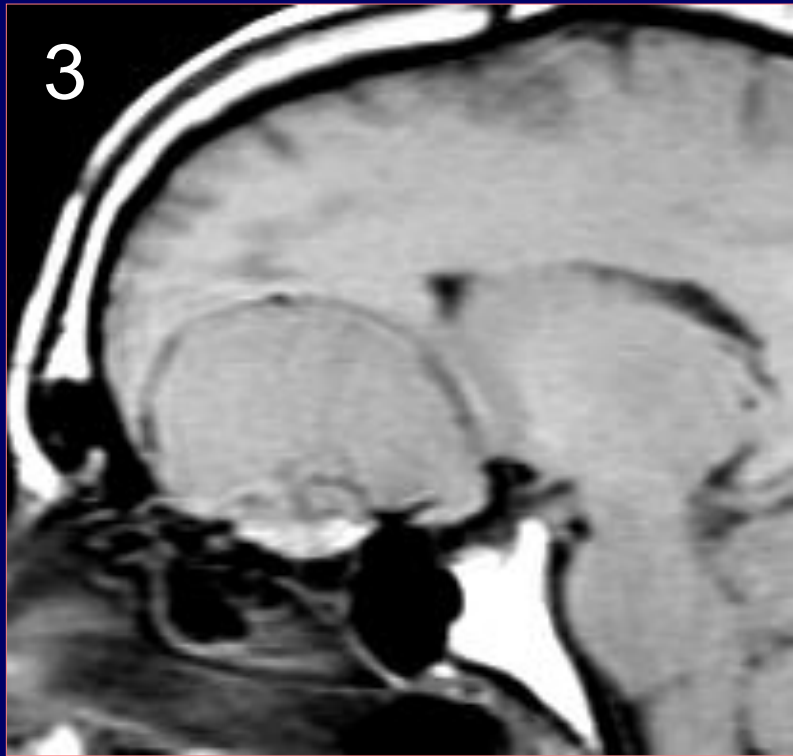
- Sagittal T1-weighted images
- Axial T2-weighted images
- Axial FLAIR images
- Diffusion-weighted images
- Gradient-echo images
- Axial T1-weighted images
- Gadolinium: Axial & Coronal T1

History: 46 y.o. man
with headaches & increasing confusion

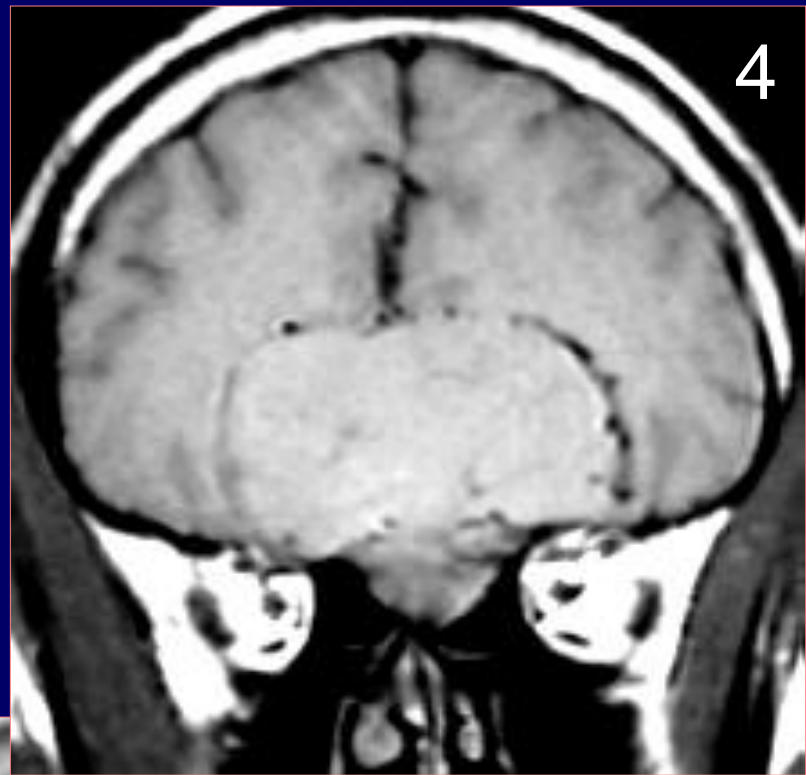


T2W

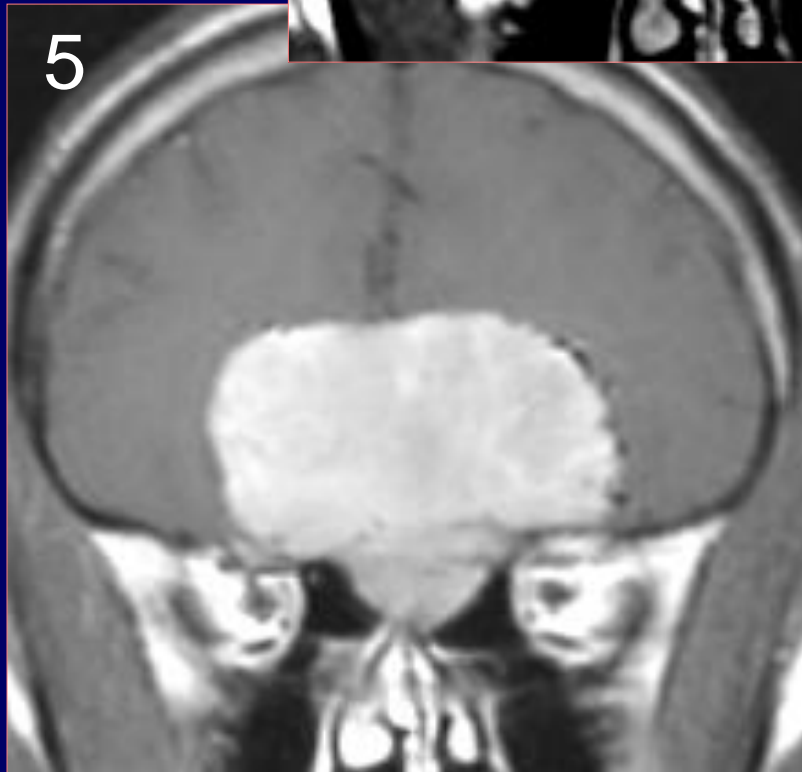
PDW



T1W



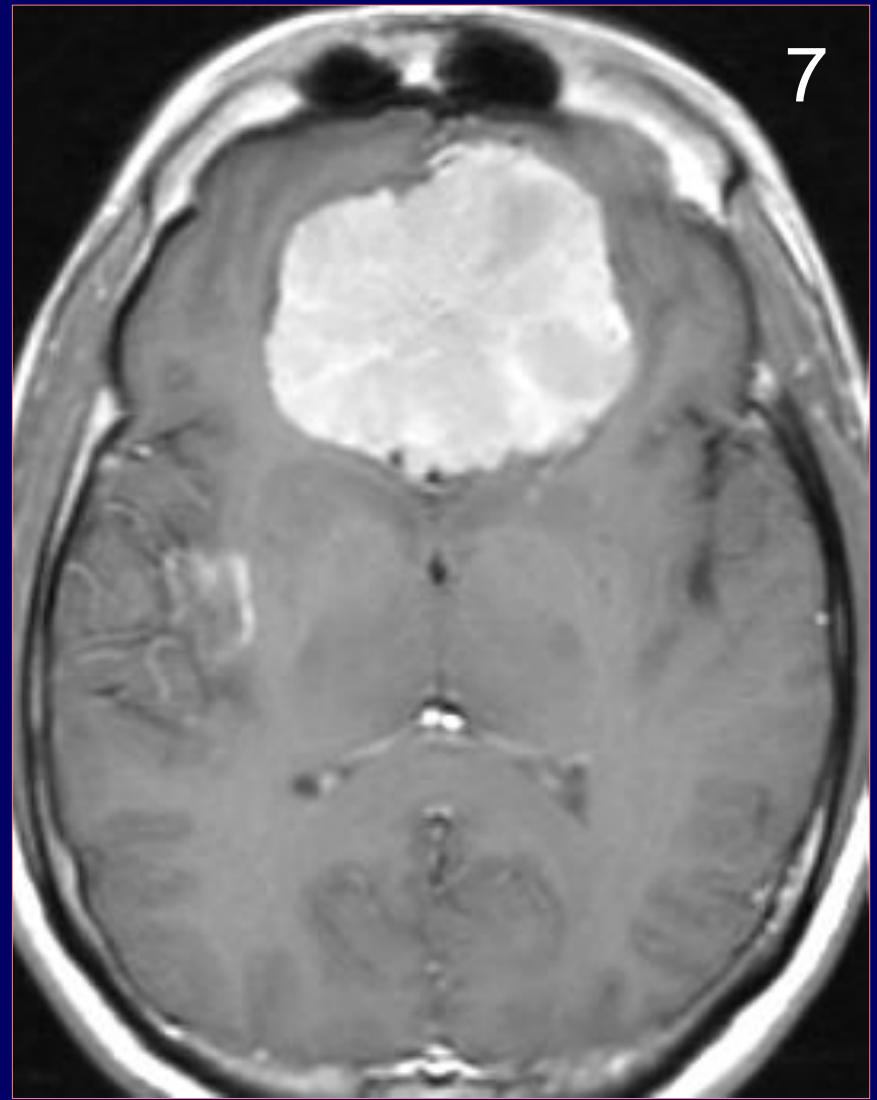
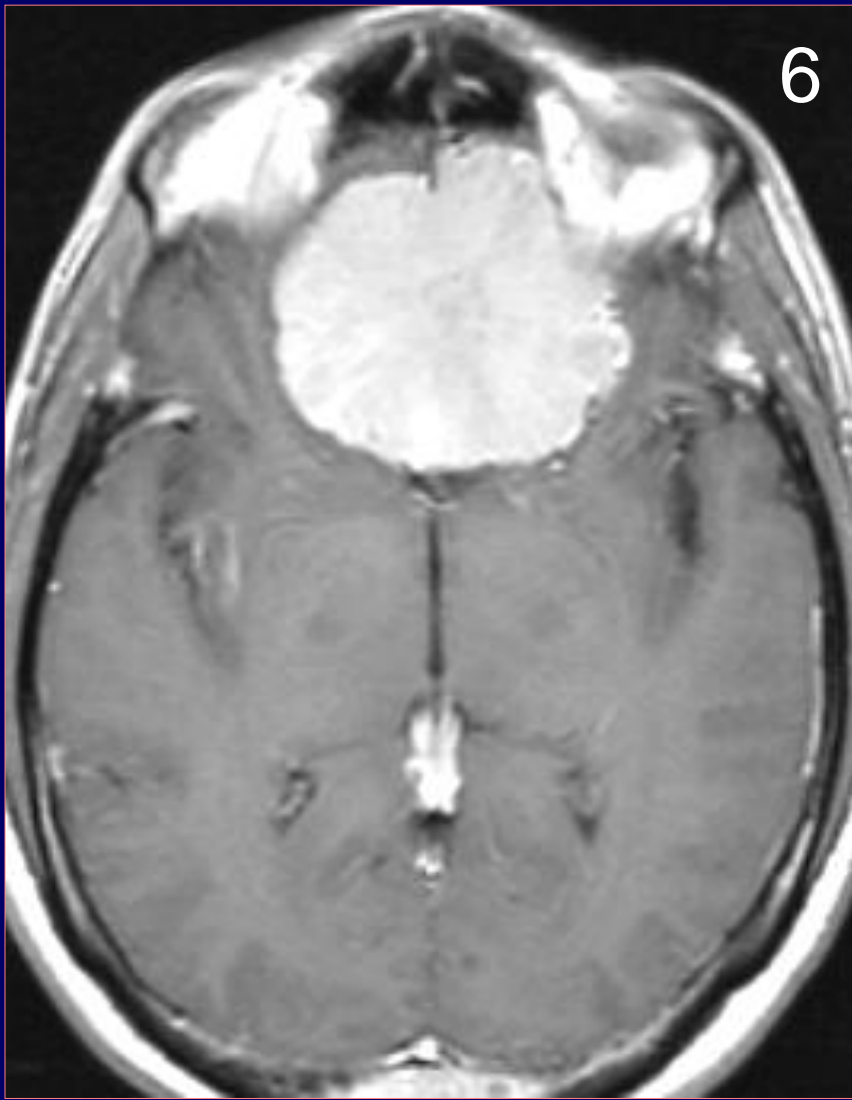
T1W



T1W / Gd

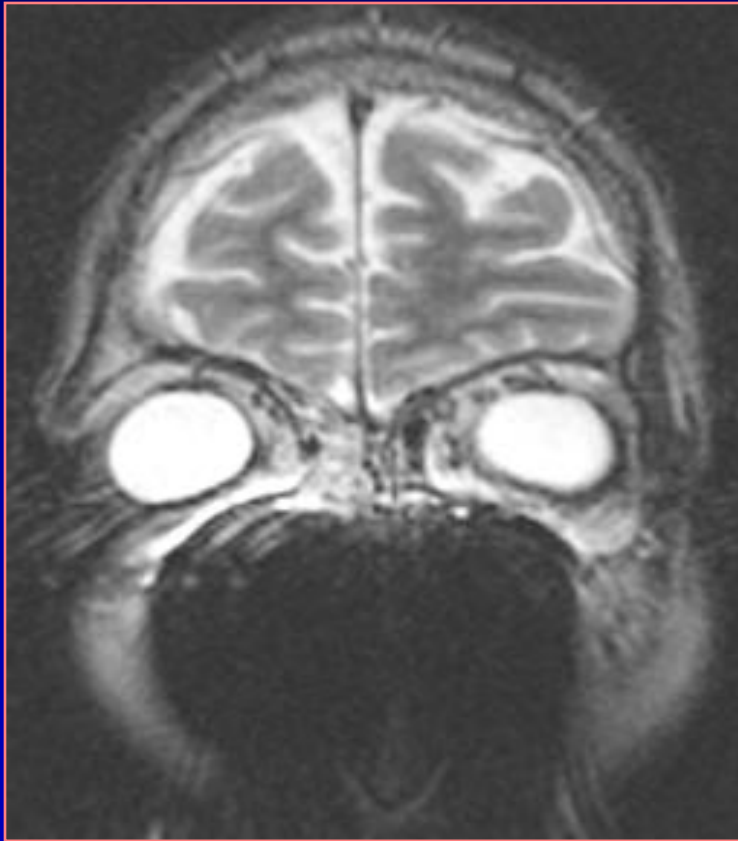
{Page 2}

Increasing confusion {Page 3}



Dx:

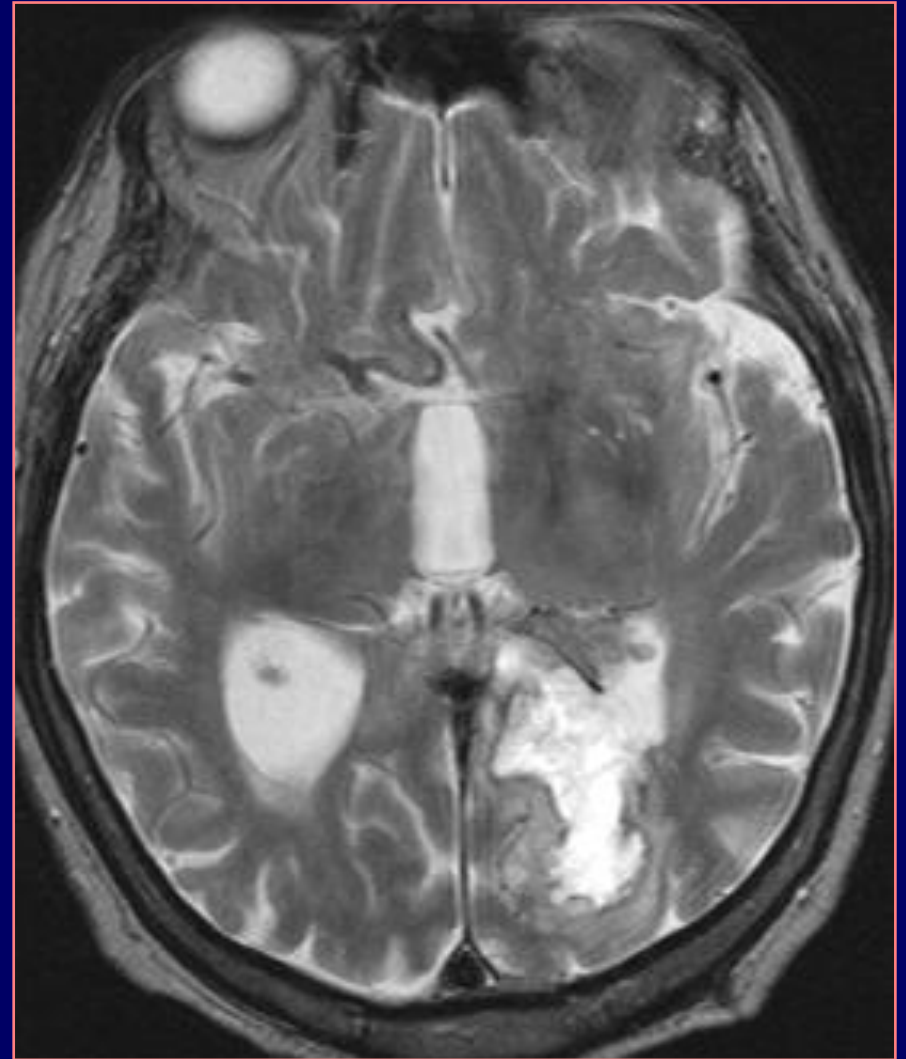
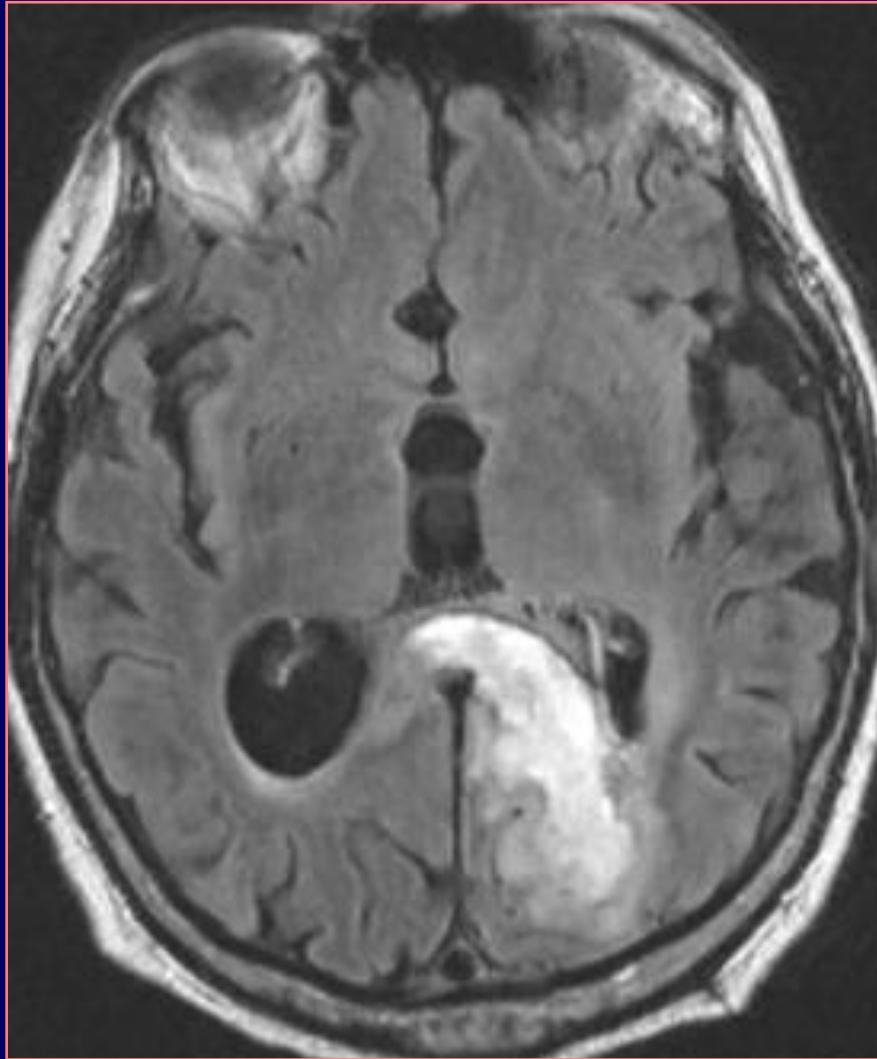
Student Cases



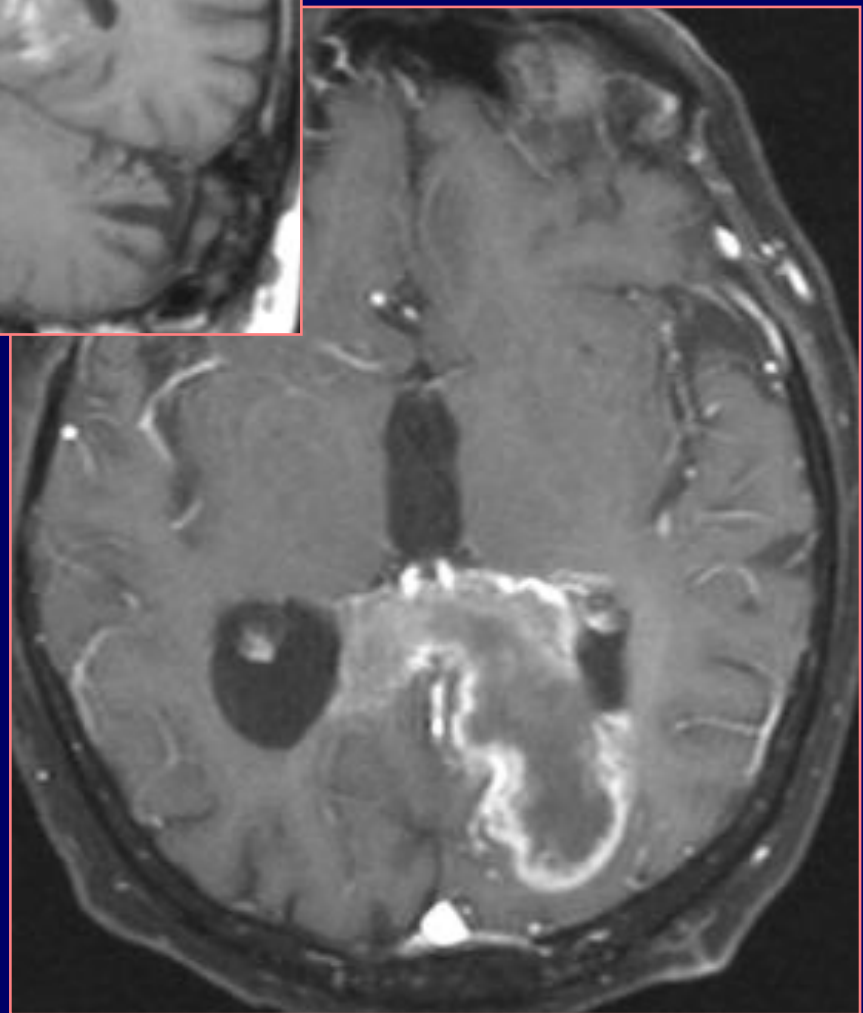
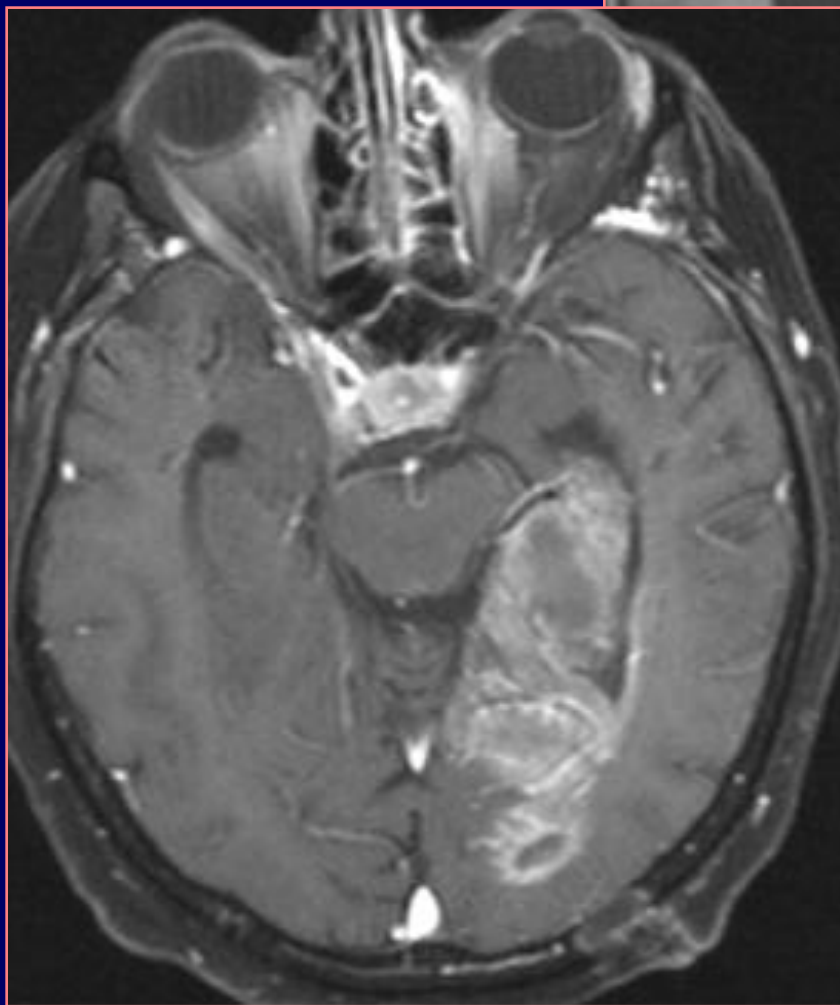
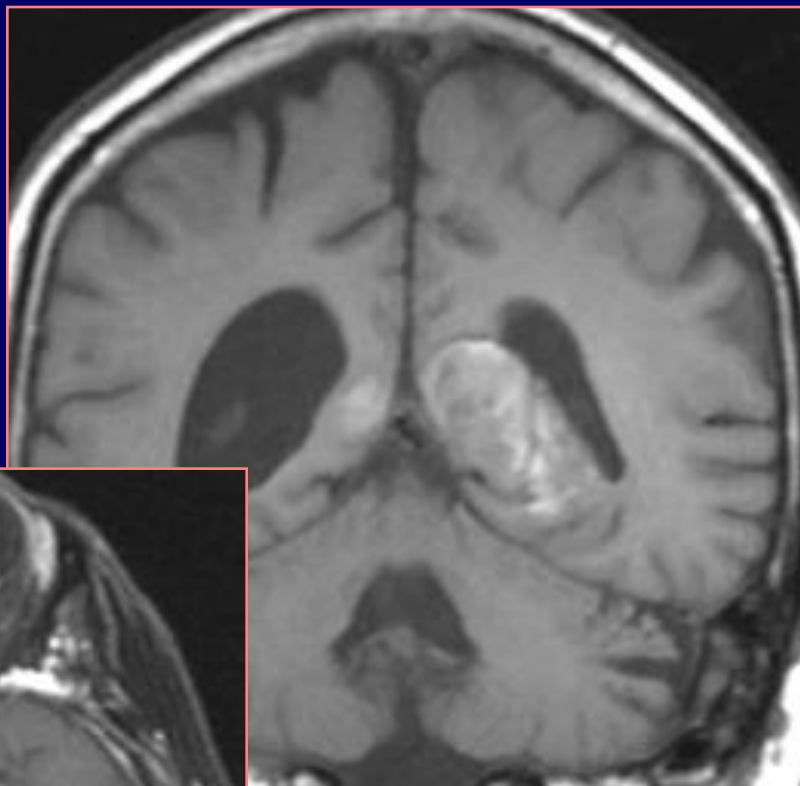
"May the FORCE be with you!"

Case 1

History: 69 y/o man with nausea & memory deficits for several weeks



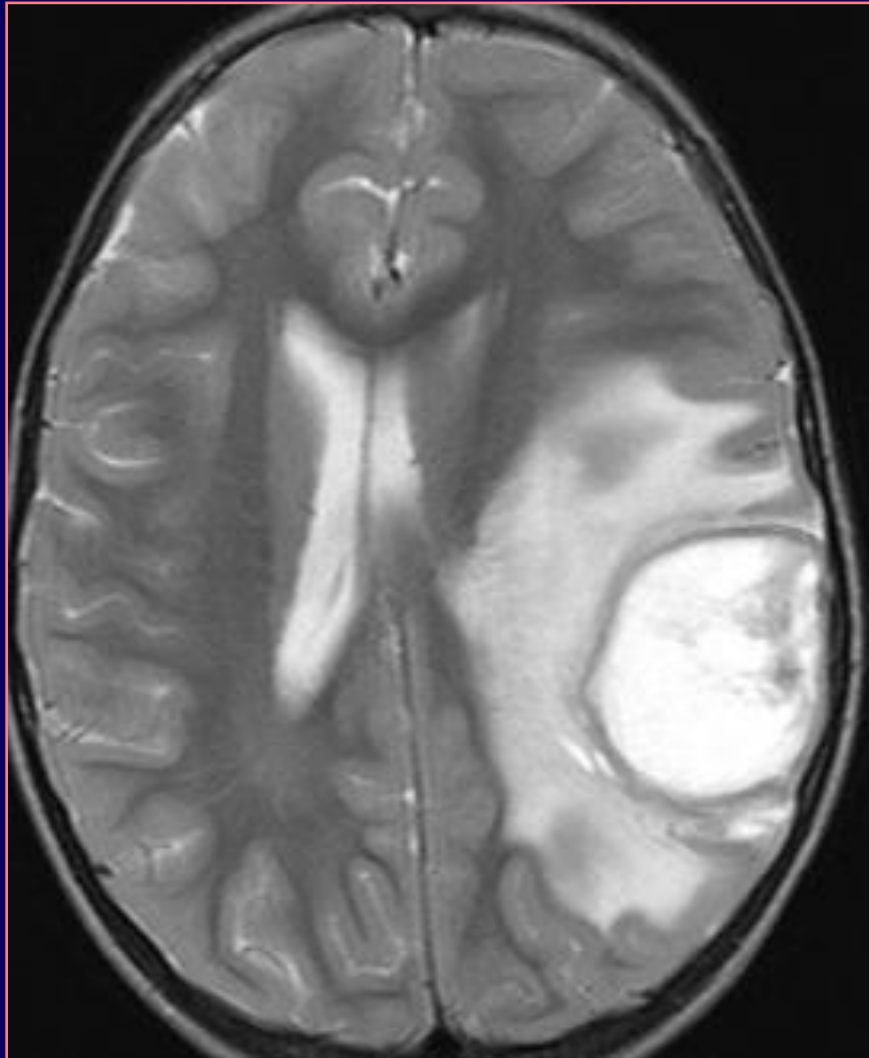
{Page 2}



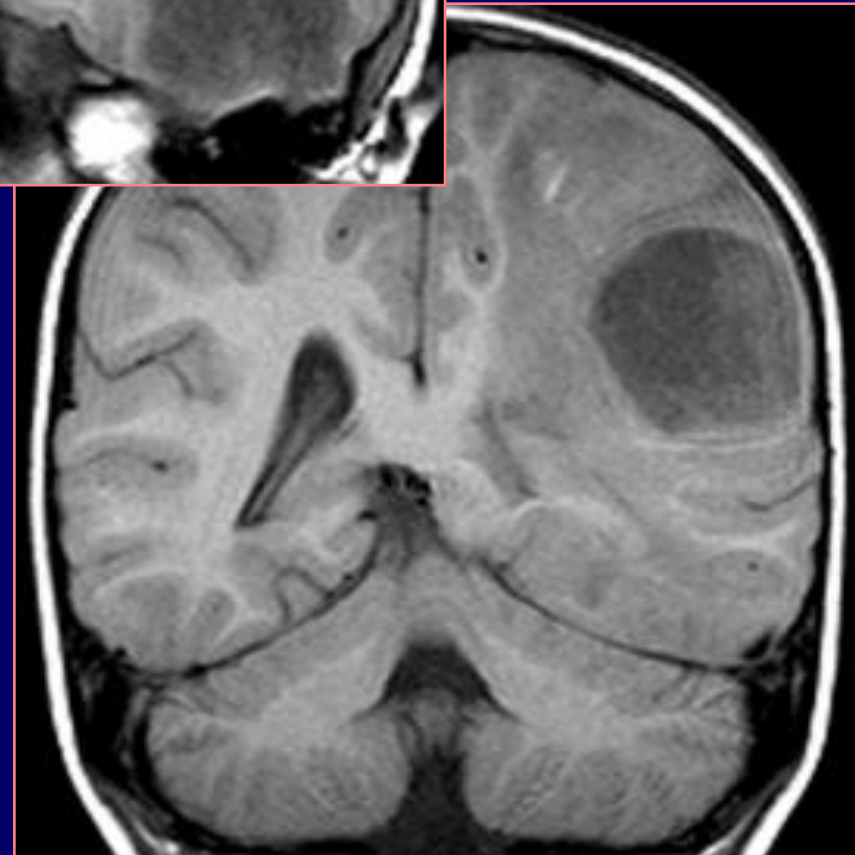
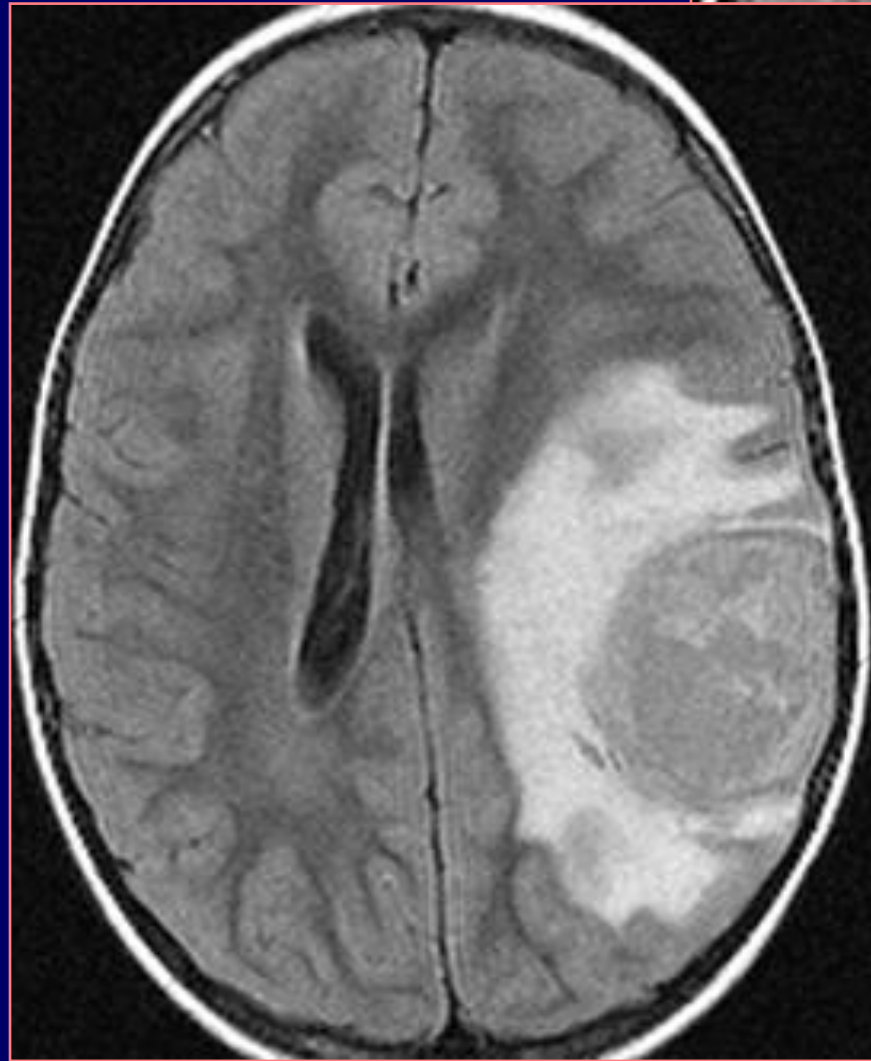
Dx:

Case 2

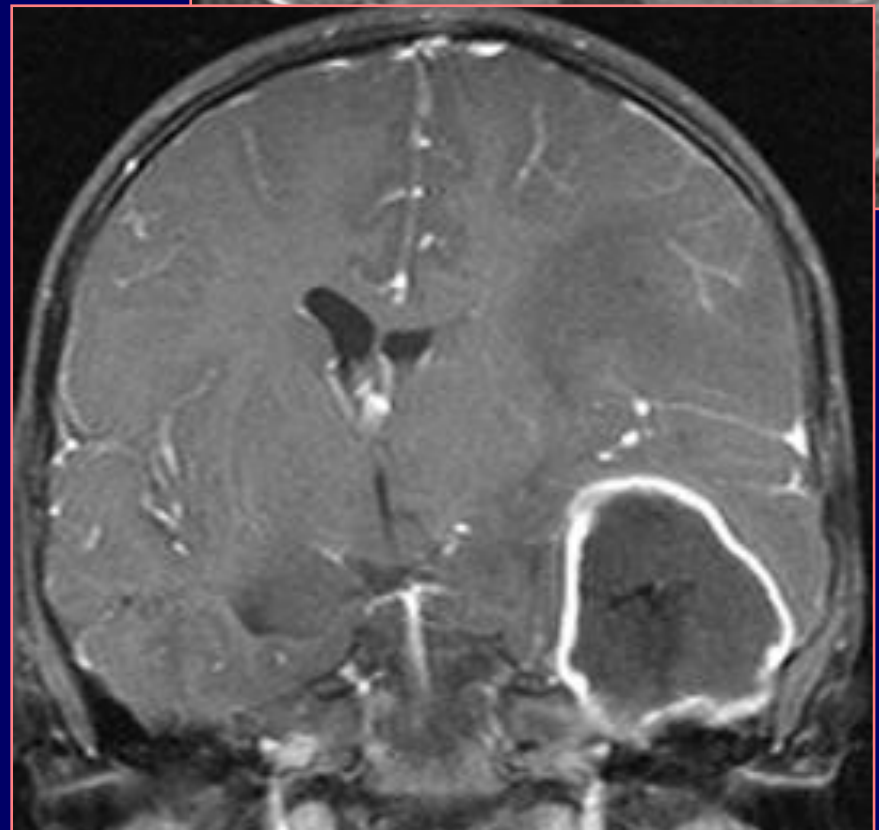
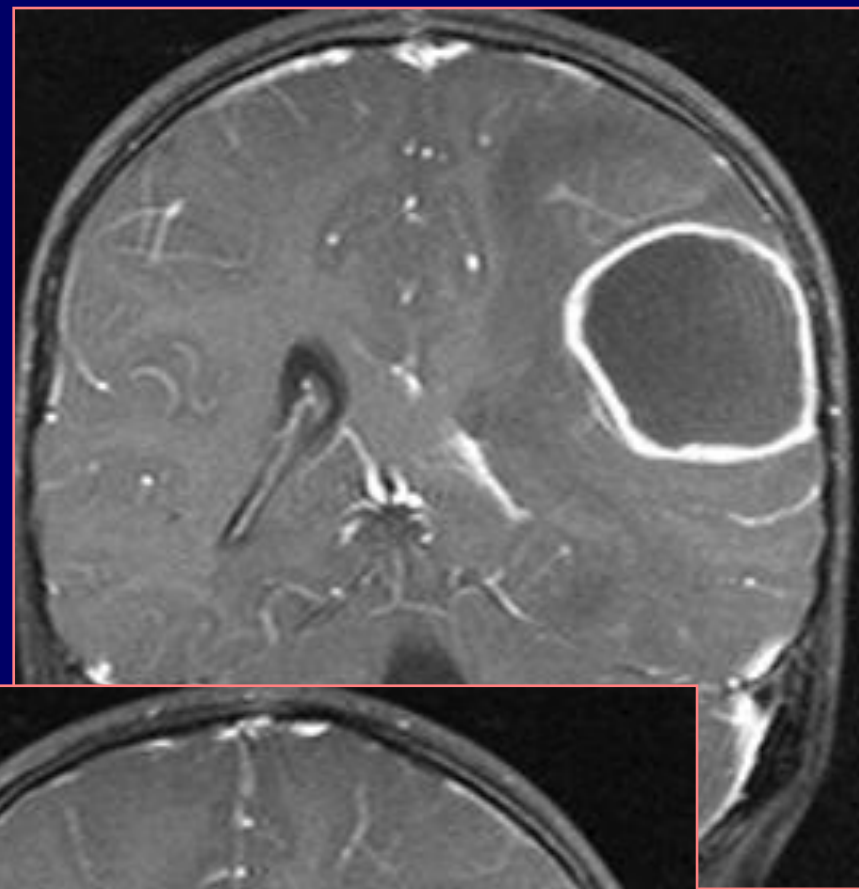
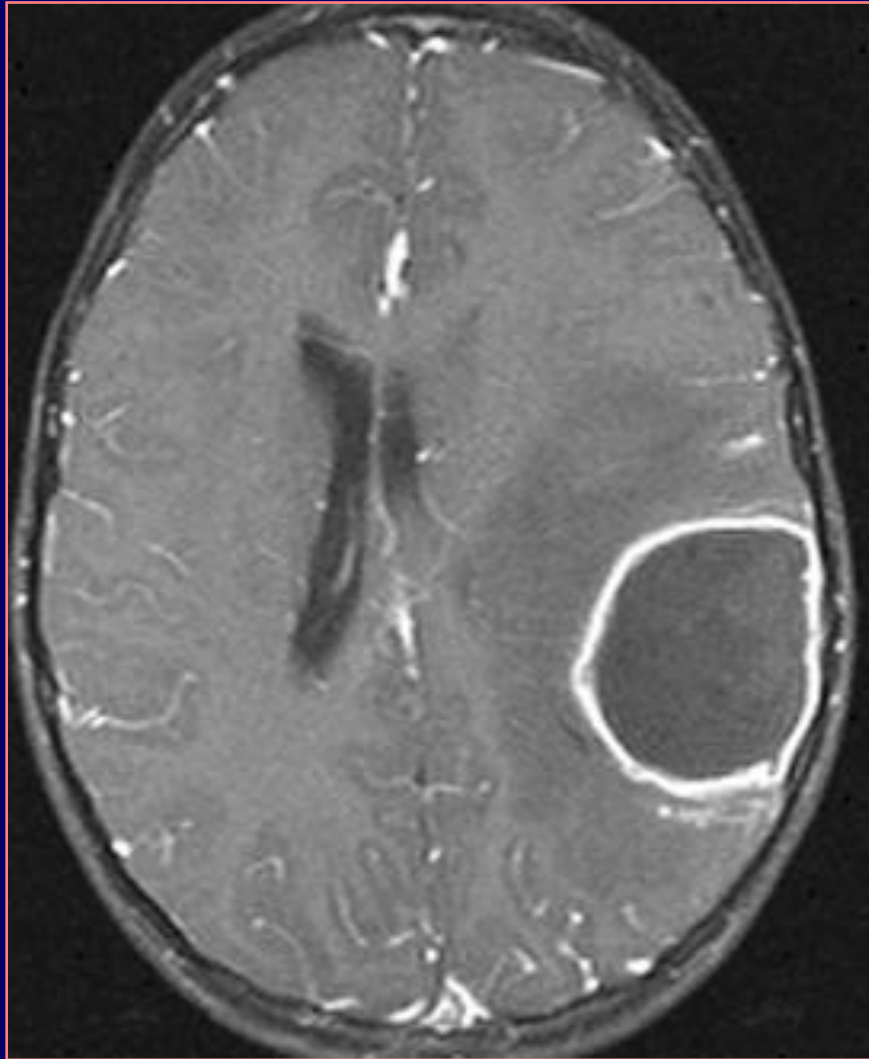
History: 5 y/o girl with seizures



{Page 2}



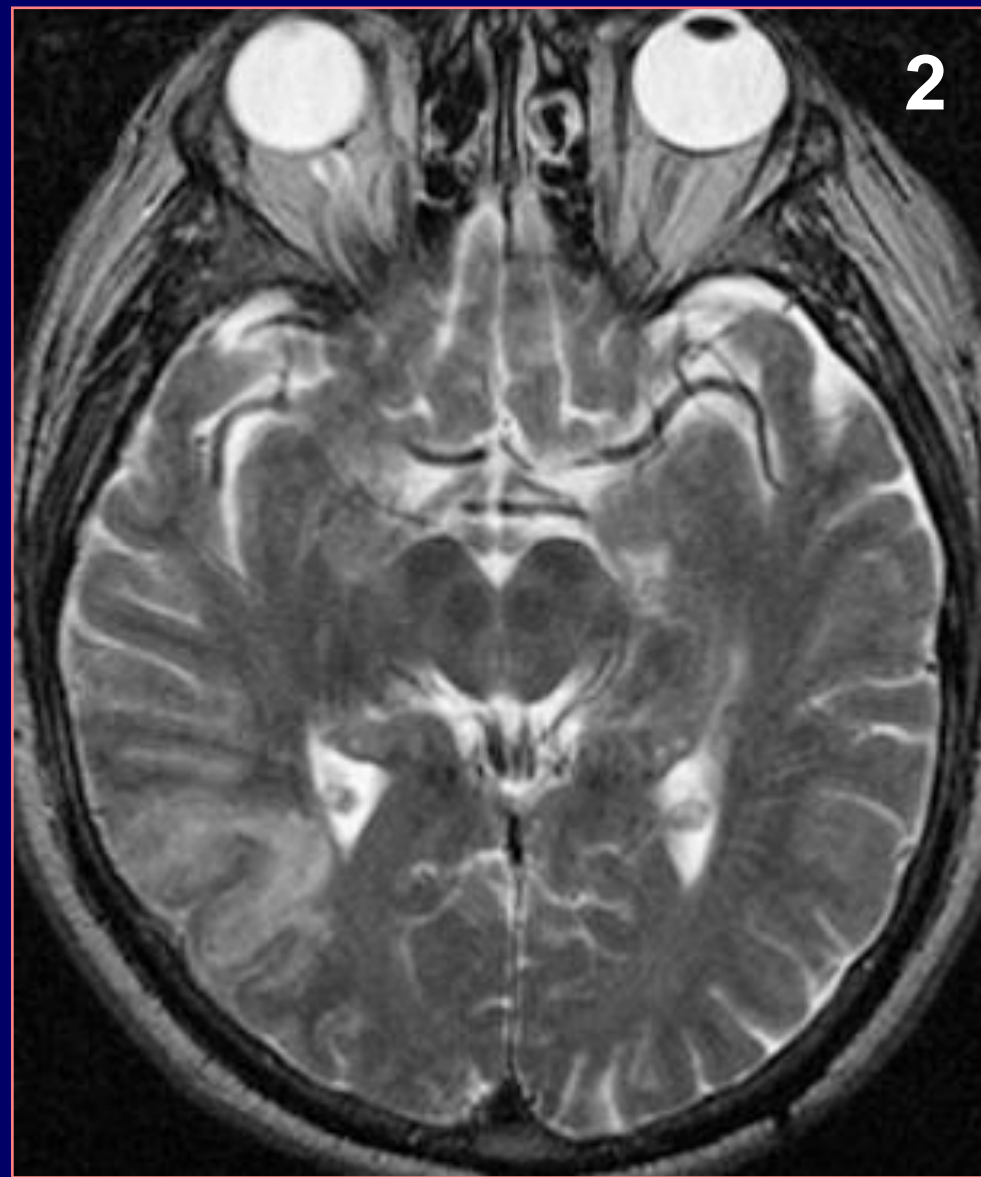
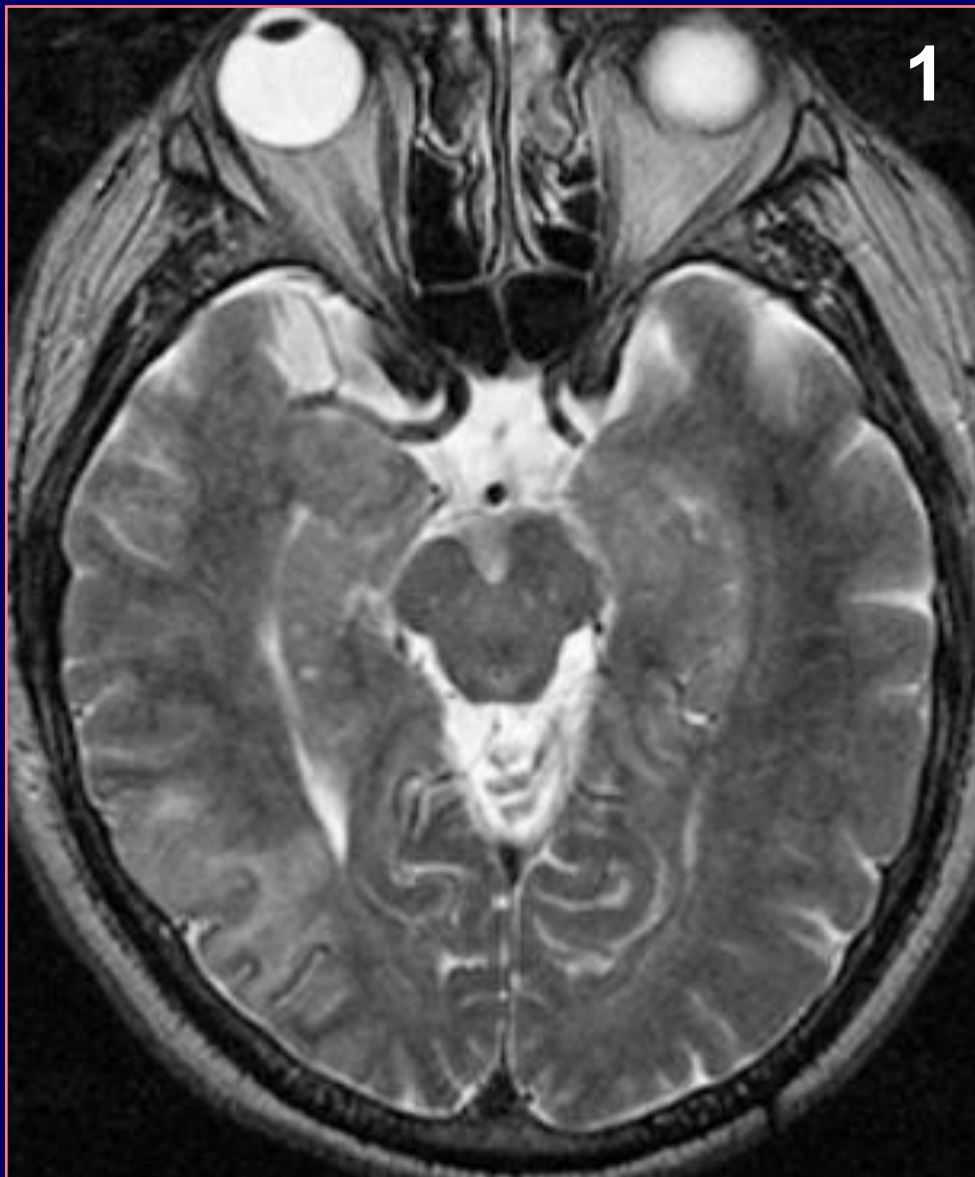
{Page 3}

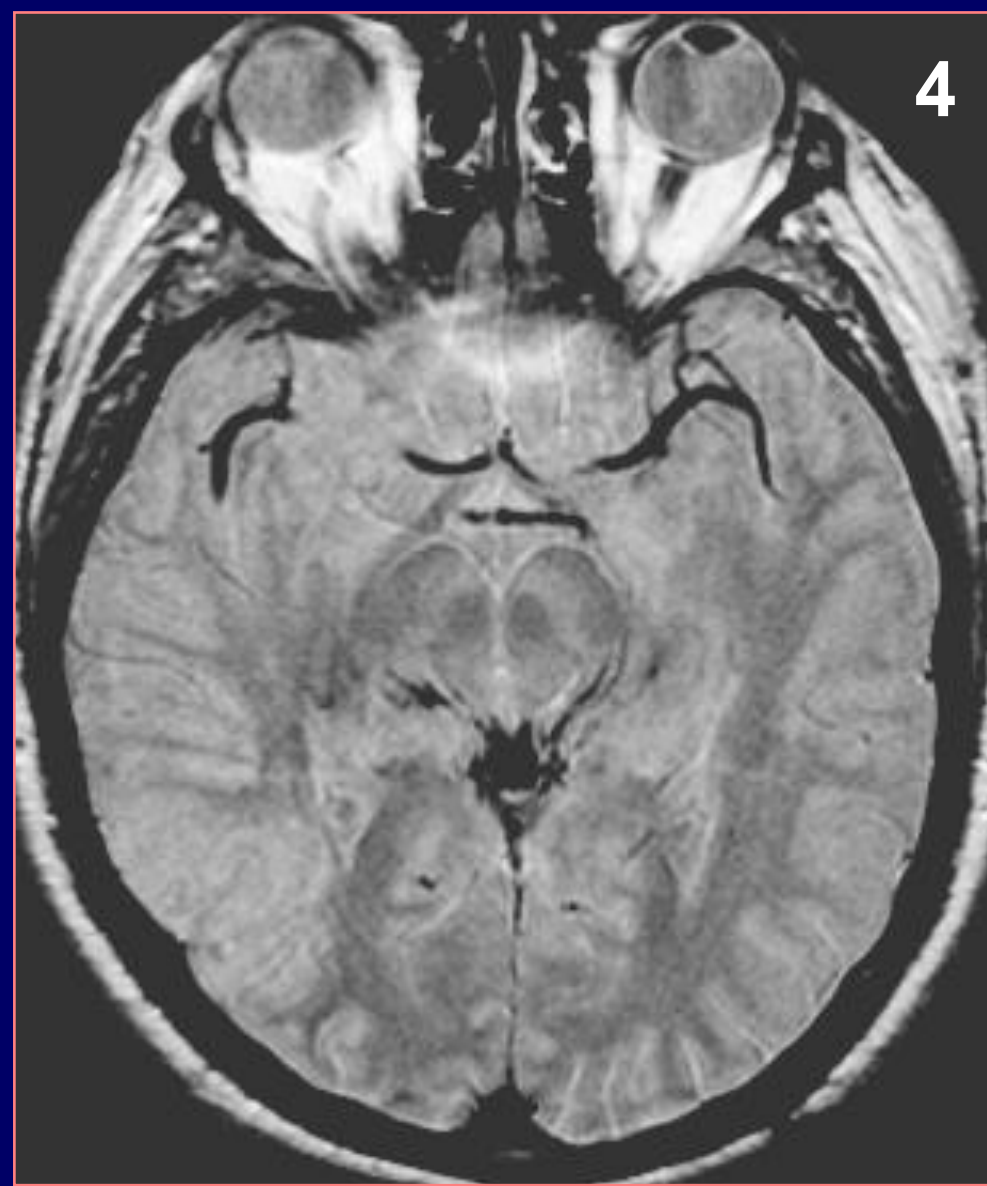
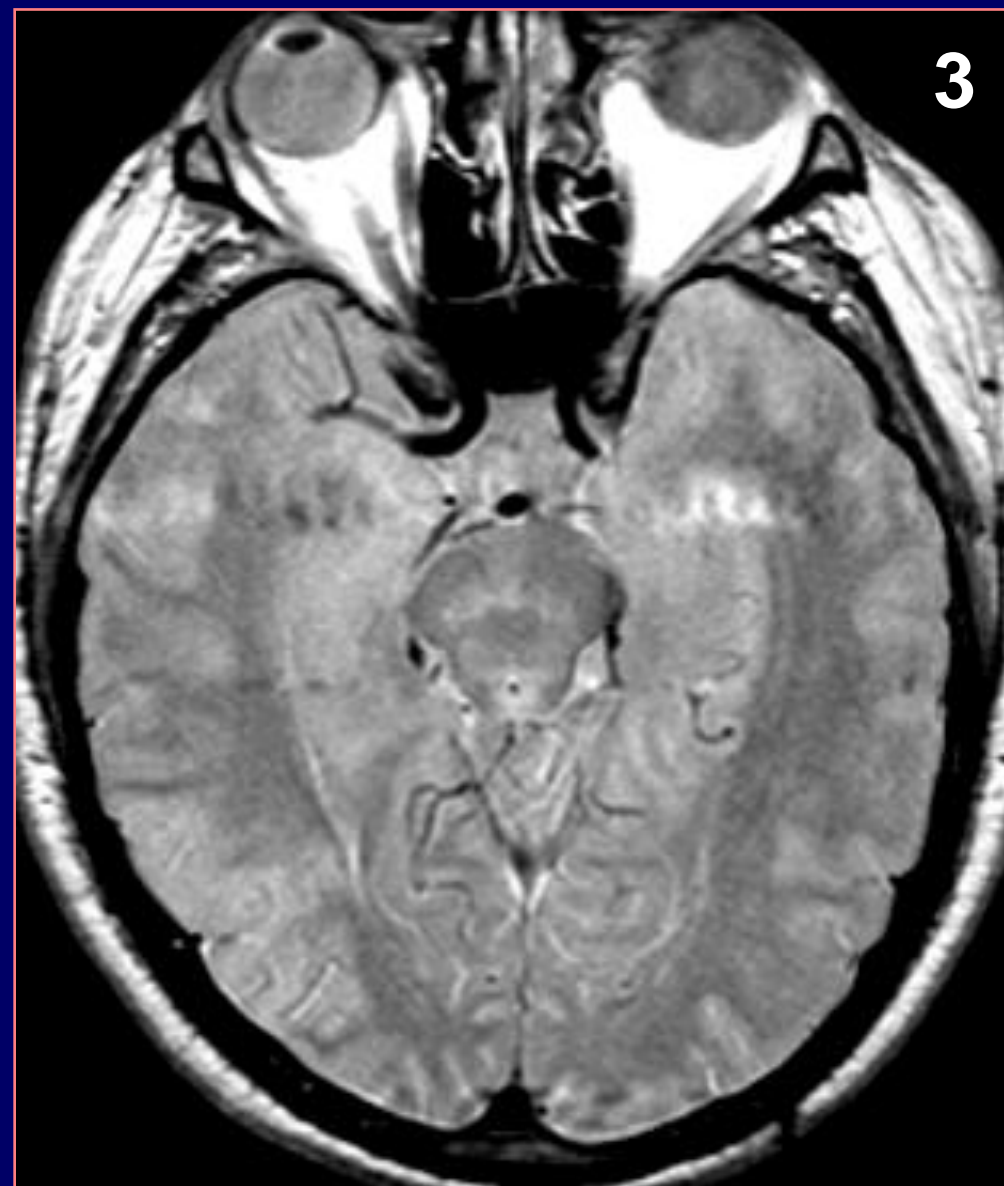


Dx:

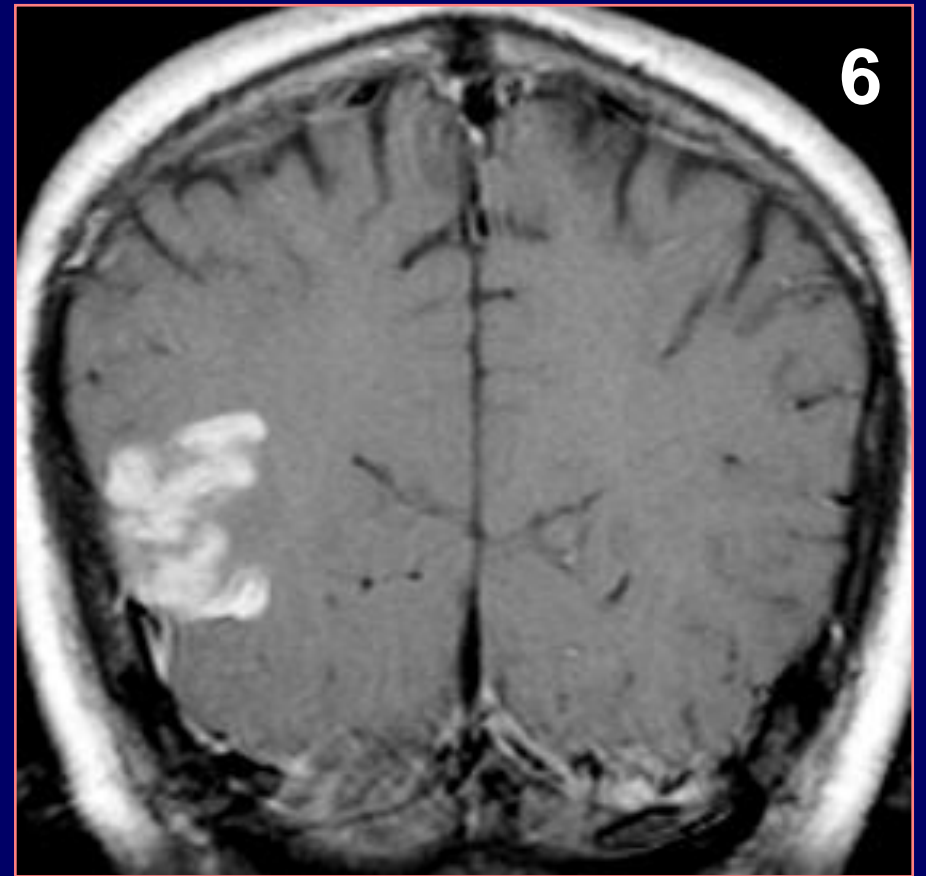
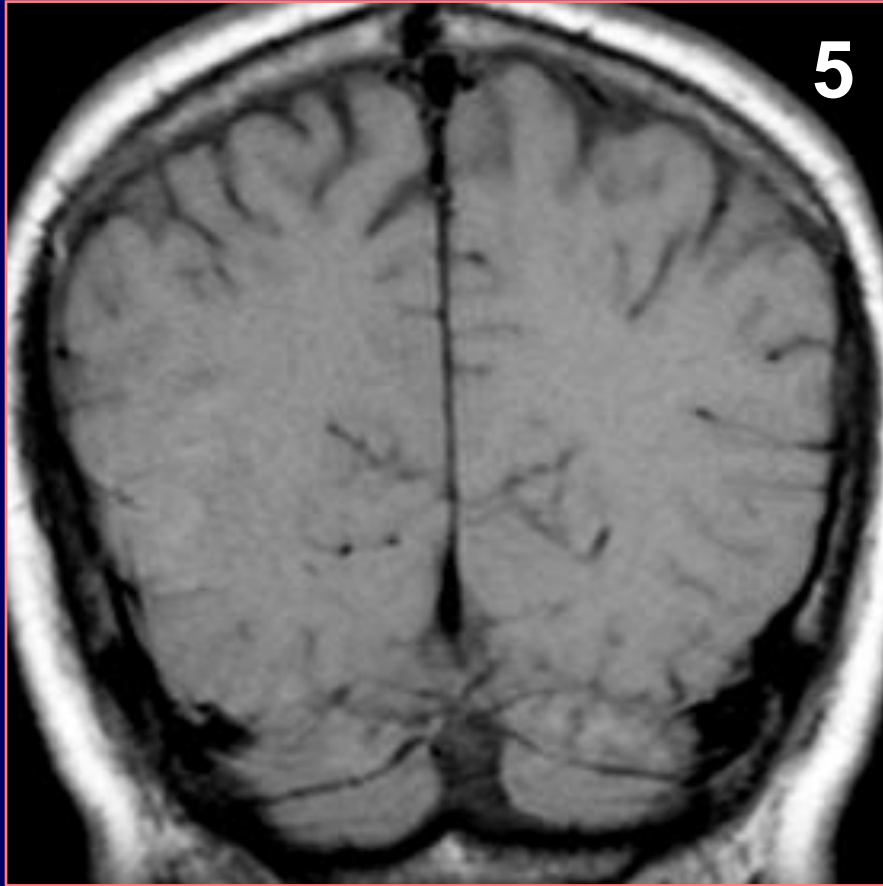
Case 3

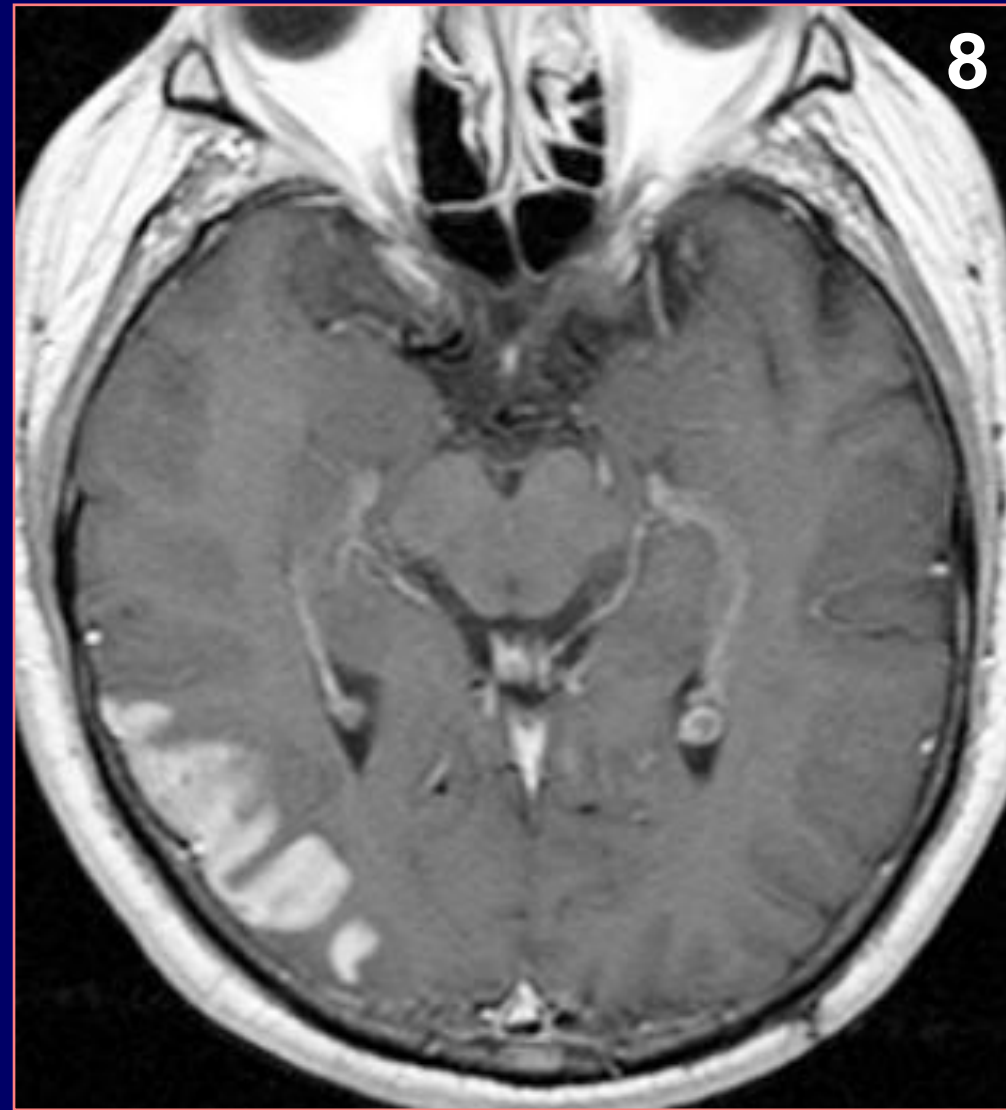
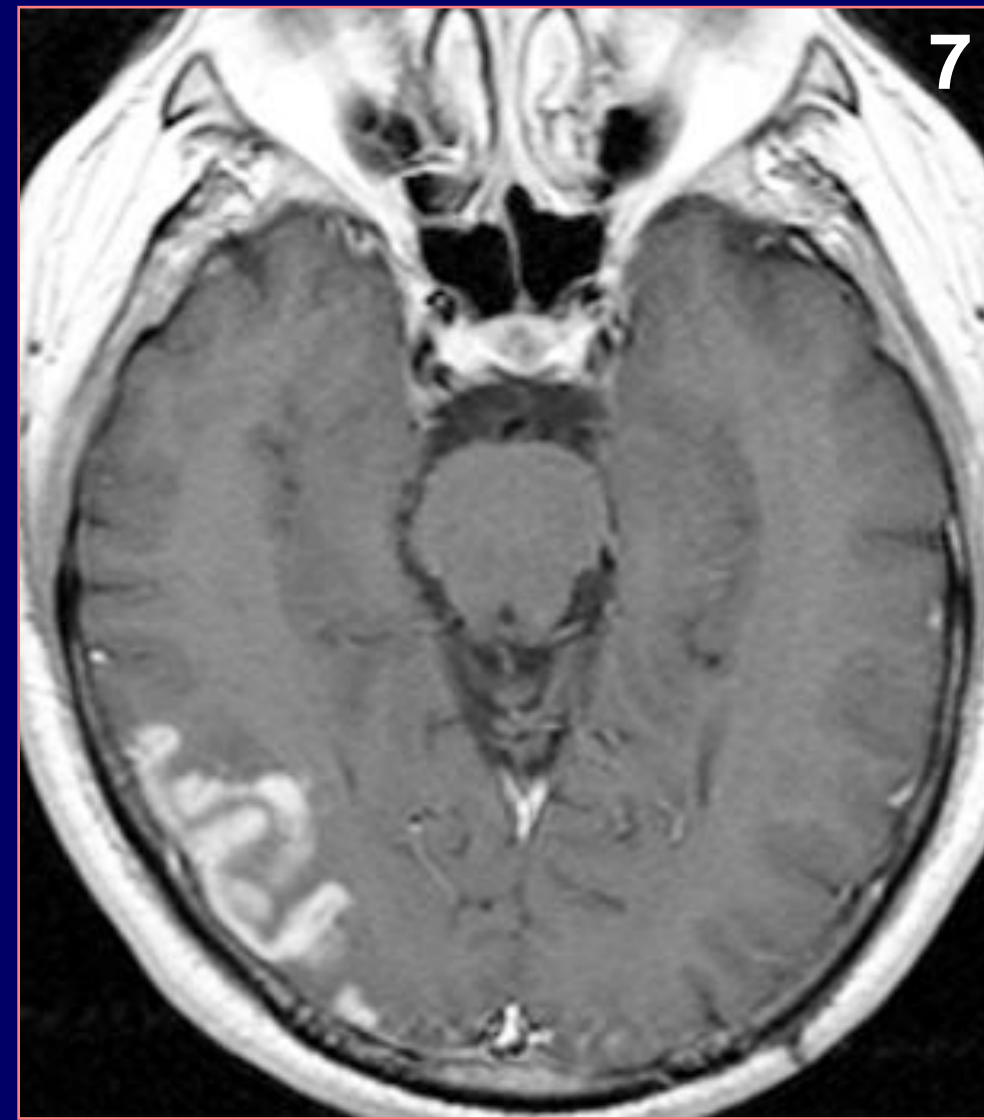
History: 62 y.o. man with mumbling speech





Mumbling speech {Page 3}

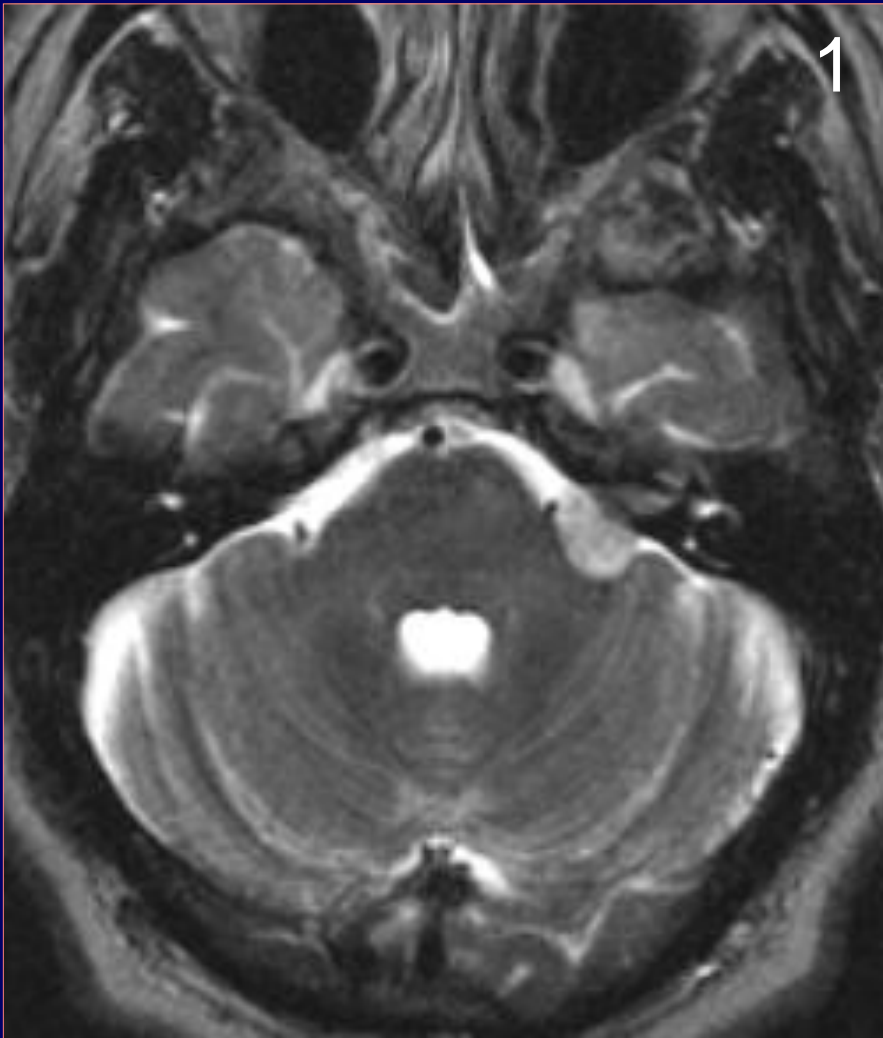


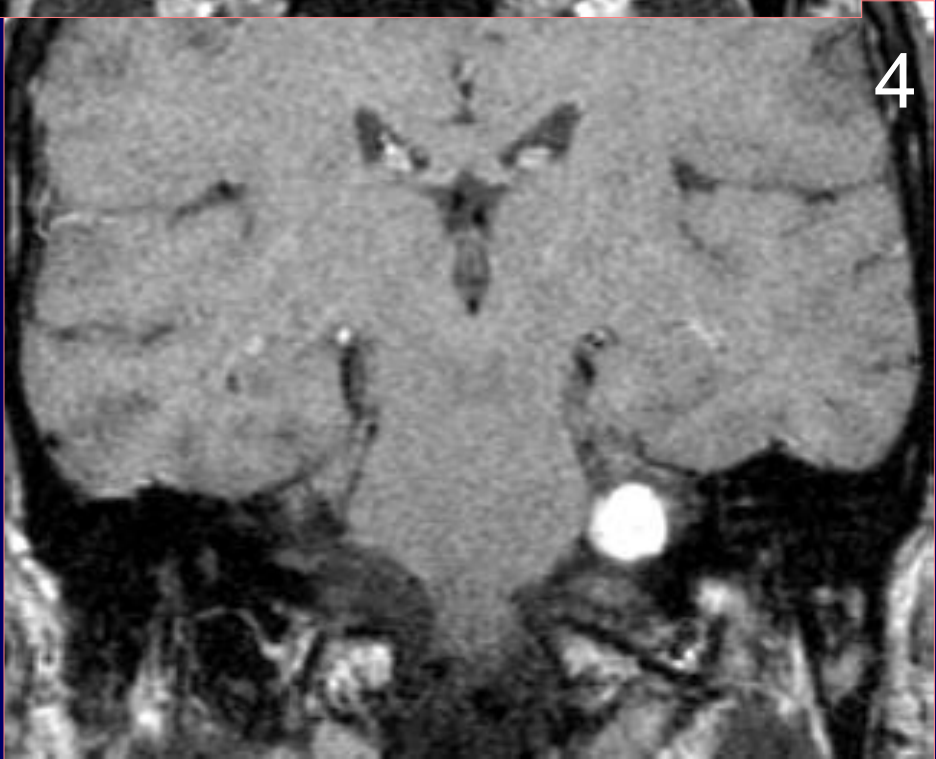
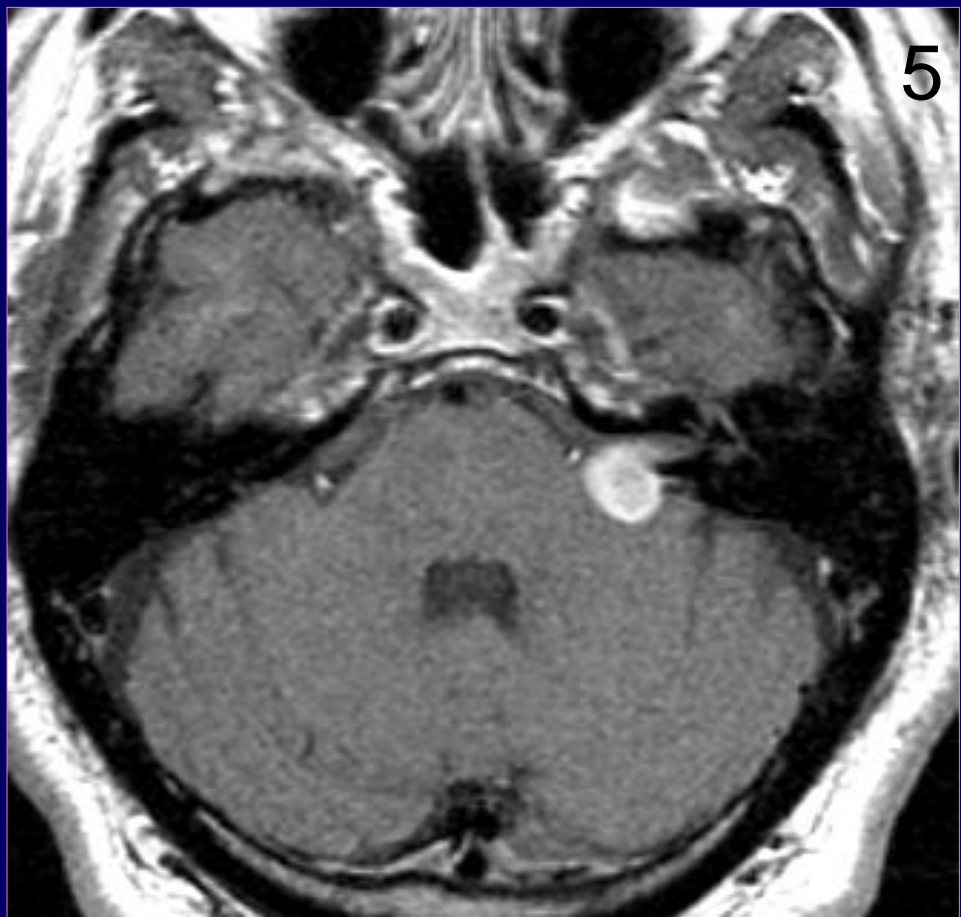
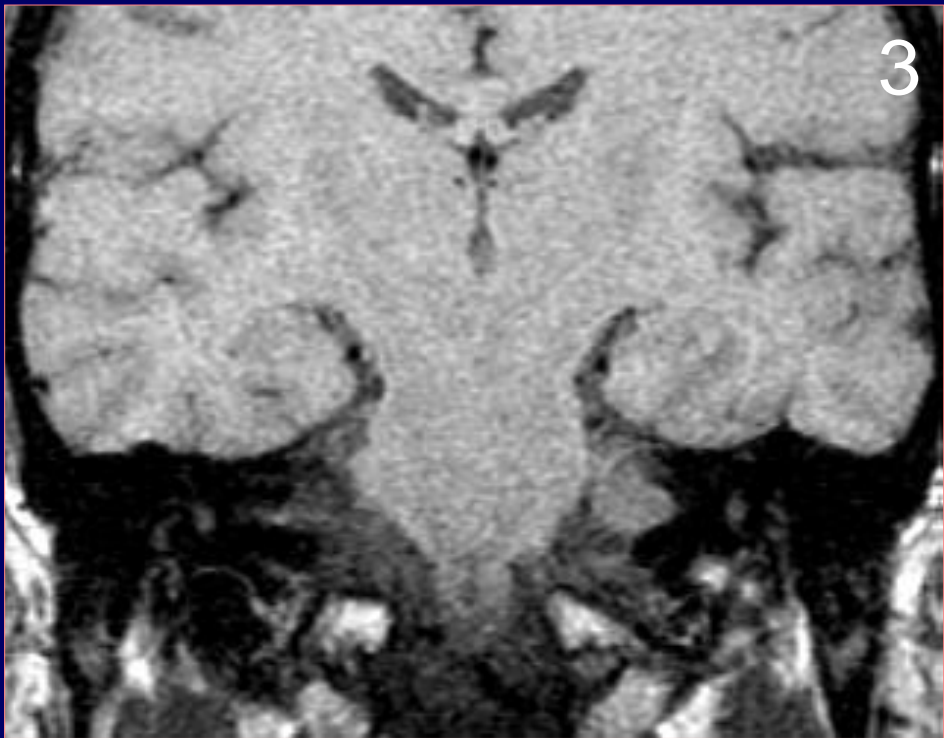


Dx:

Case 4

History: 48 y.o. male with a sensorineural hearing loss



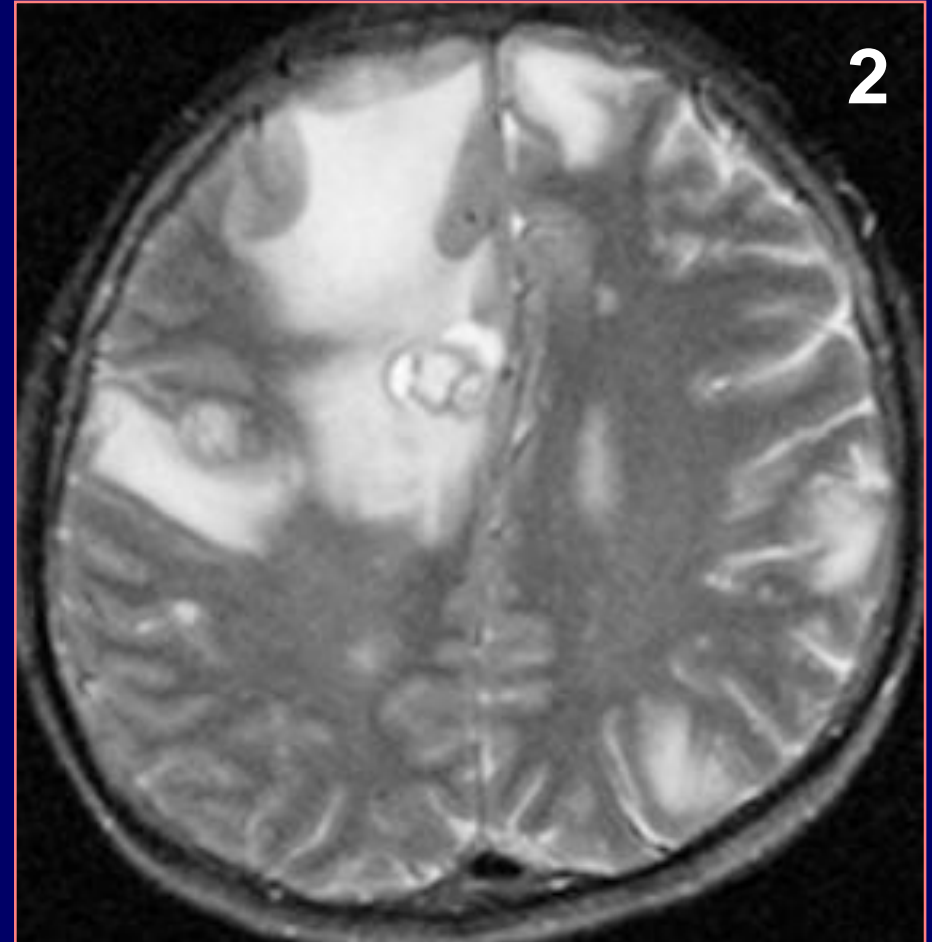
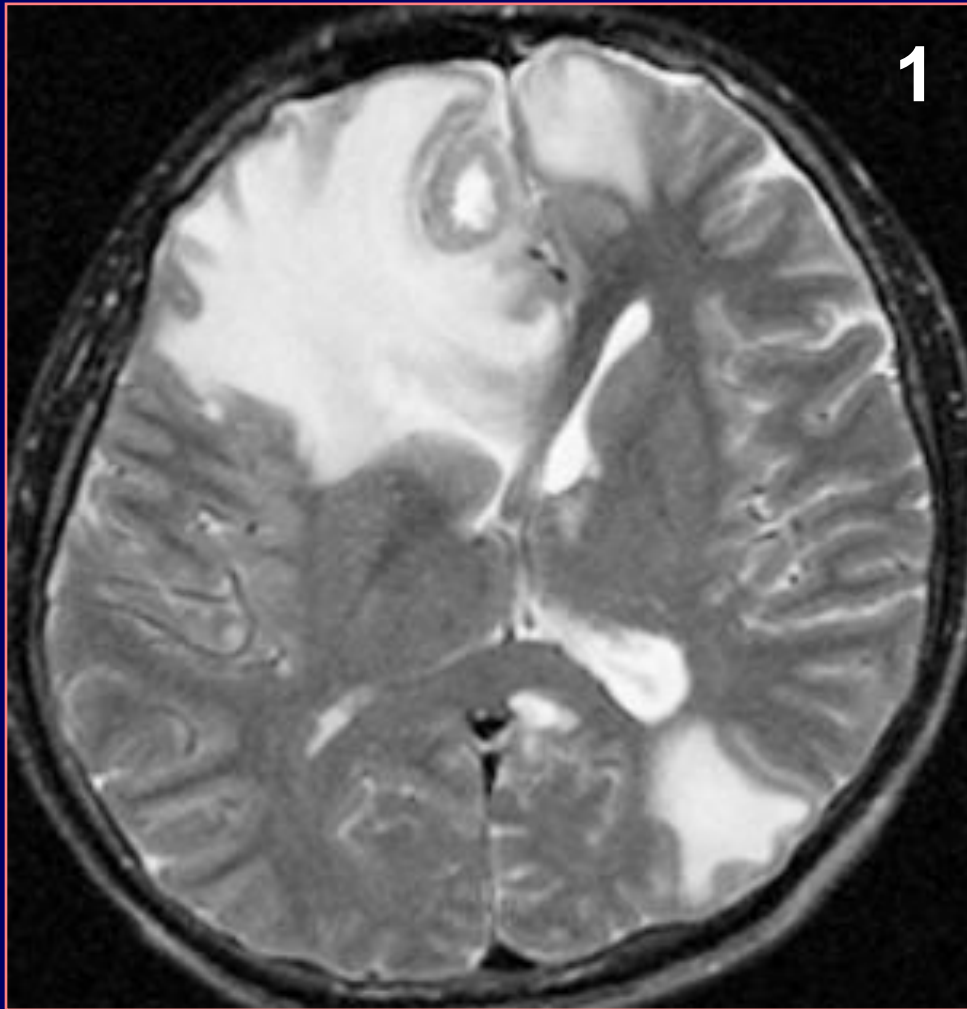


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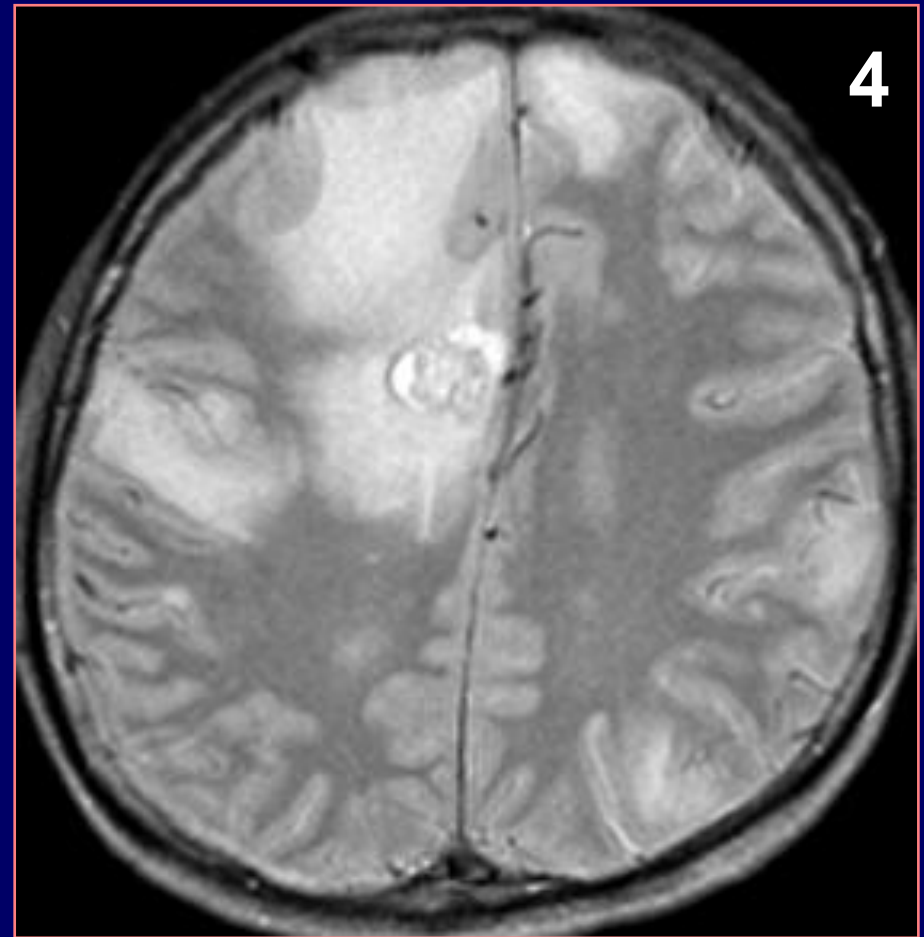
Dx:

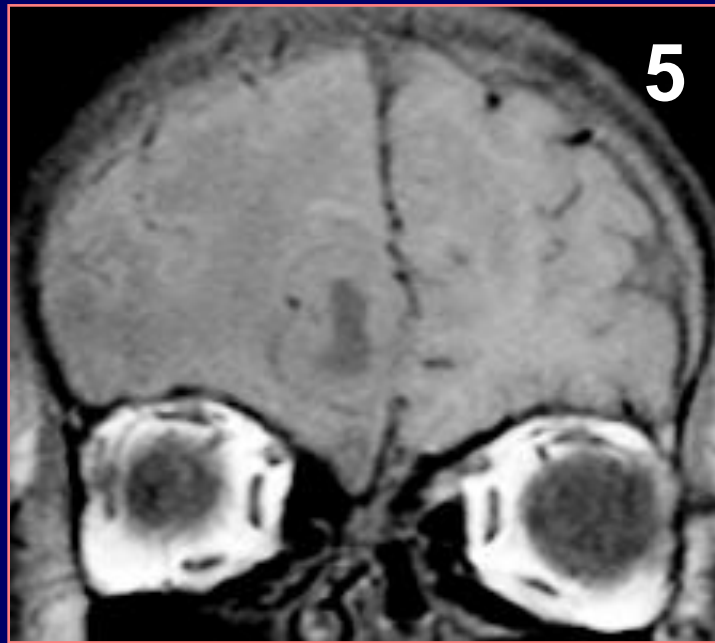
Case 5

History: 48 y.o. man with
headaches & confusion

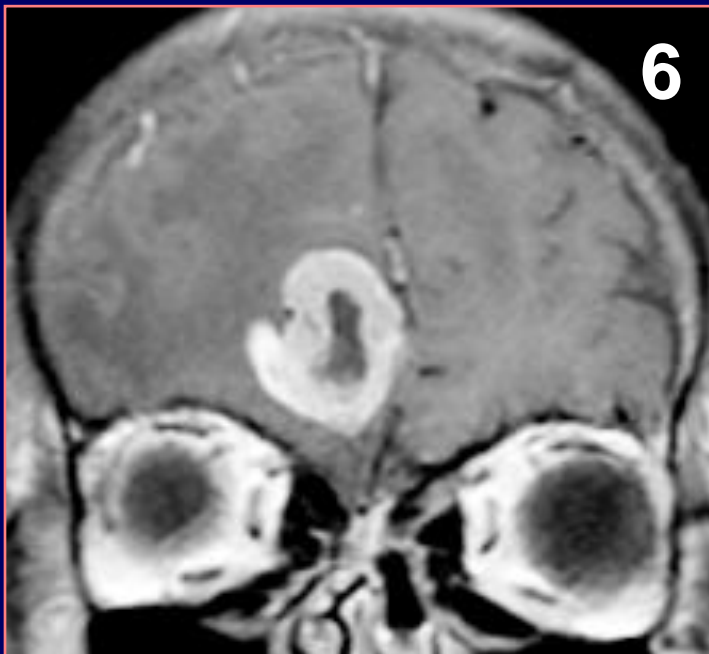
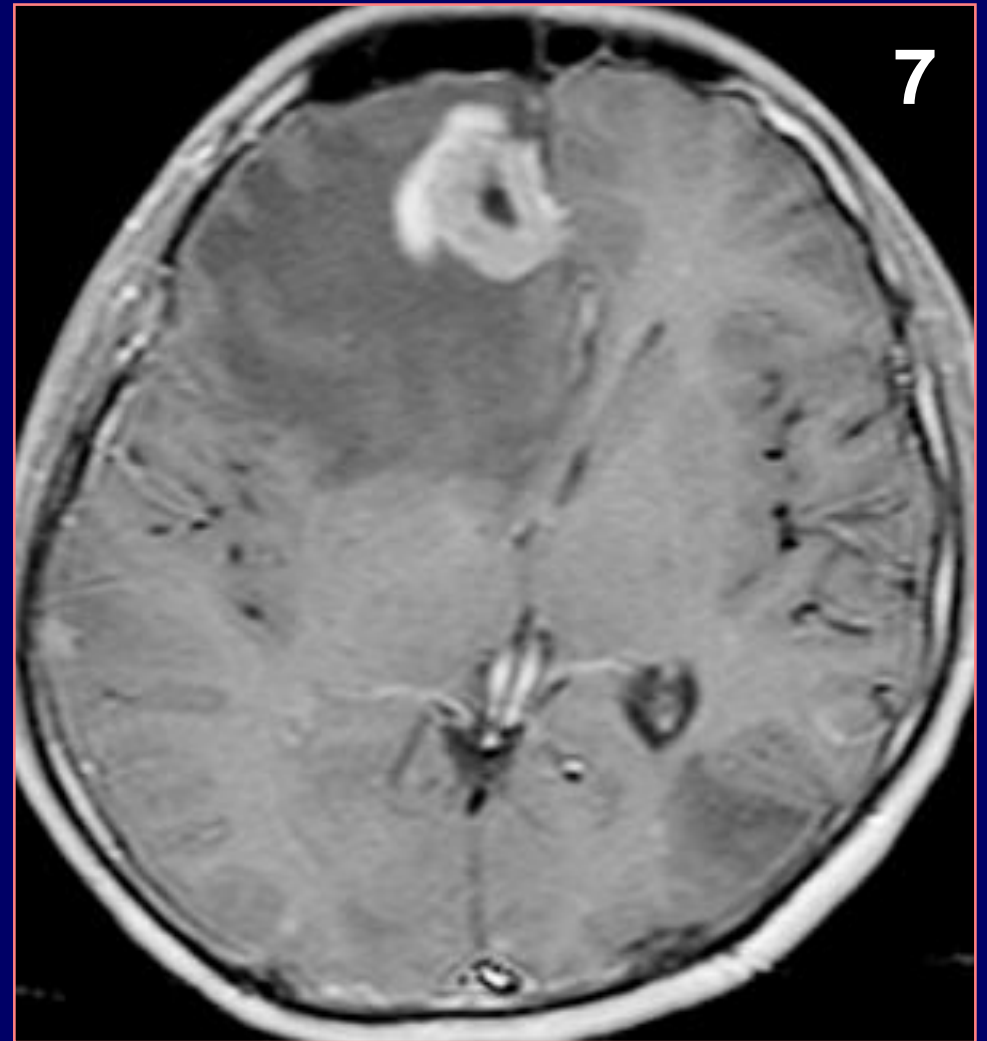


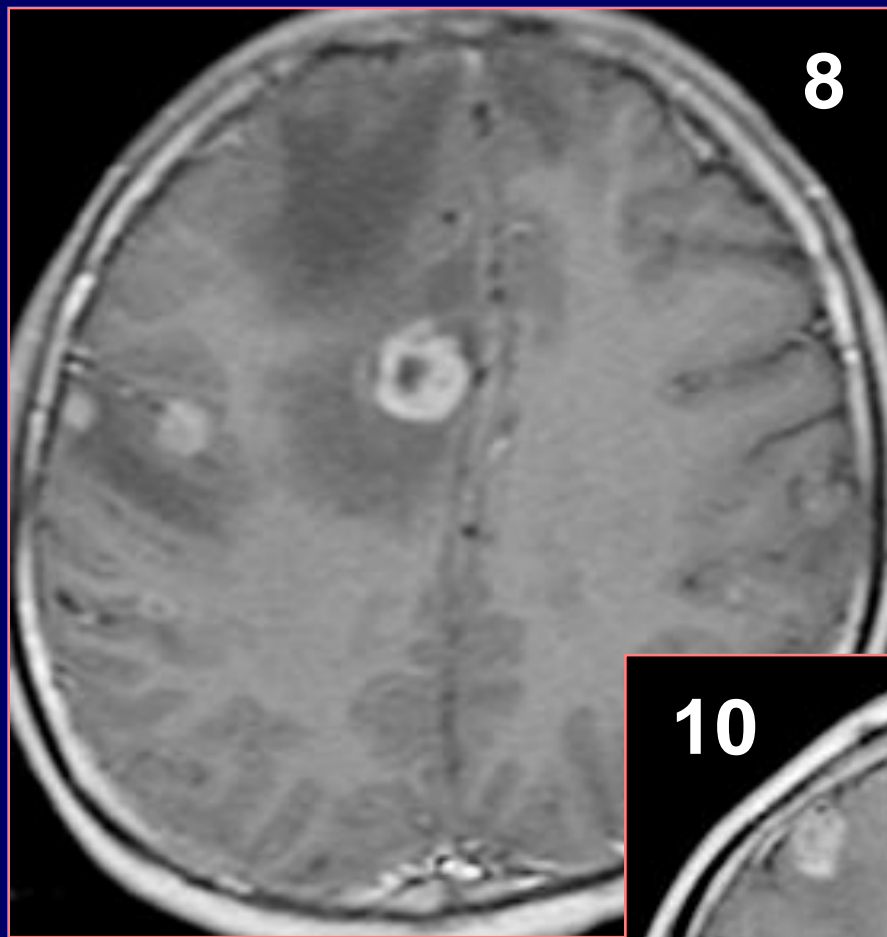
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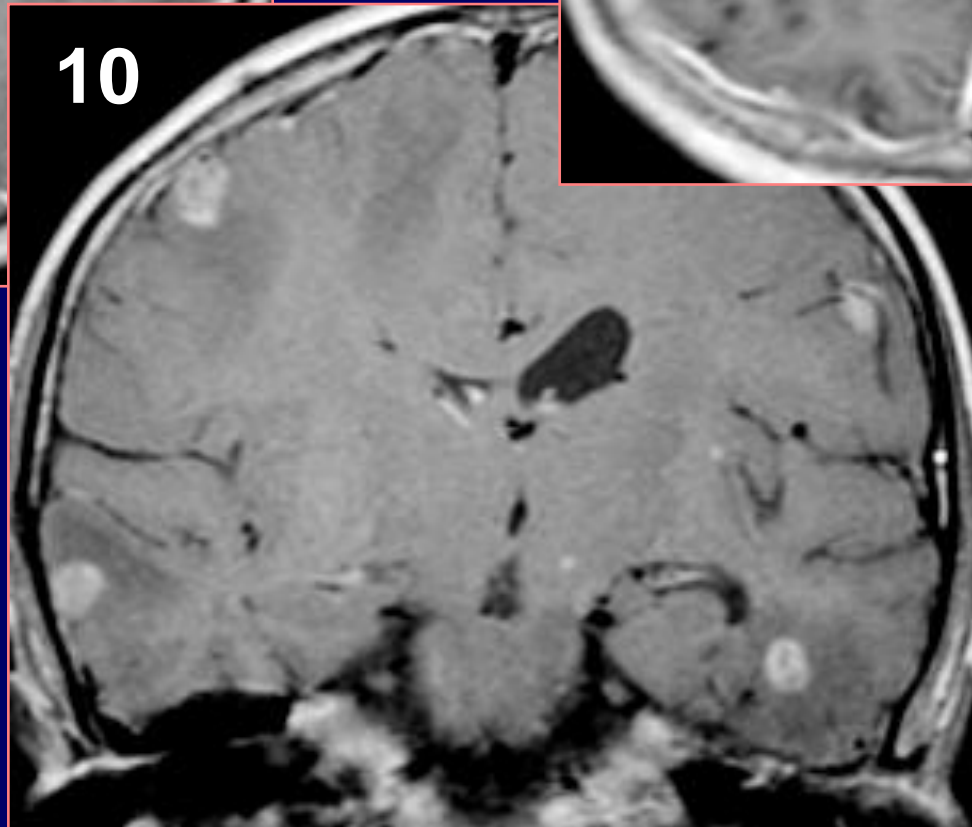
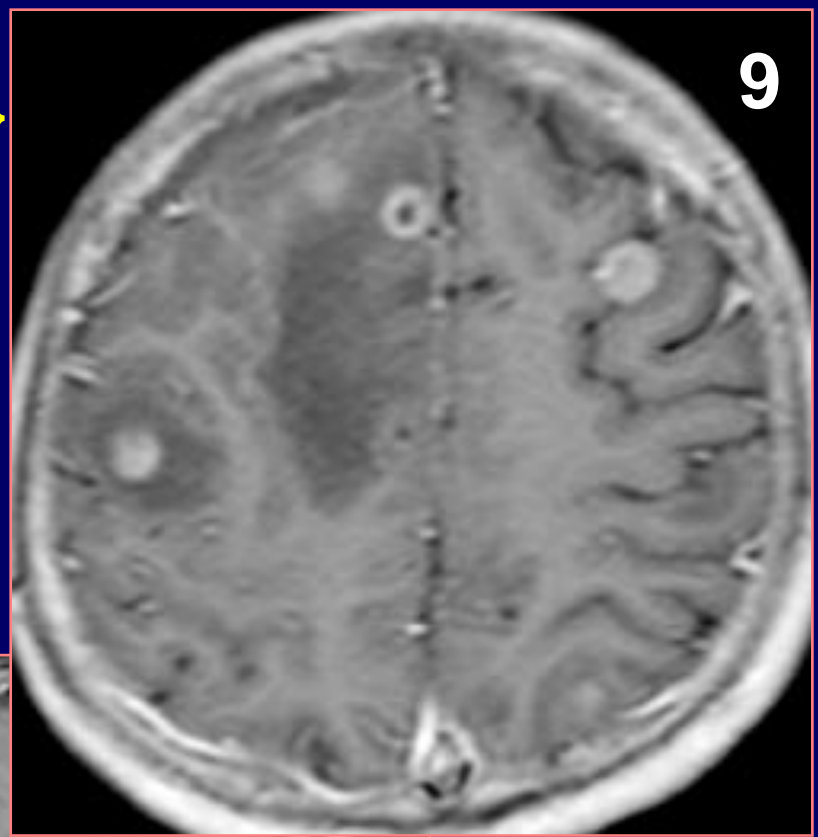


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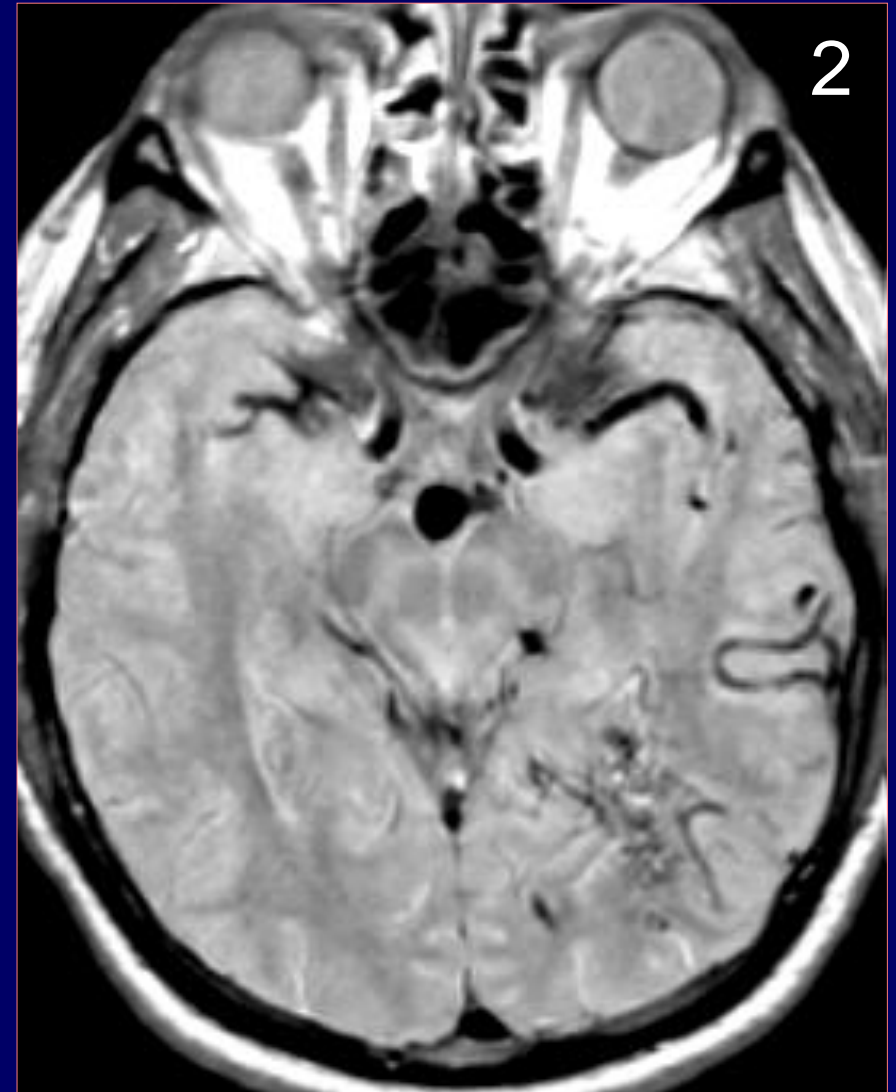
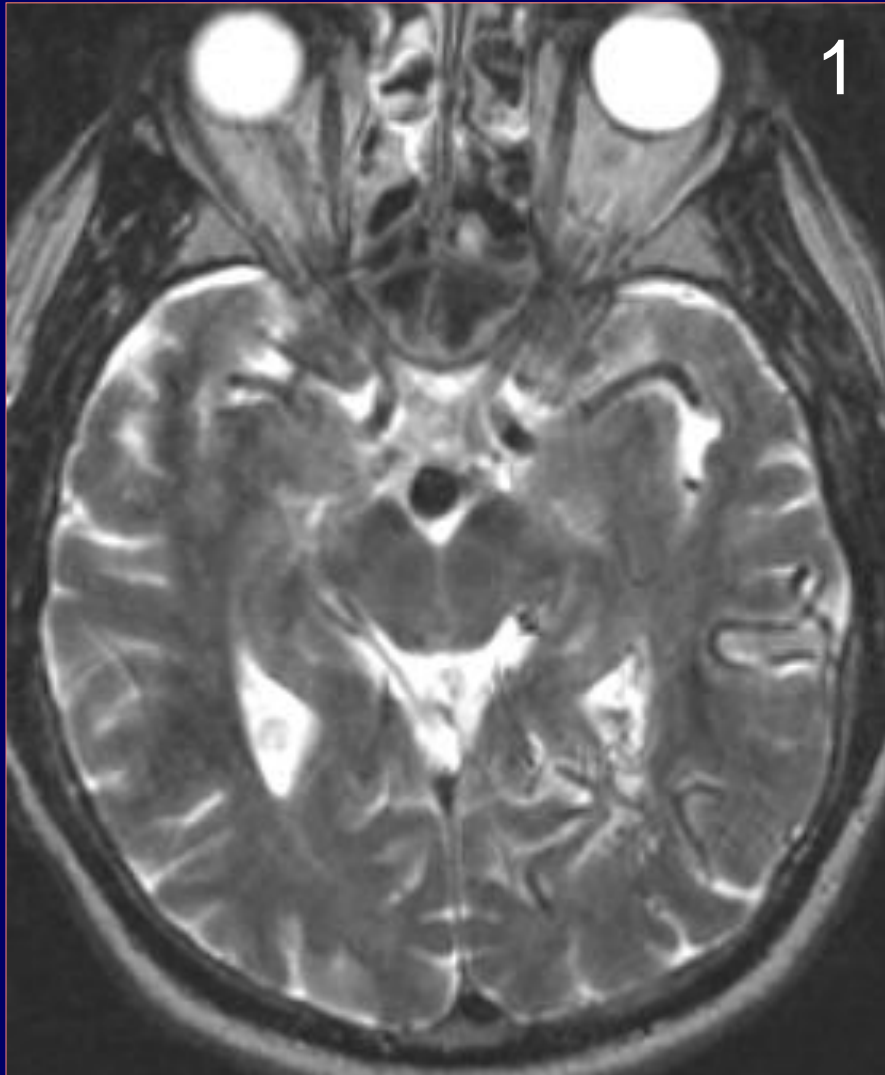
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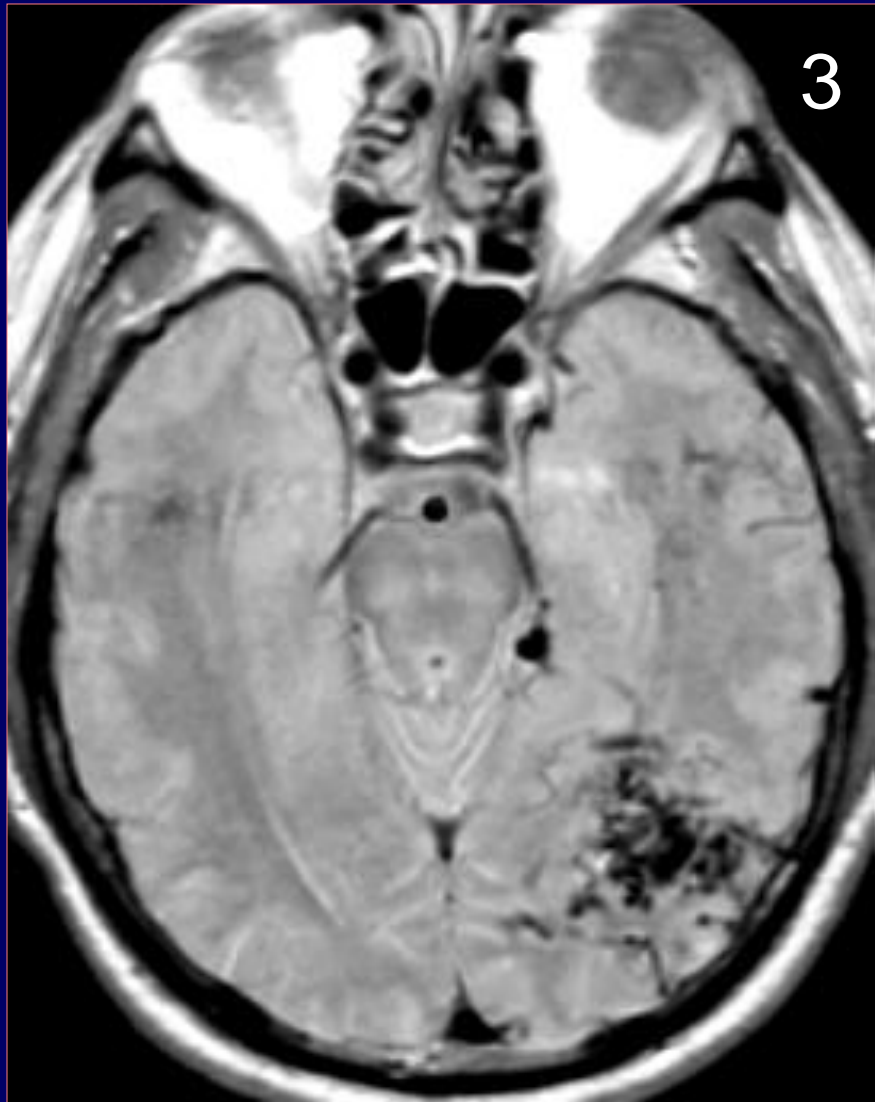


Dx:

Case 6

History: 36 y.o. man with seizures

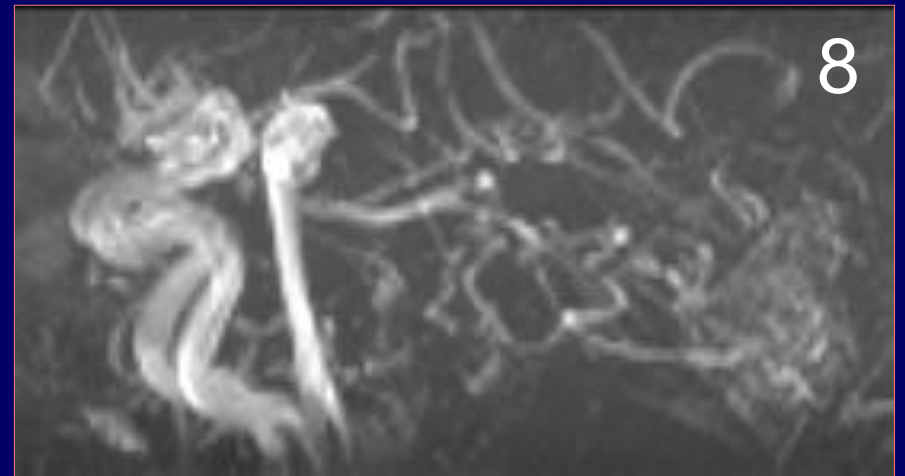
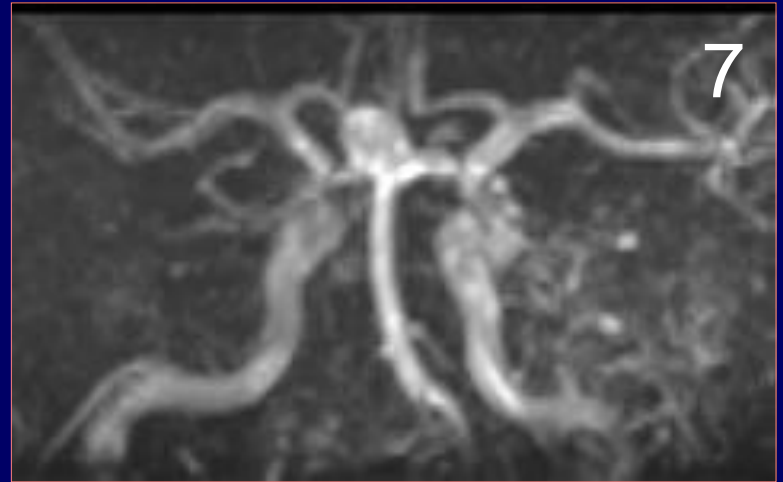




History: Seizures
{Page 2}



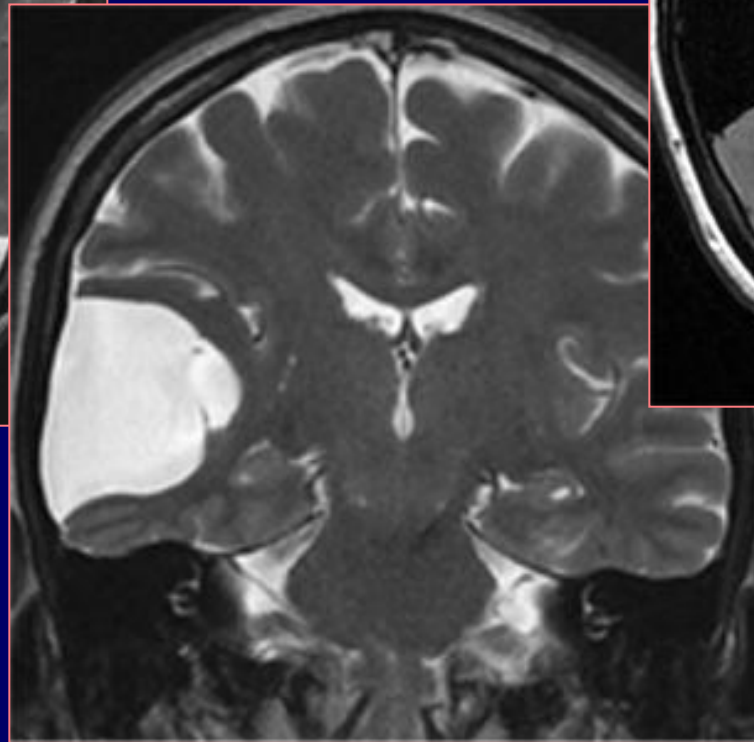
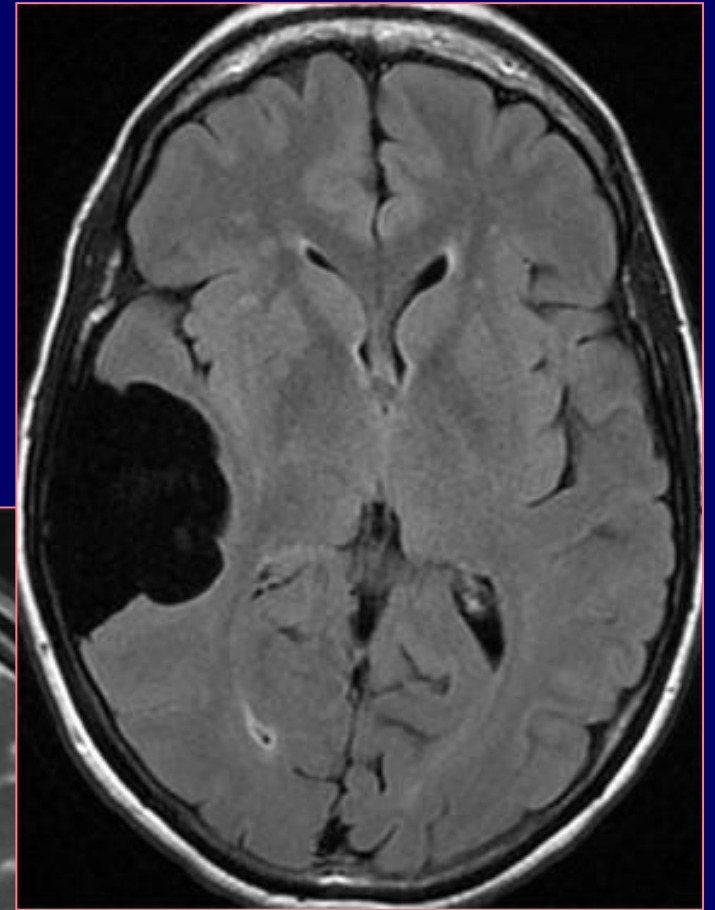
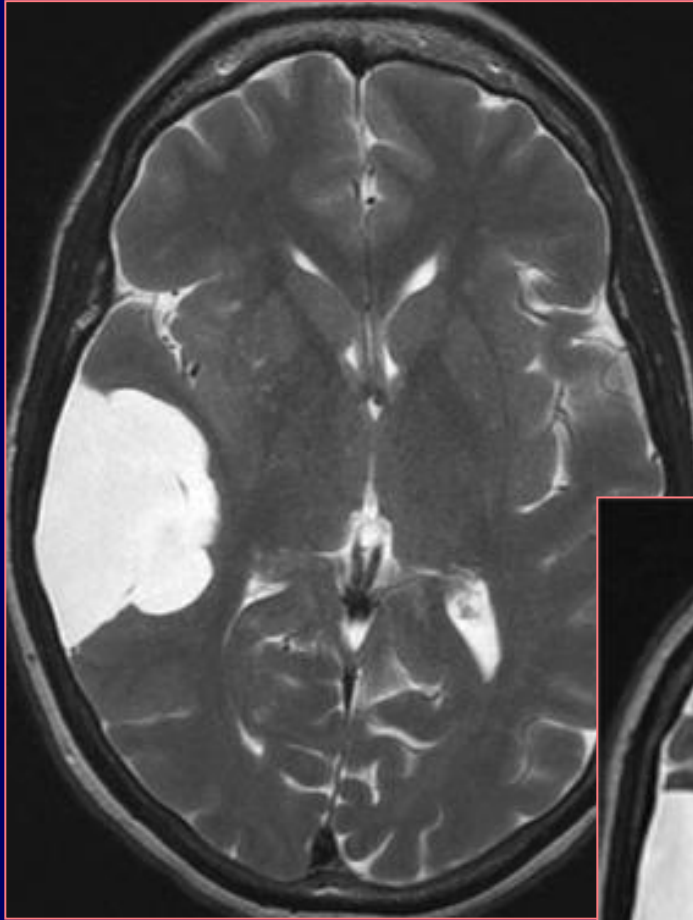
{Page 3}



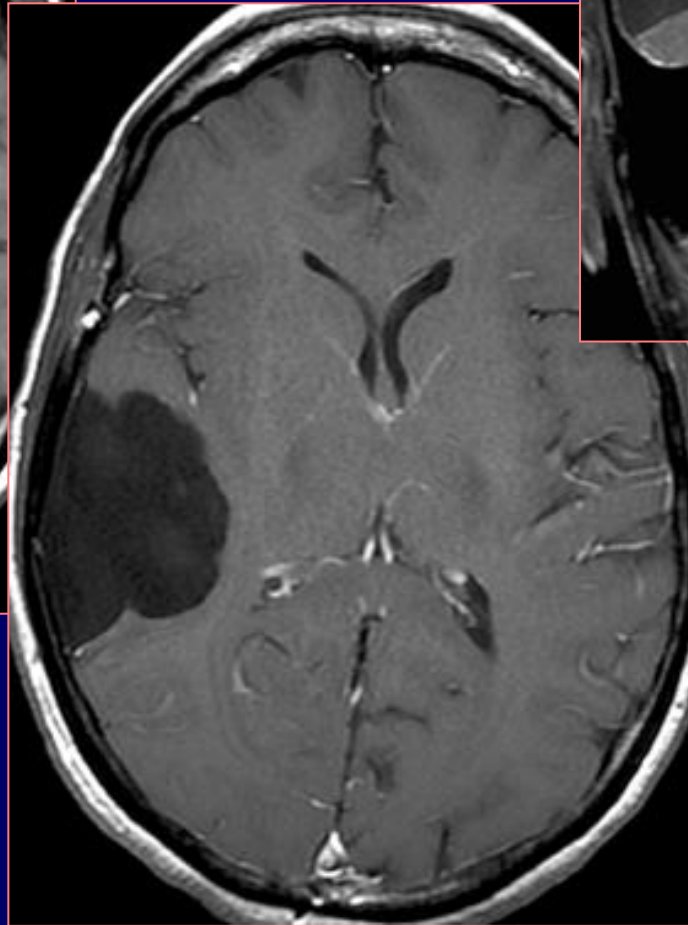
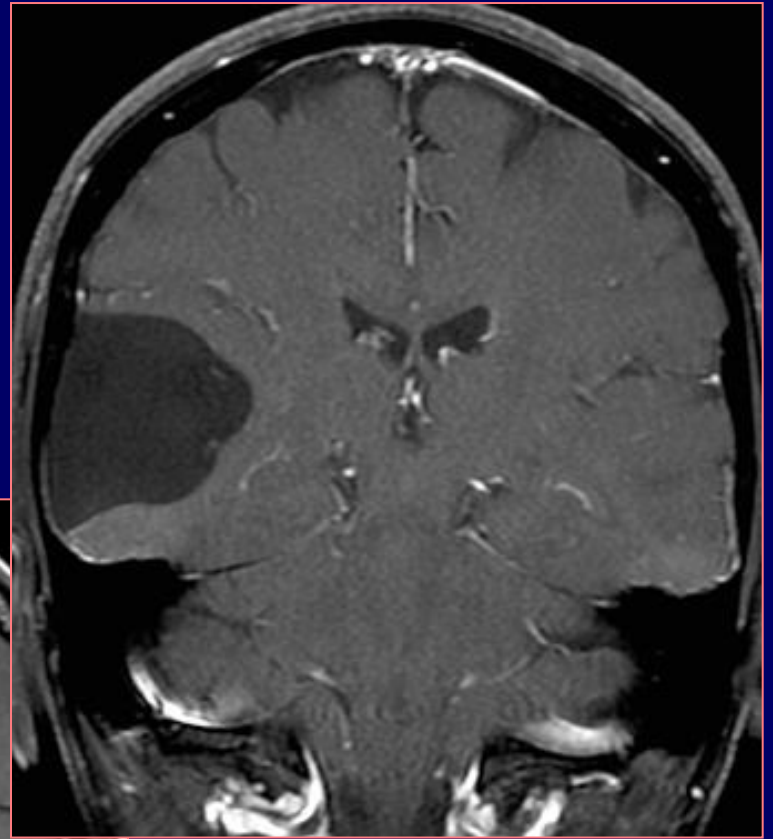
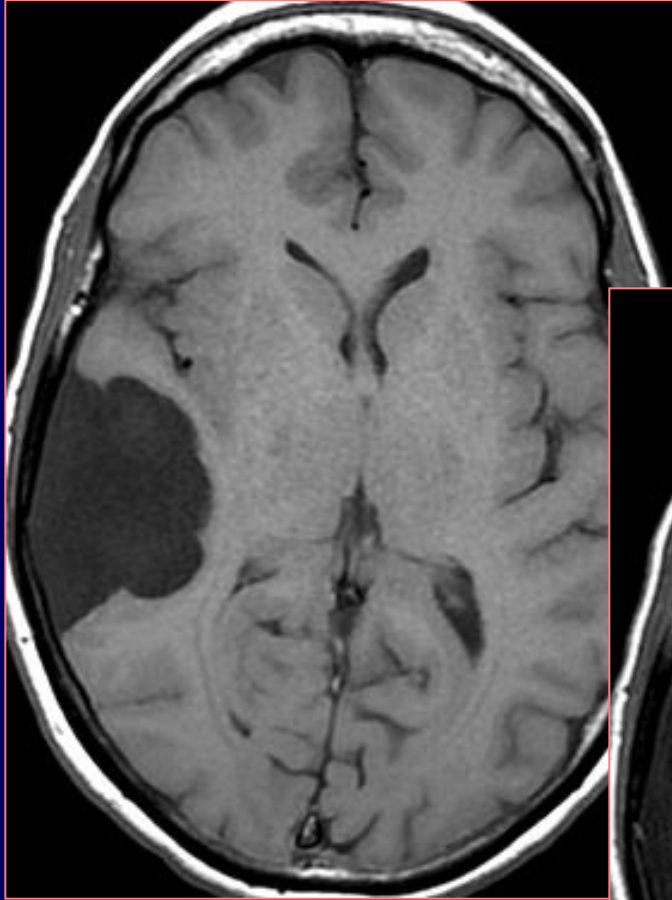
Dx:

Case 7

History: 62 y/o woman with headaches



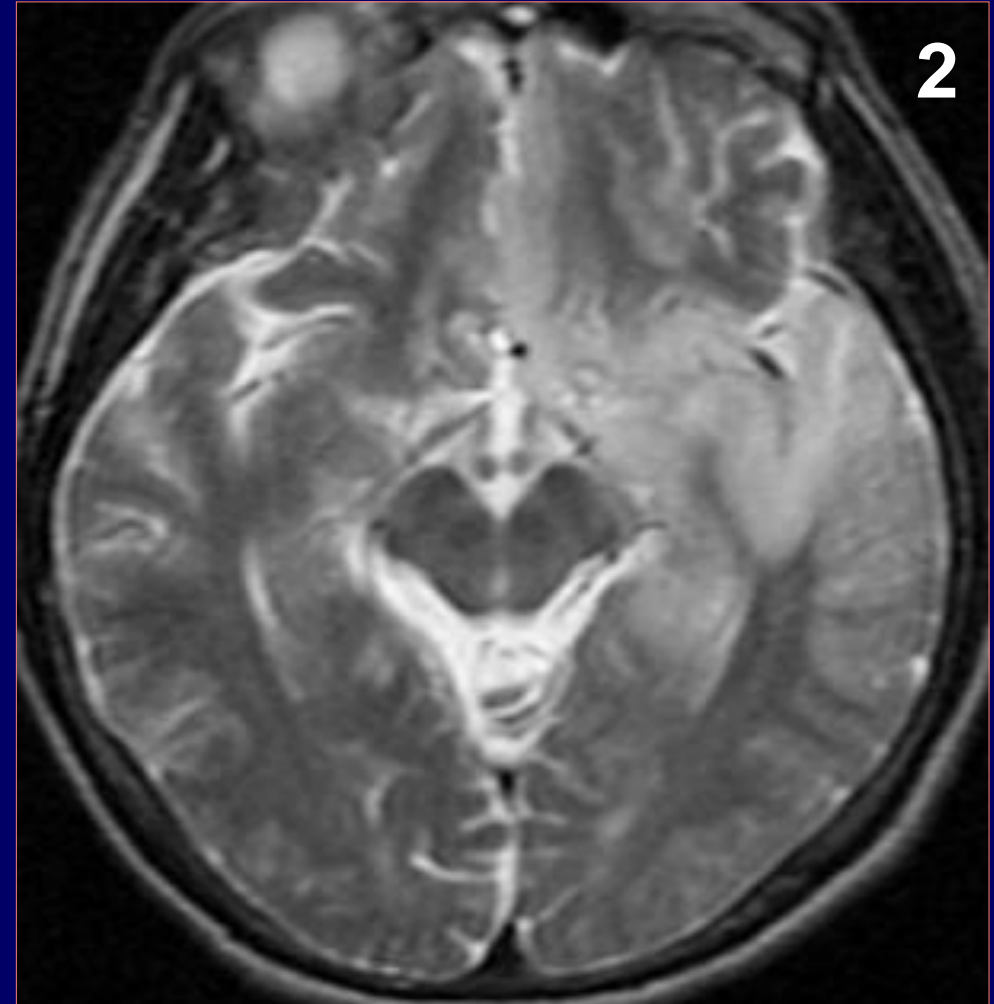
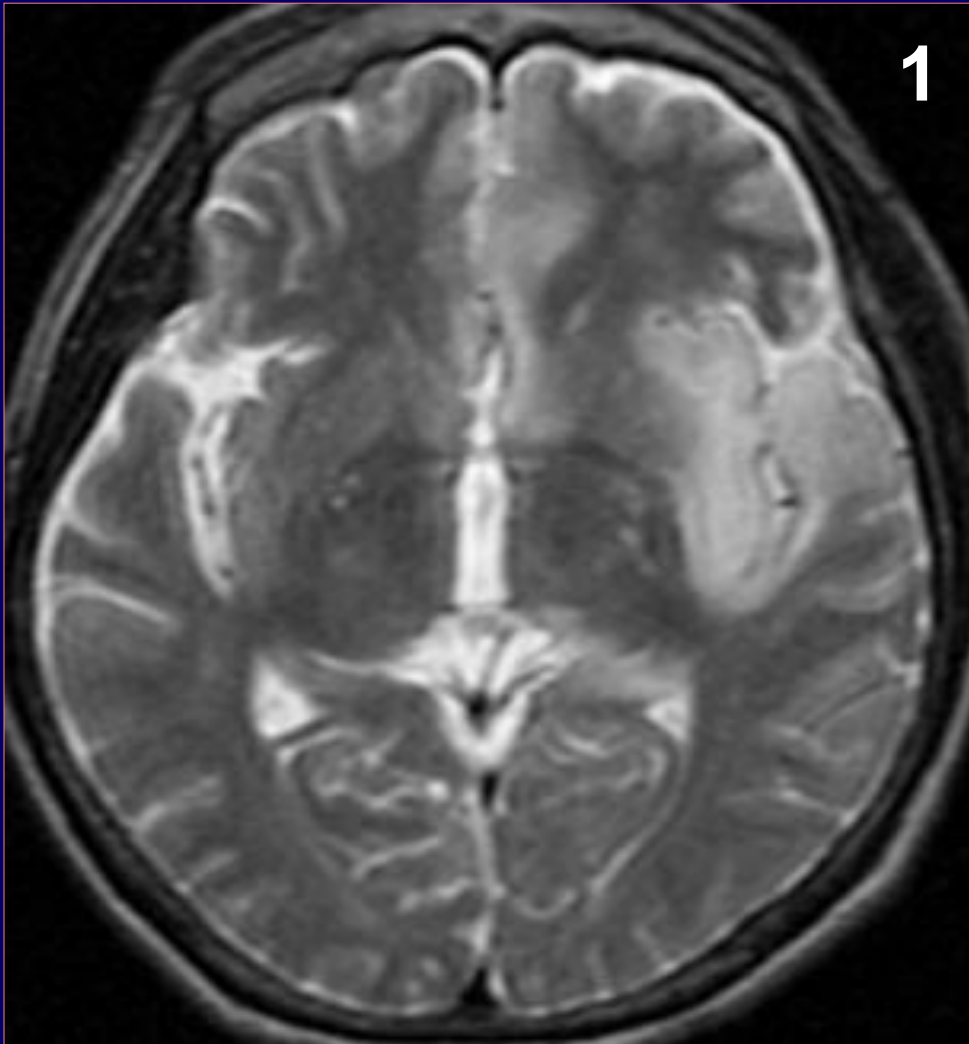
{Page 2}



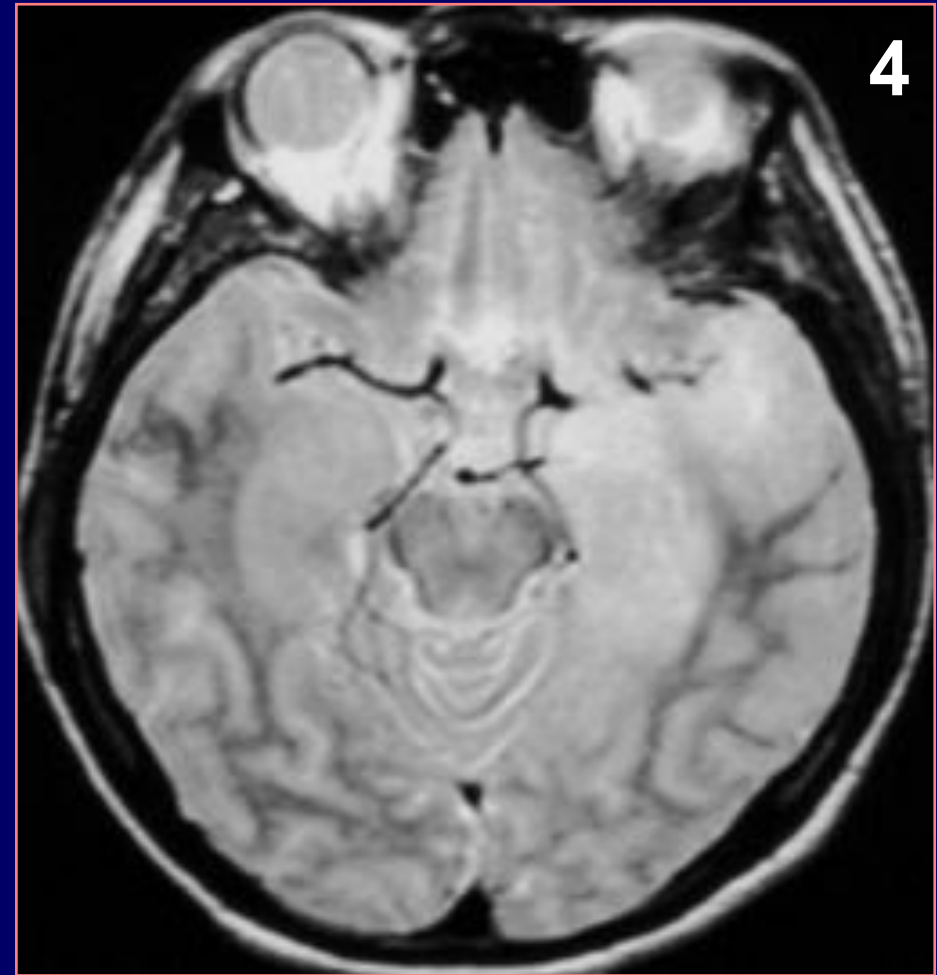
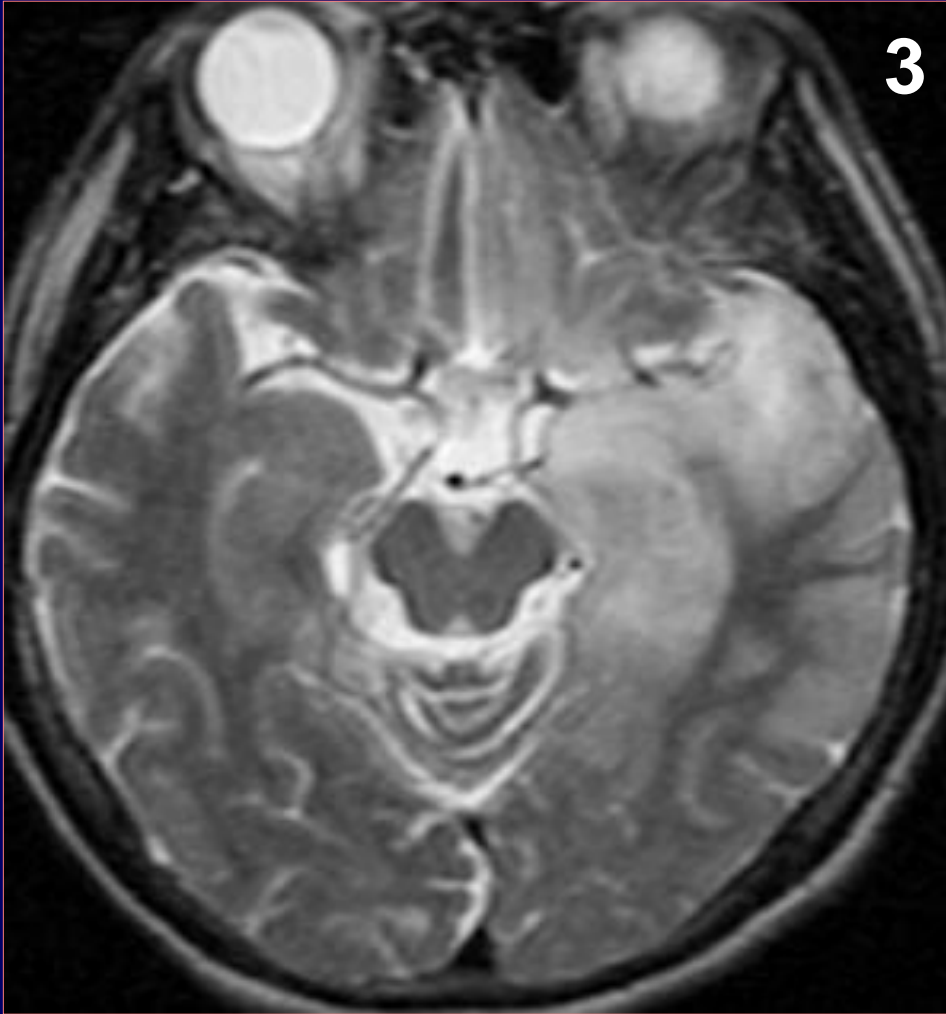
Dx:

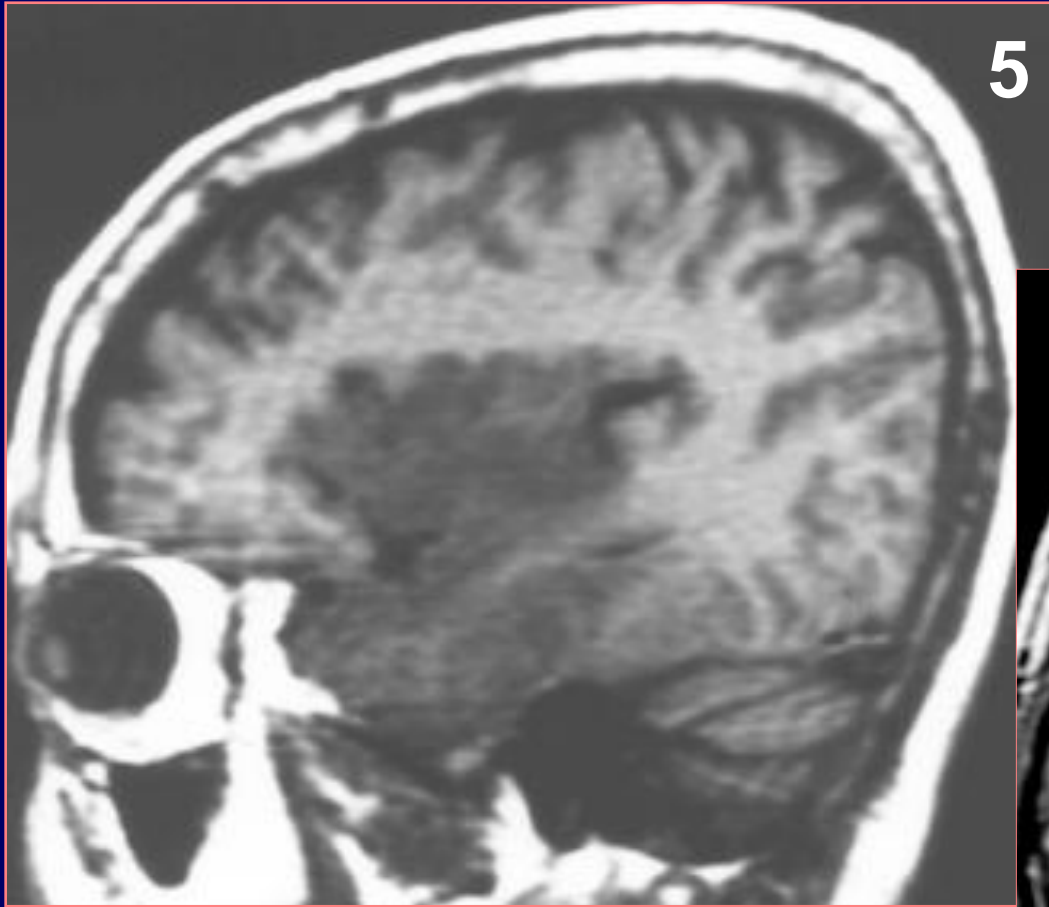
Case 8

History: 27 y.o. man with increasing confusion & lethargy

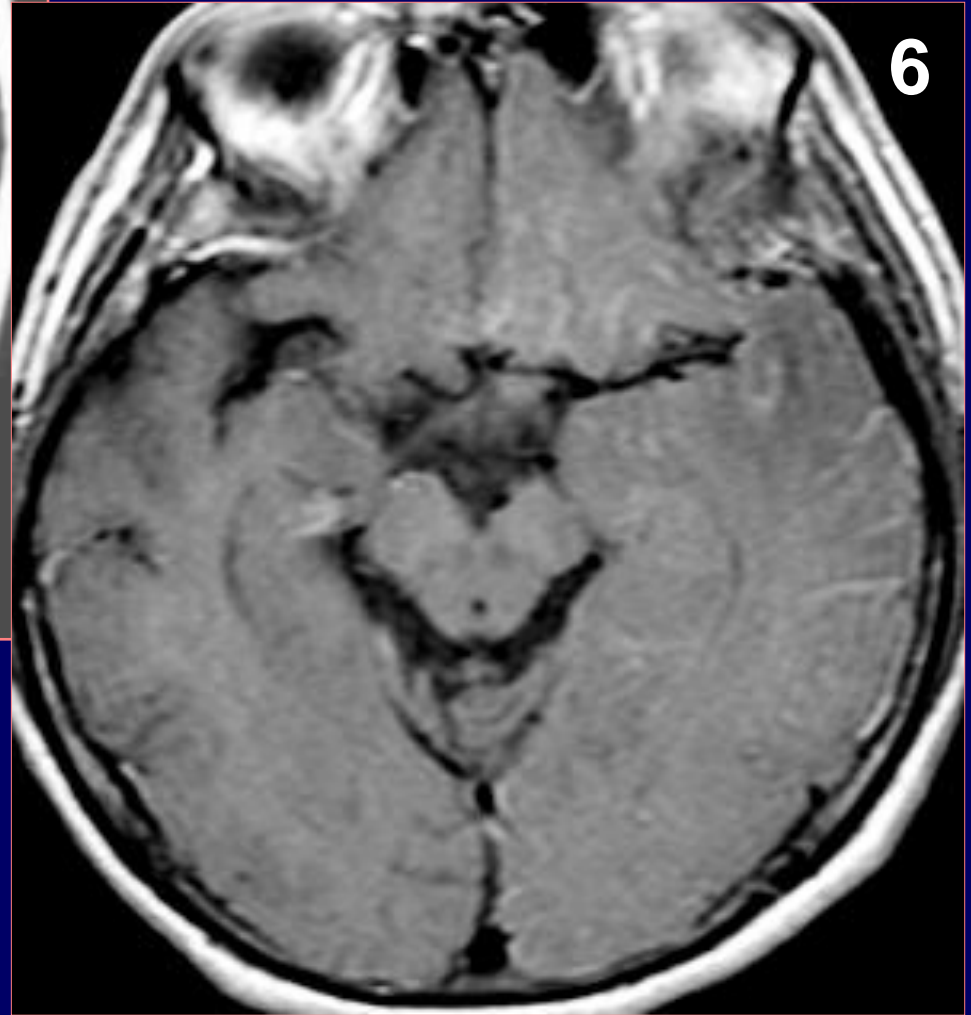


Confusion and lethargy {Page 2}

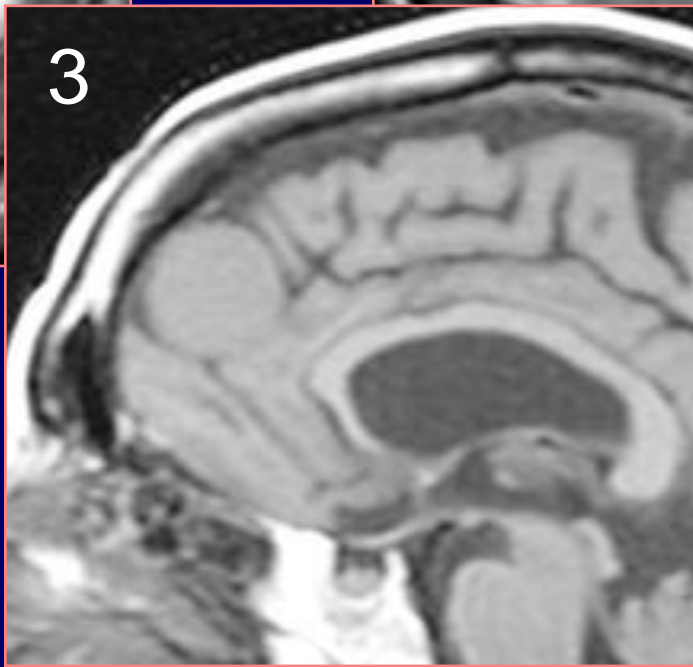
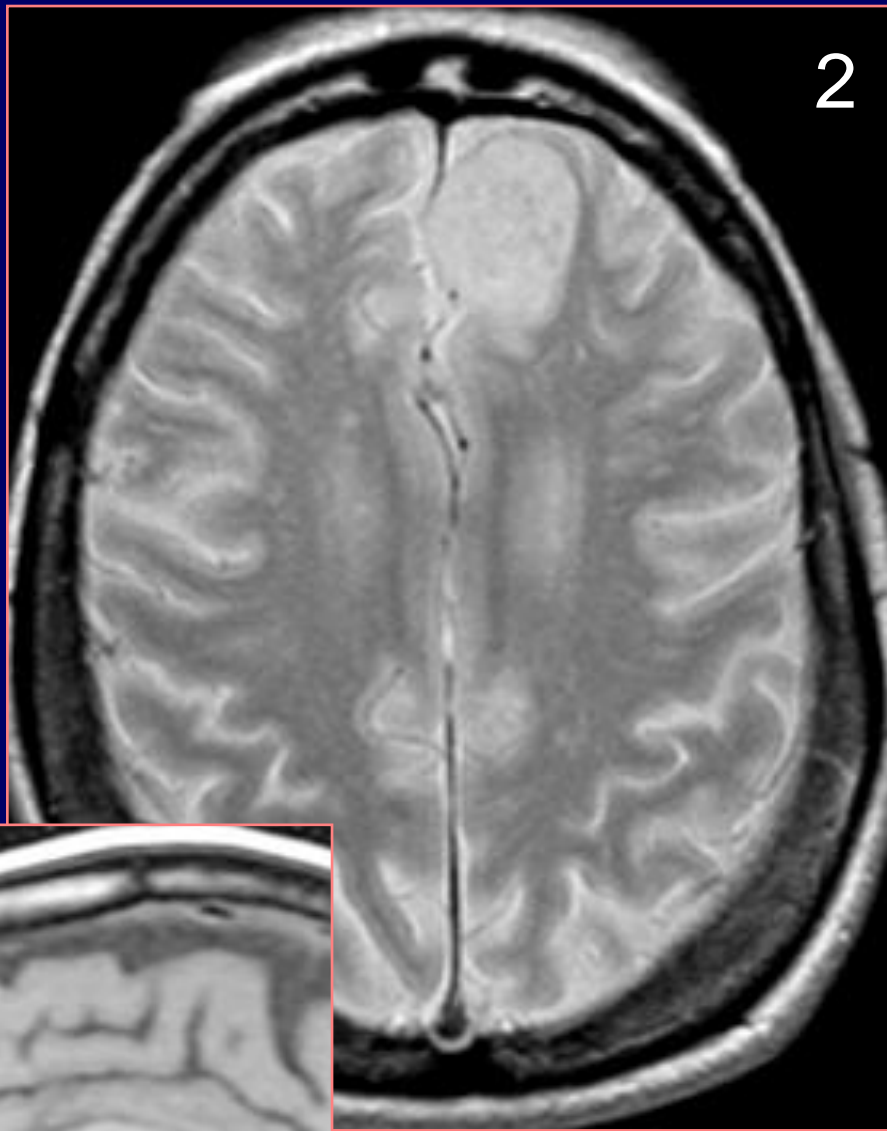
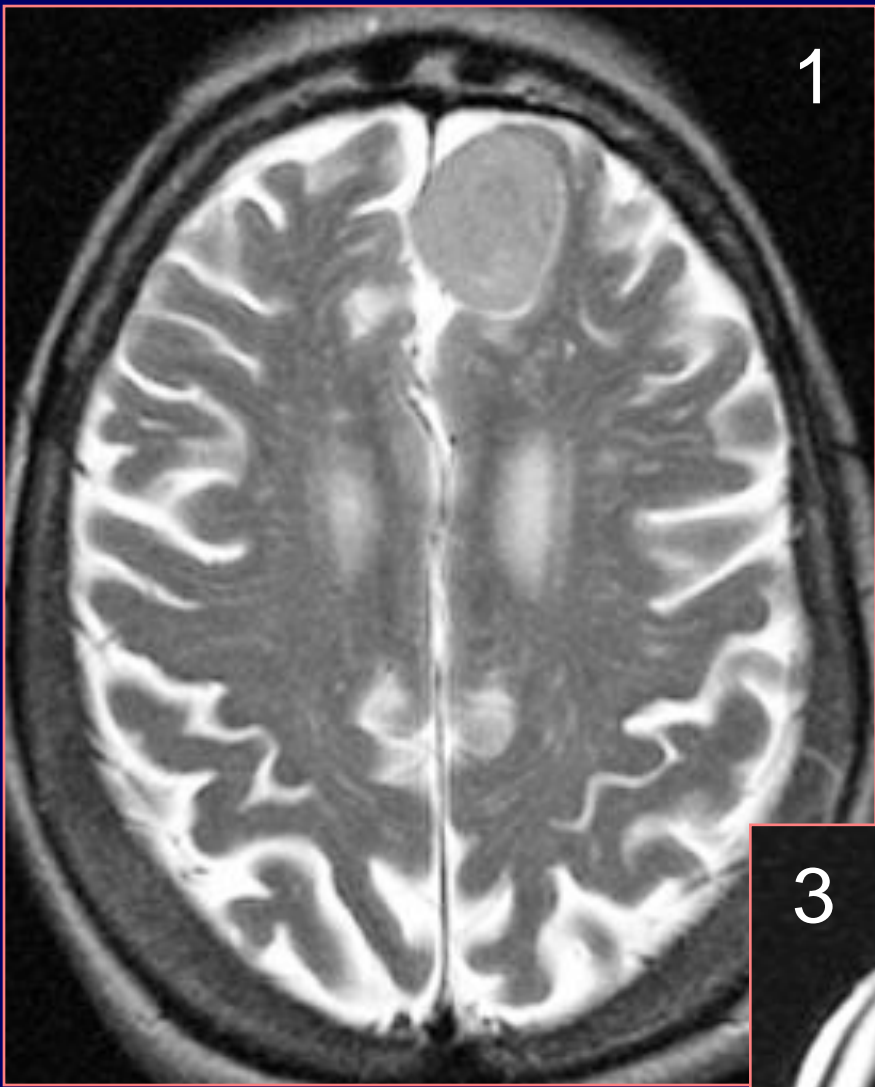




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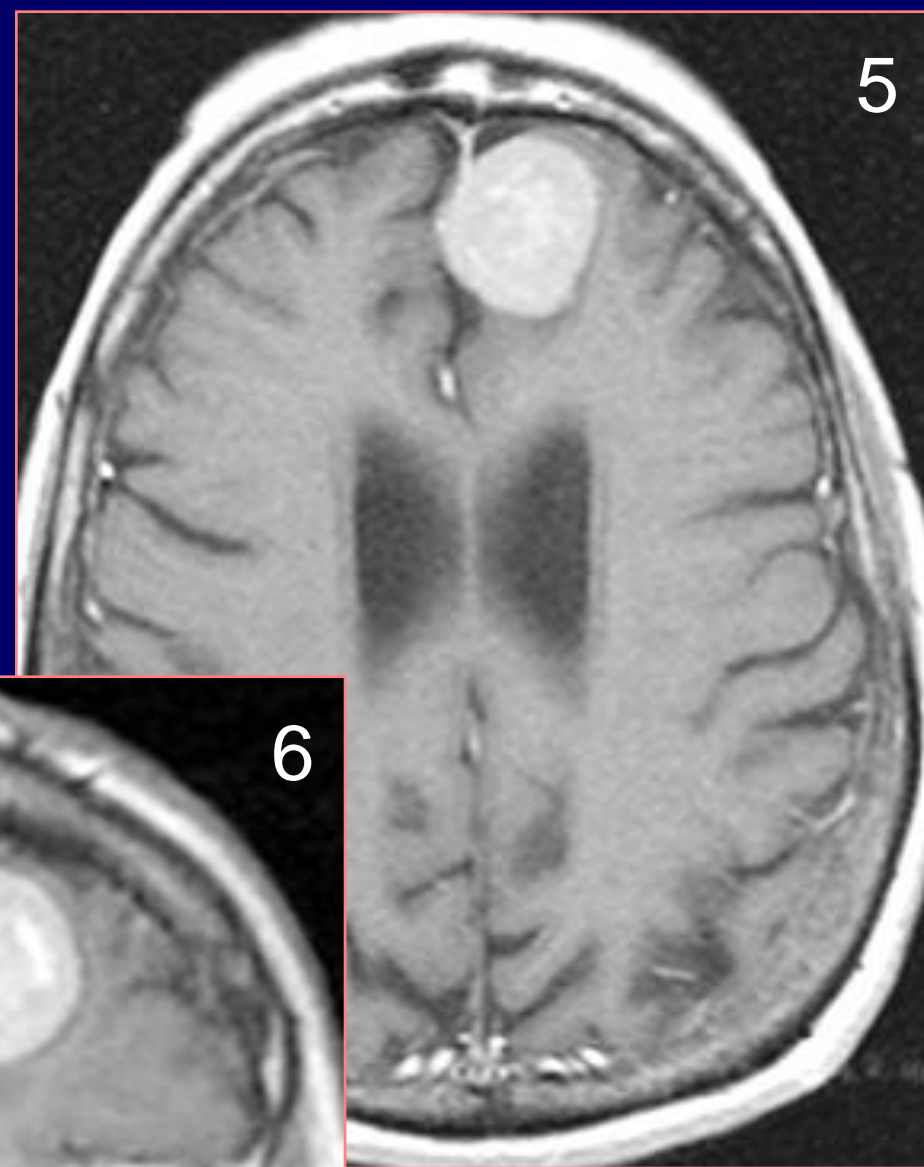
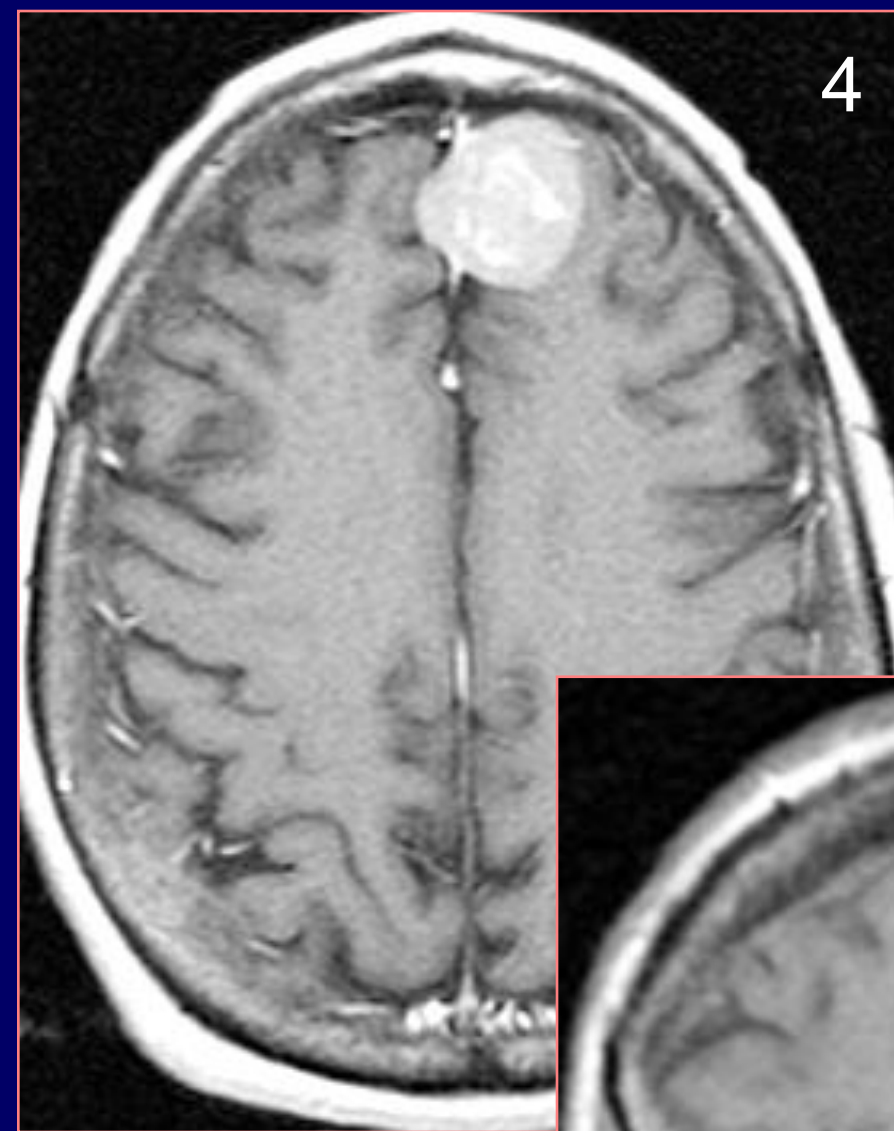


Dx:



History: 72 y.o. woman
with headaches

Case 9

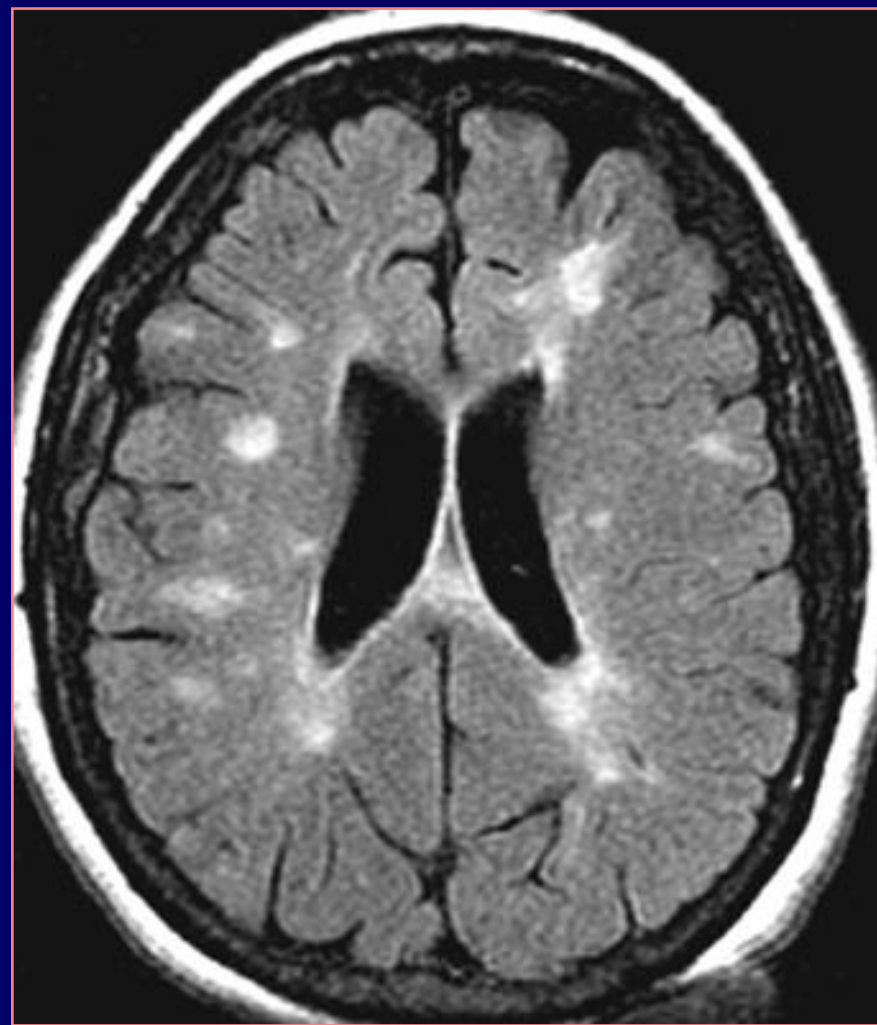
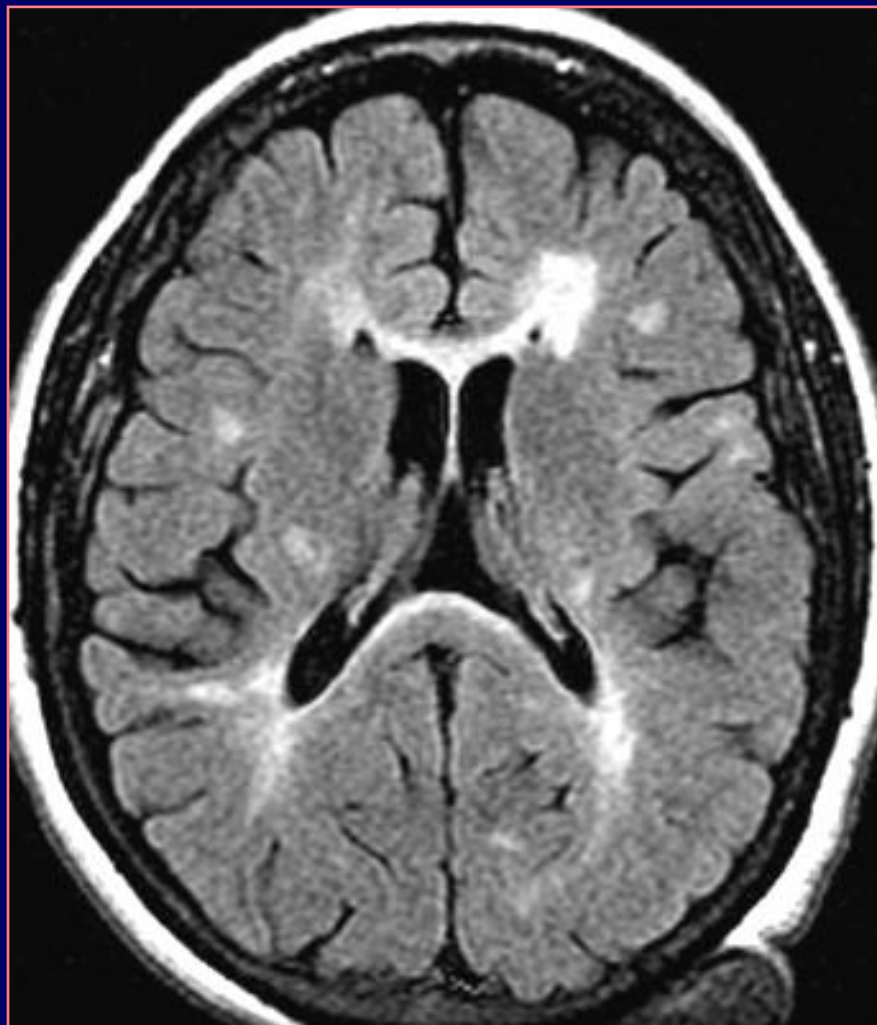


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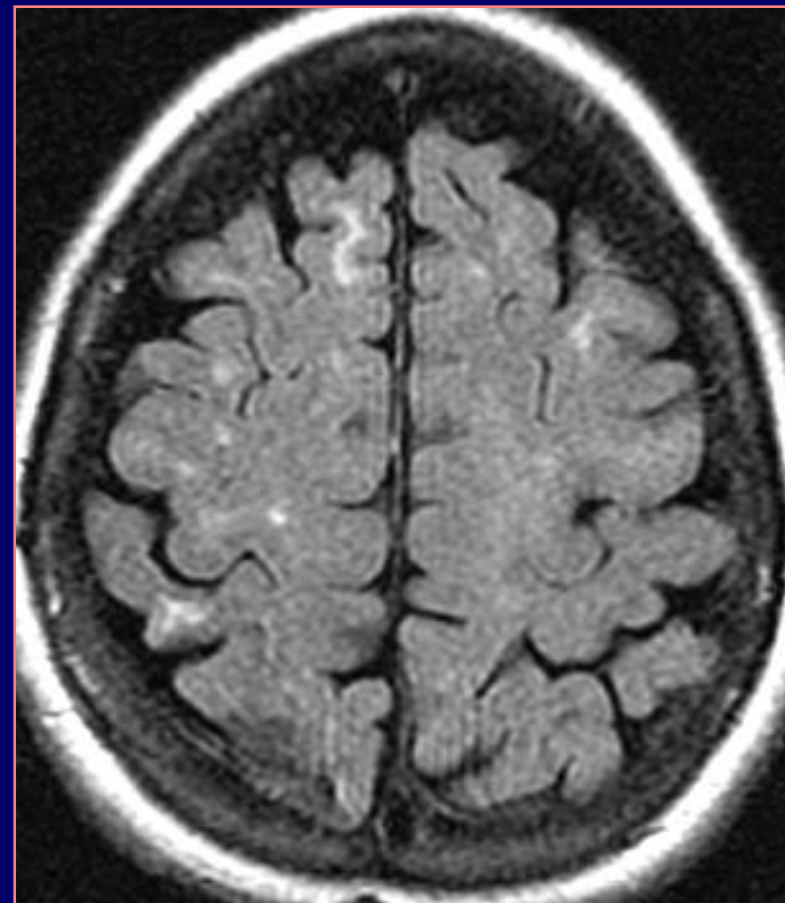
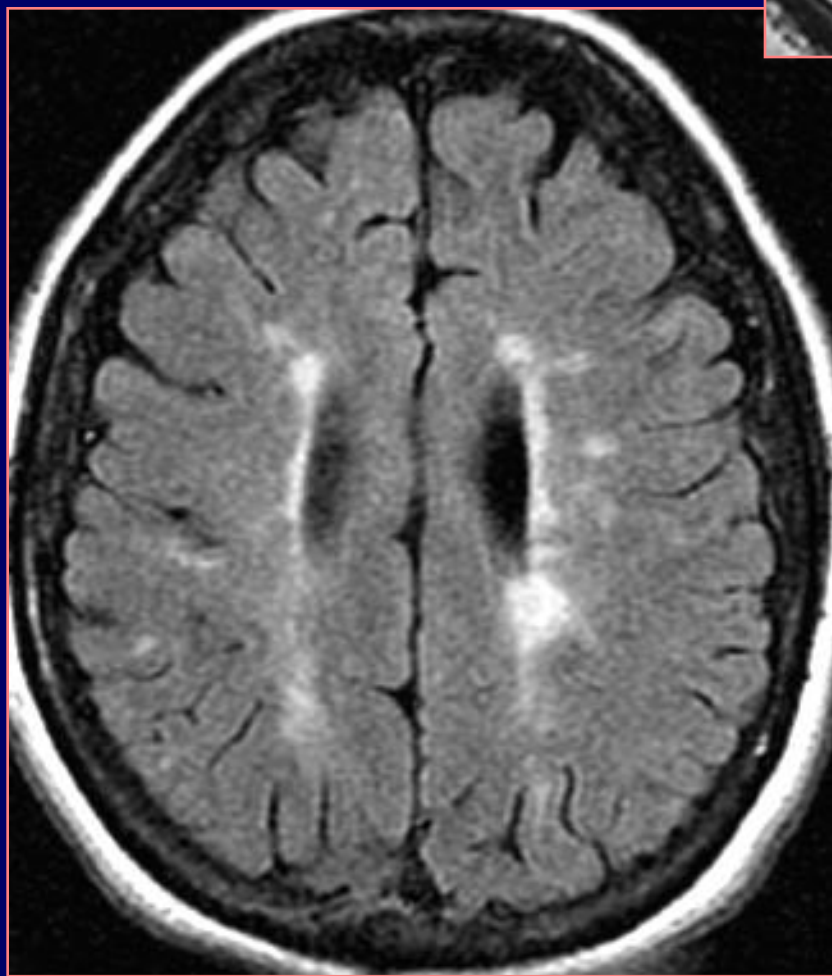
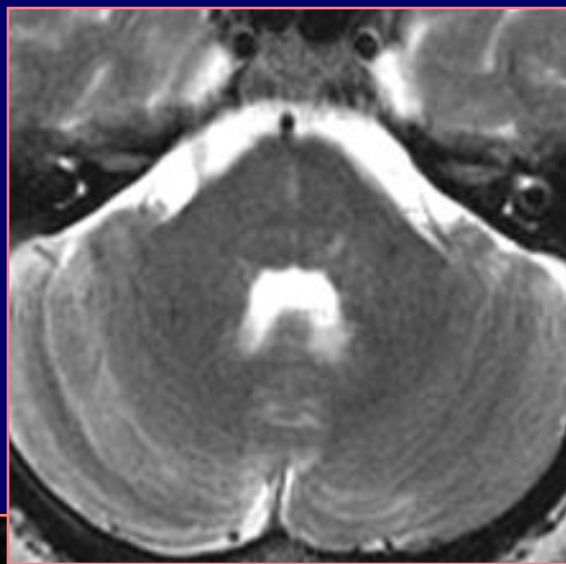
Dx:

Case 10

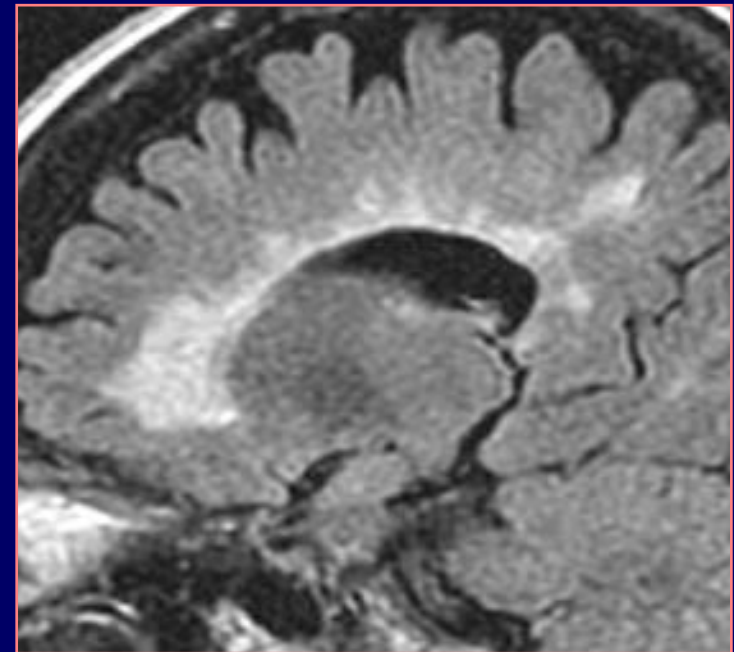
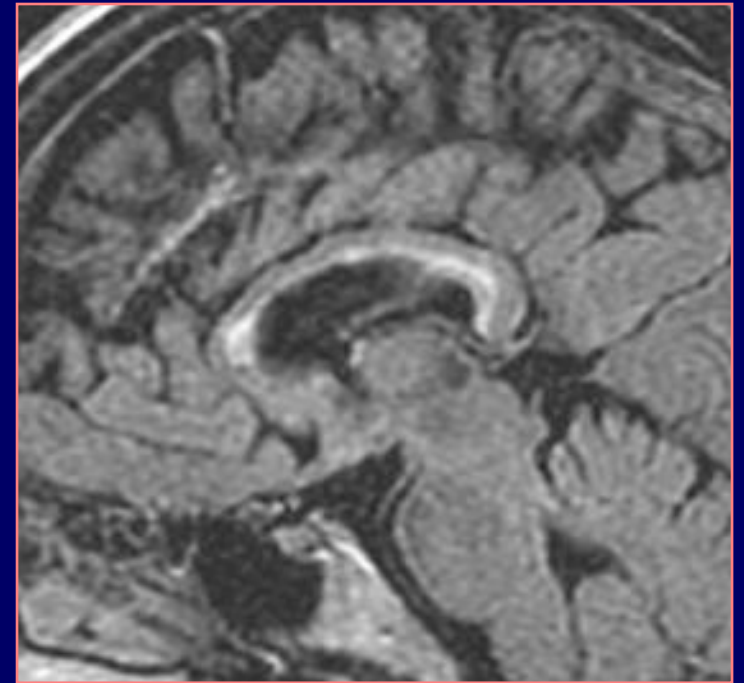
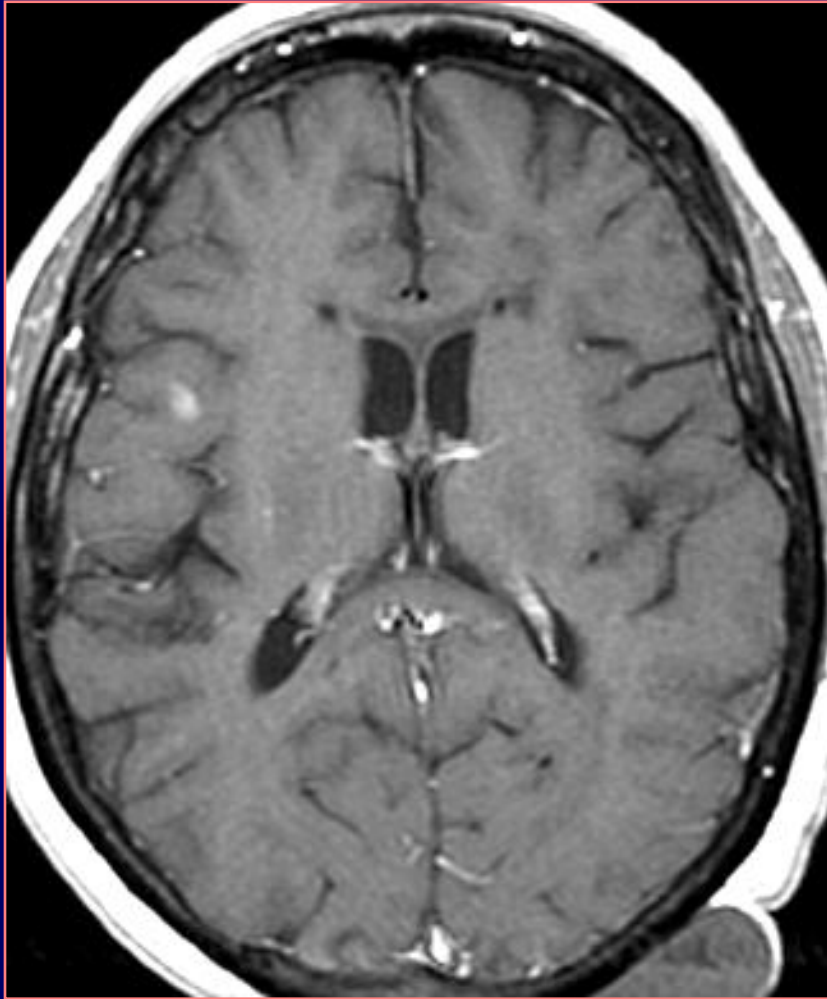
History: 55 y/o female with motor weakness, double vision, & emotional lability



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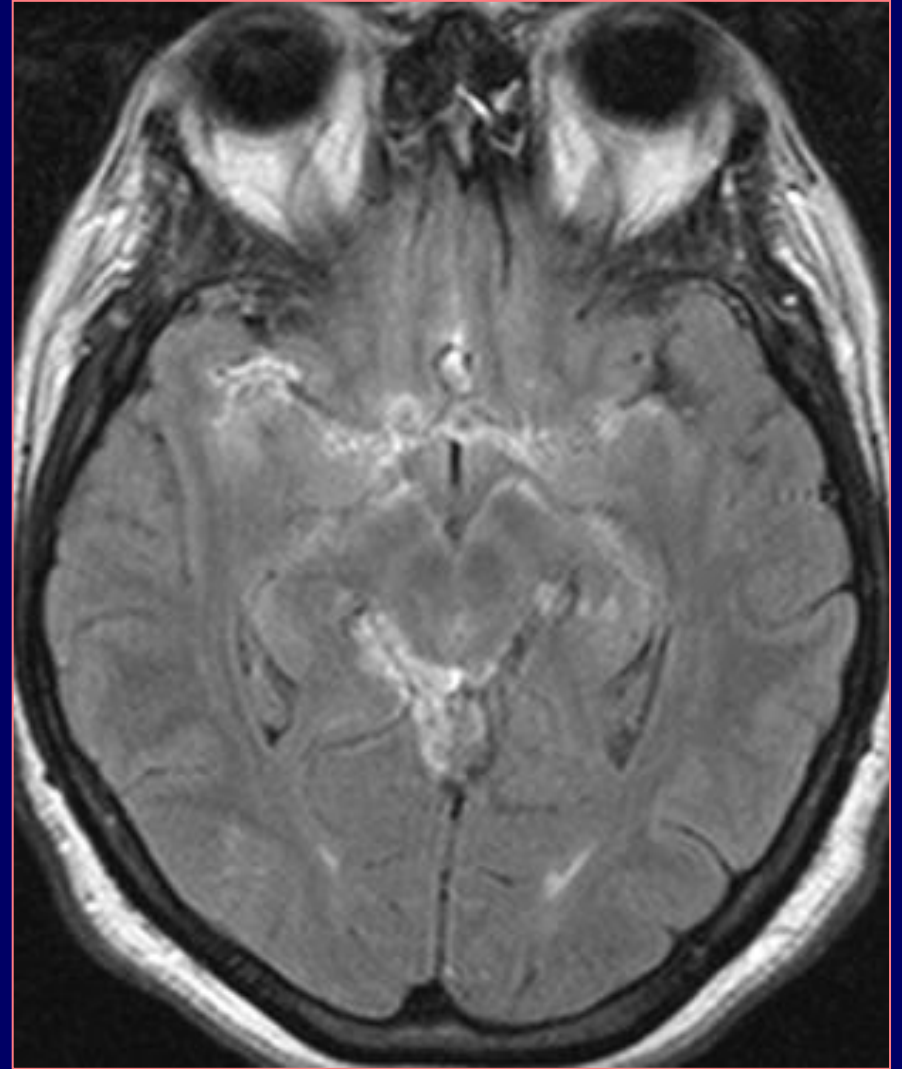
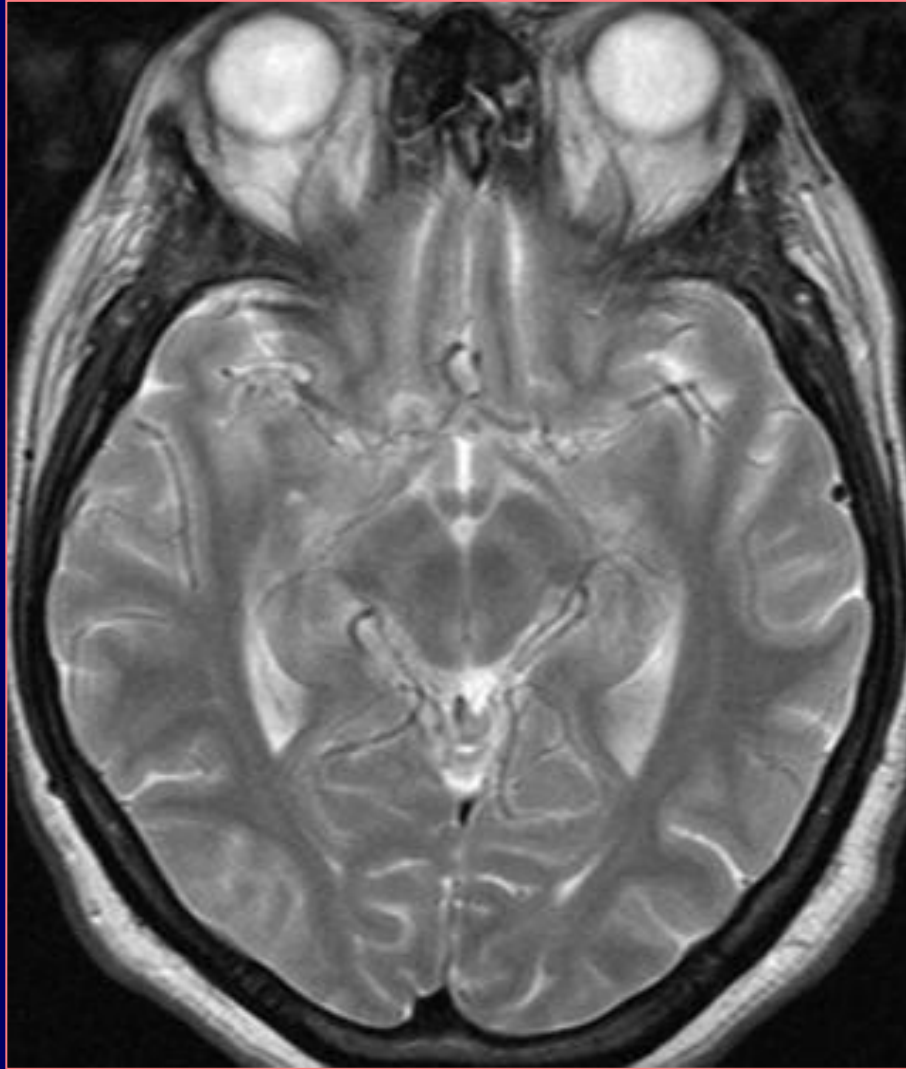
{Page 3}

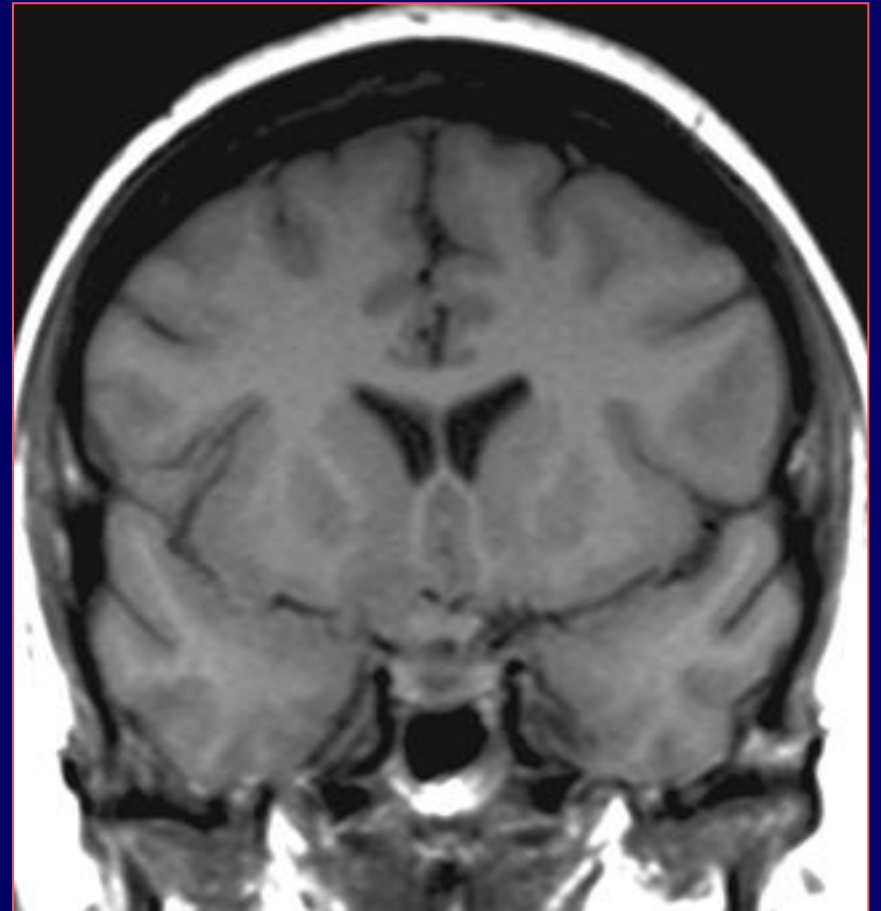
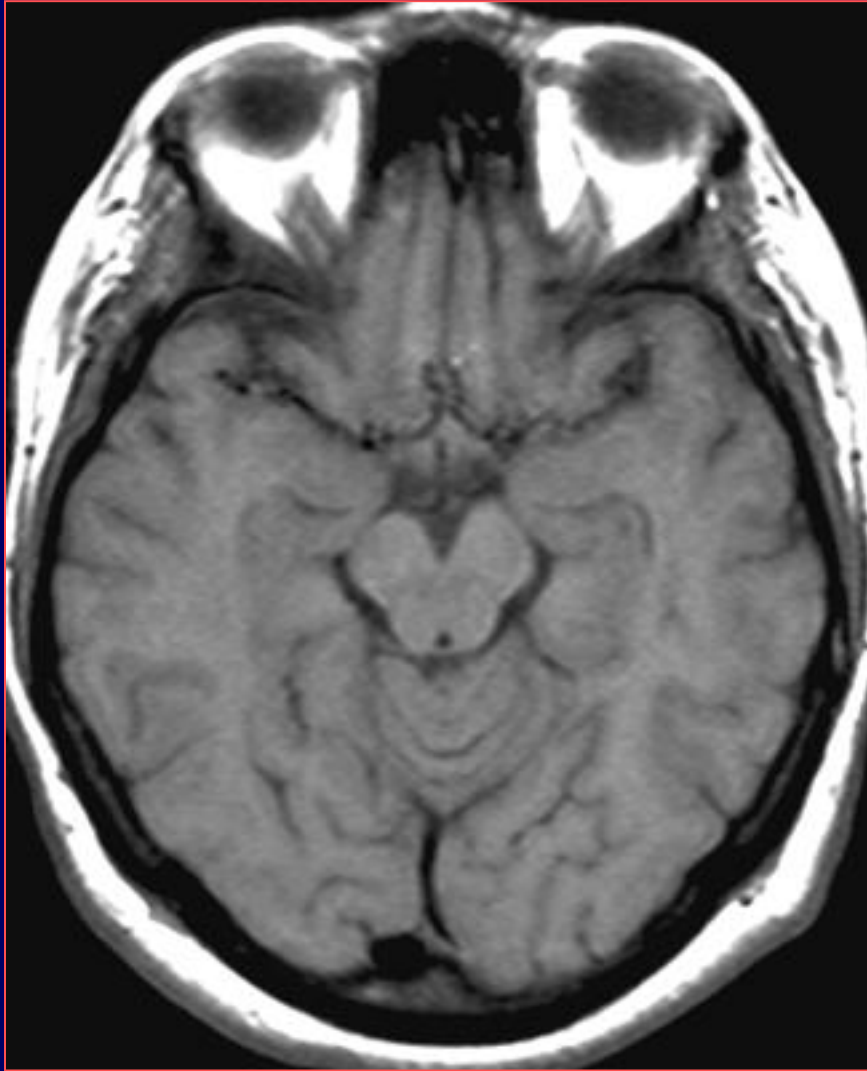


Dx:

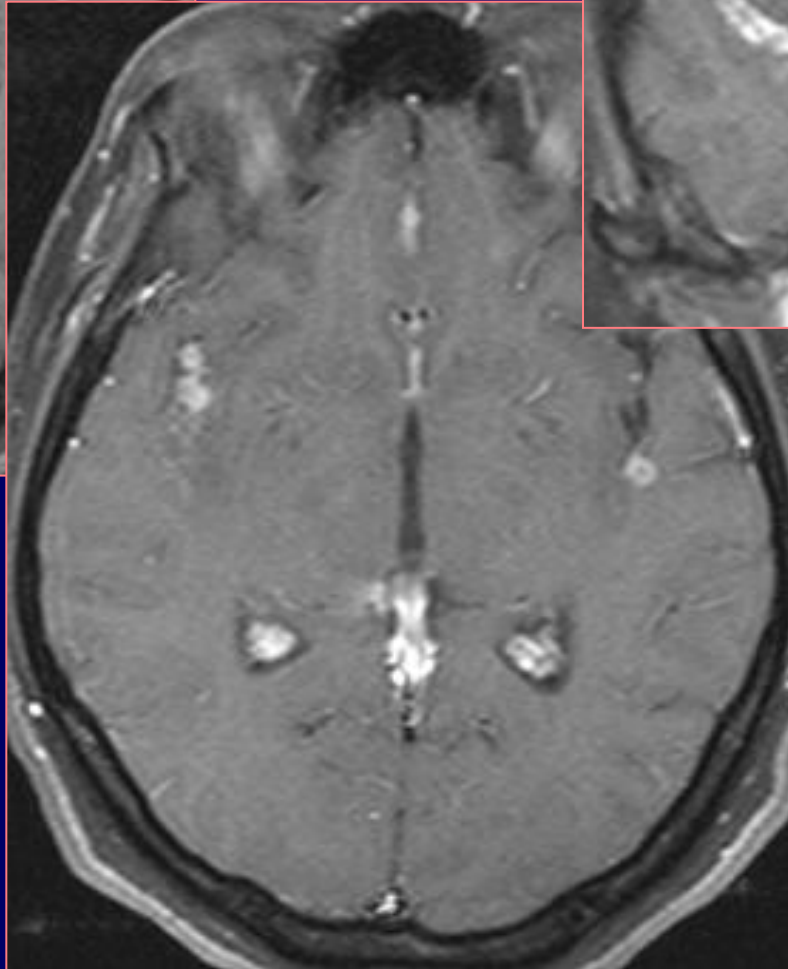
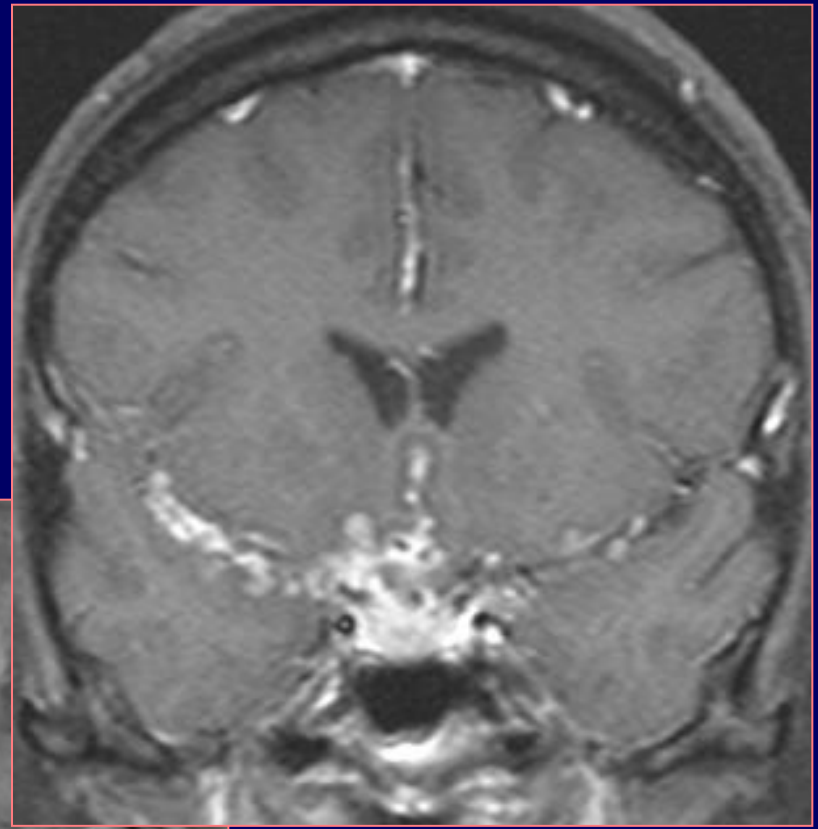
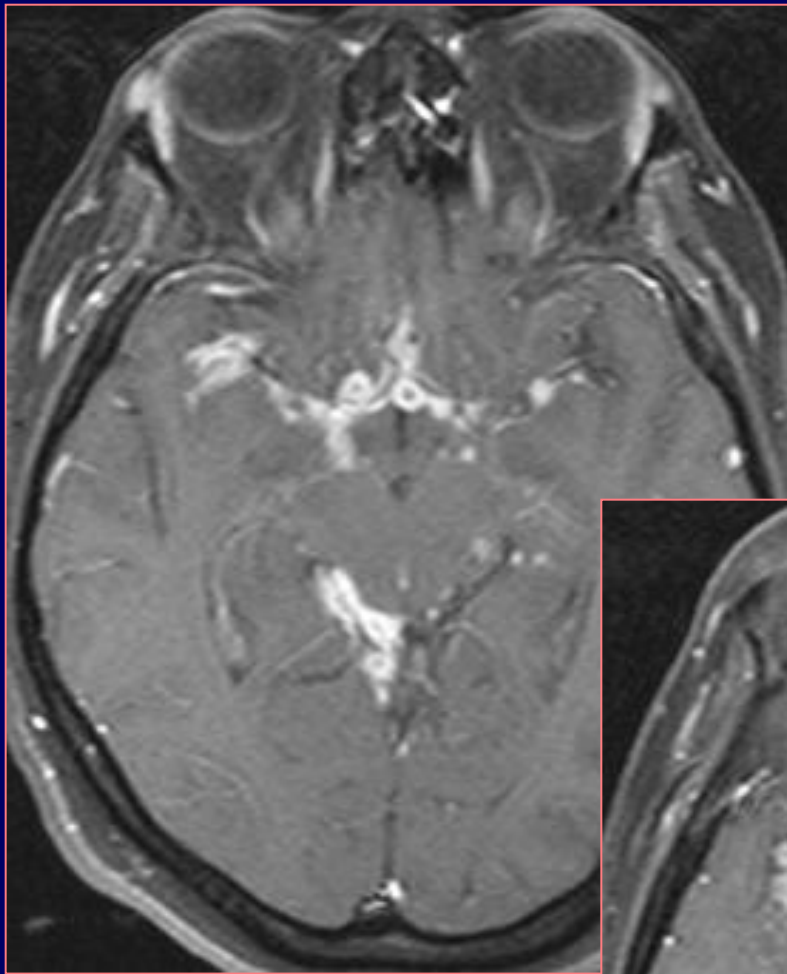
Case 11

History: 42 y/o female with chronic headaches





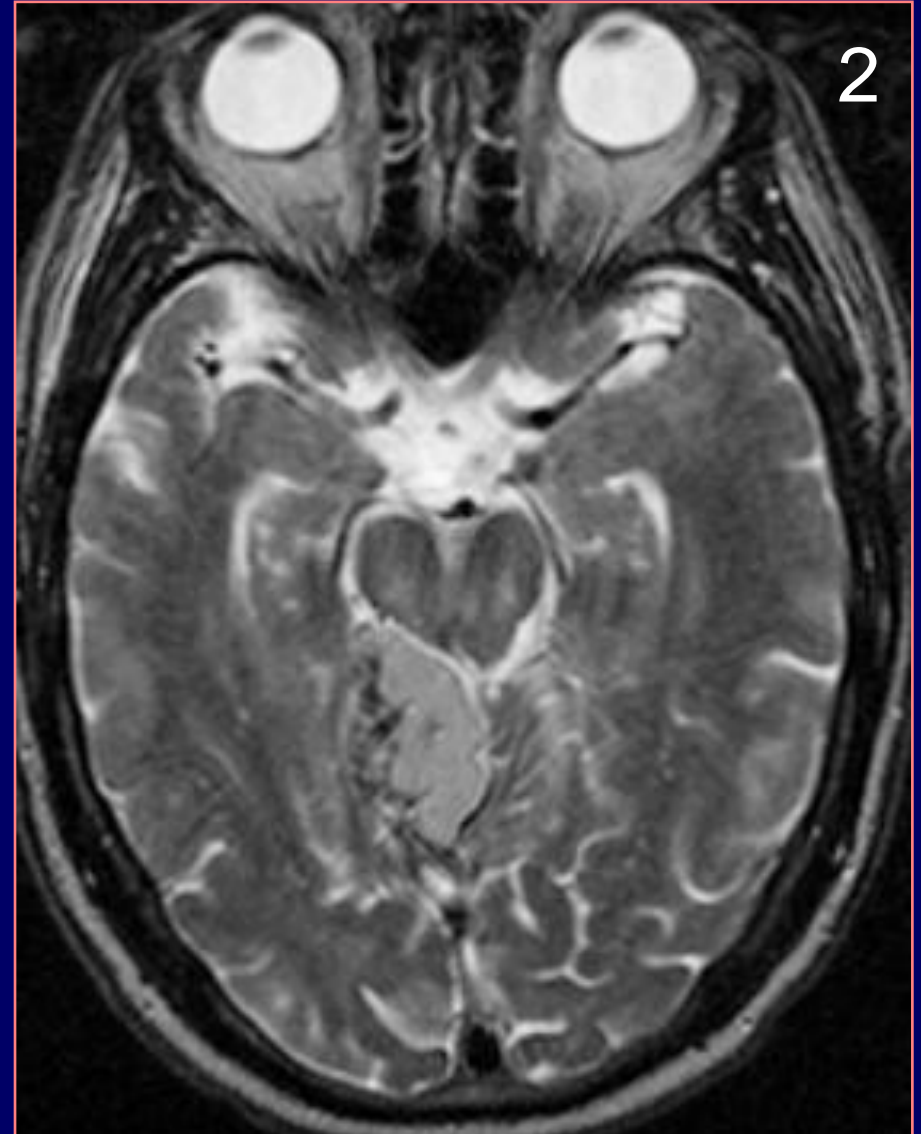
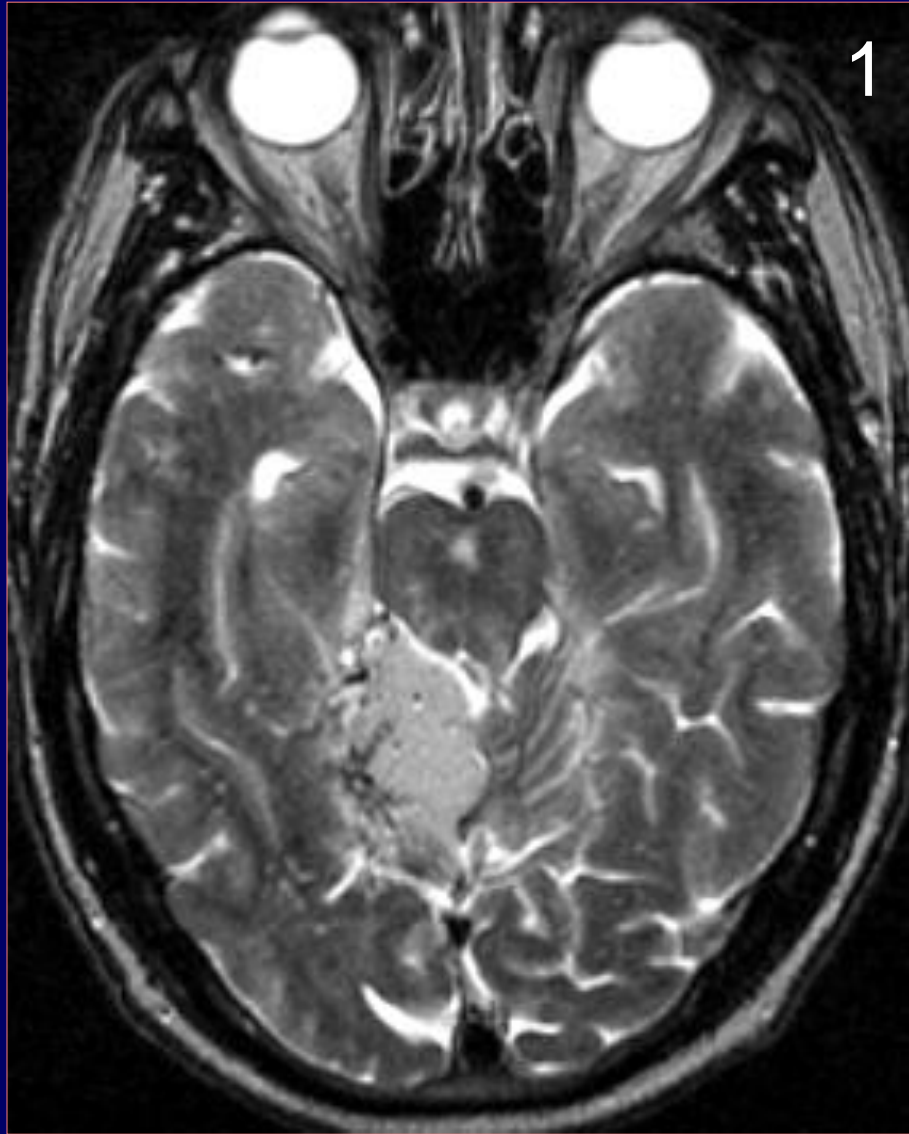
{Page 3}



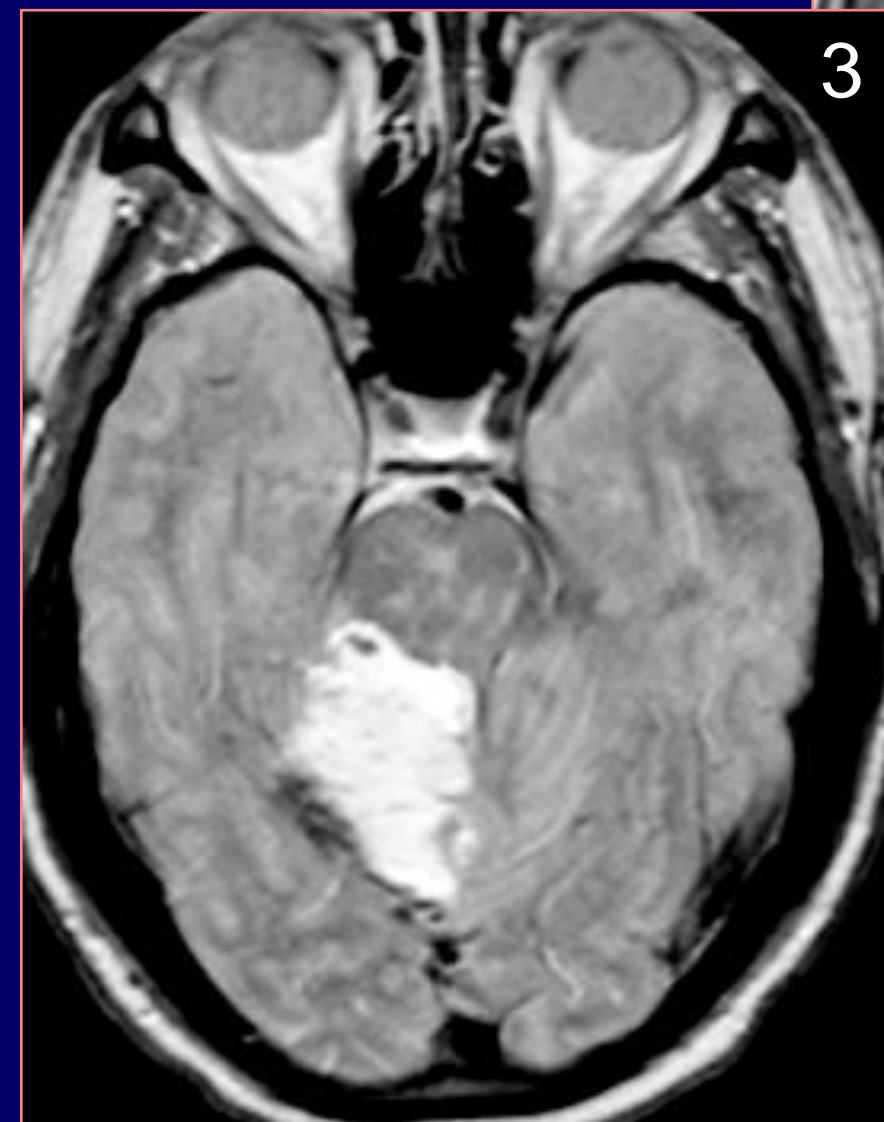
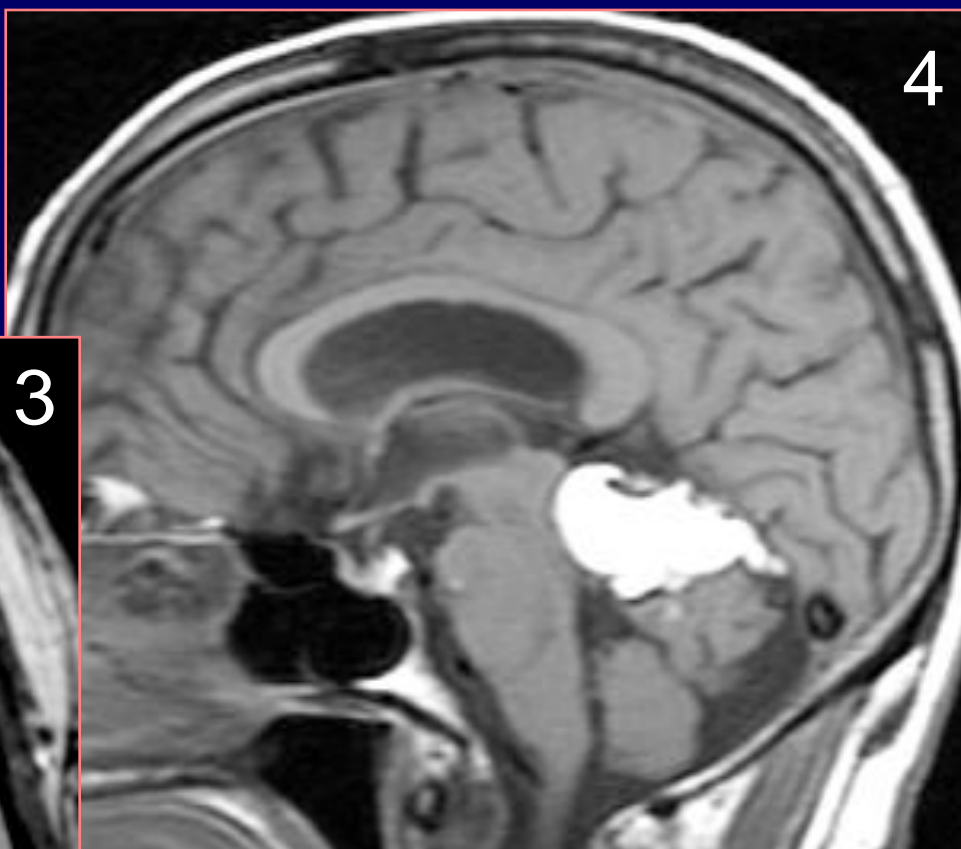
Dx:

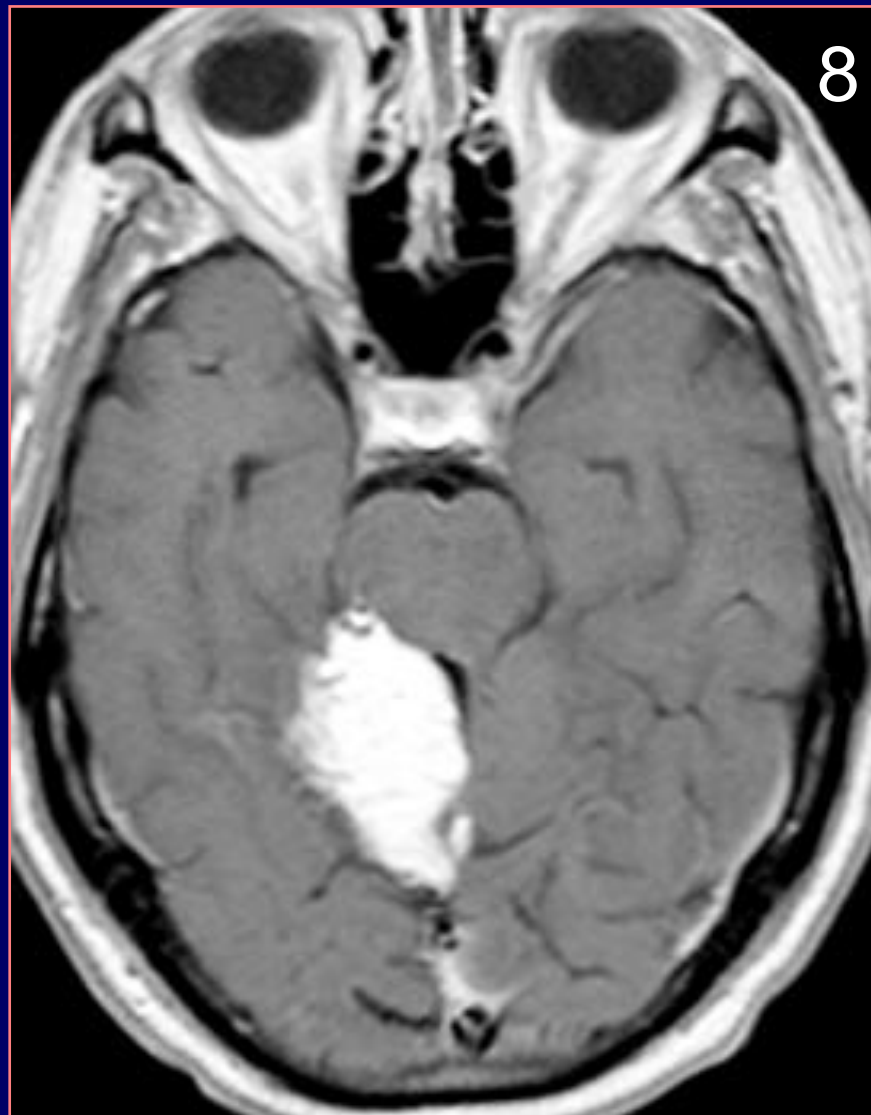
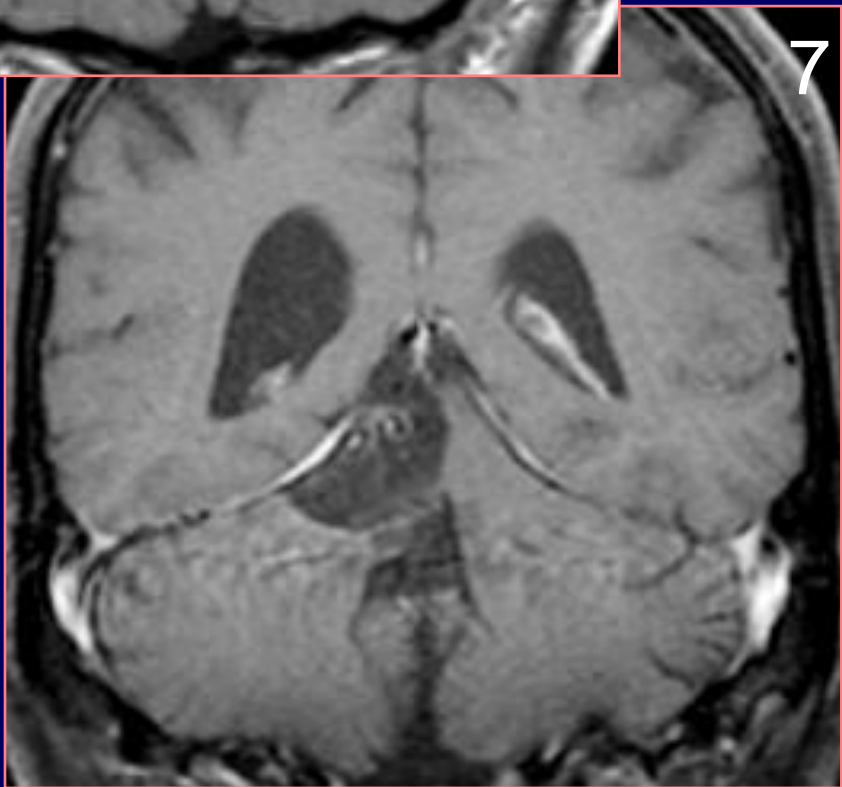
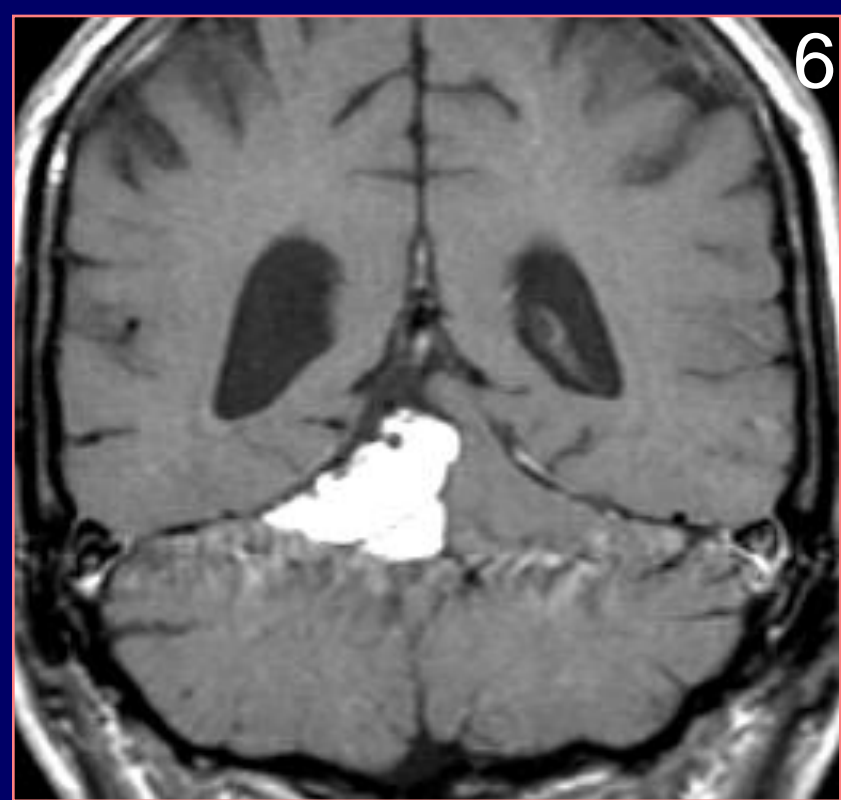
Case 12

History: 75 y.o. male
with dysmetria in upper extremities



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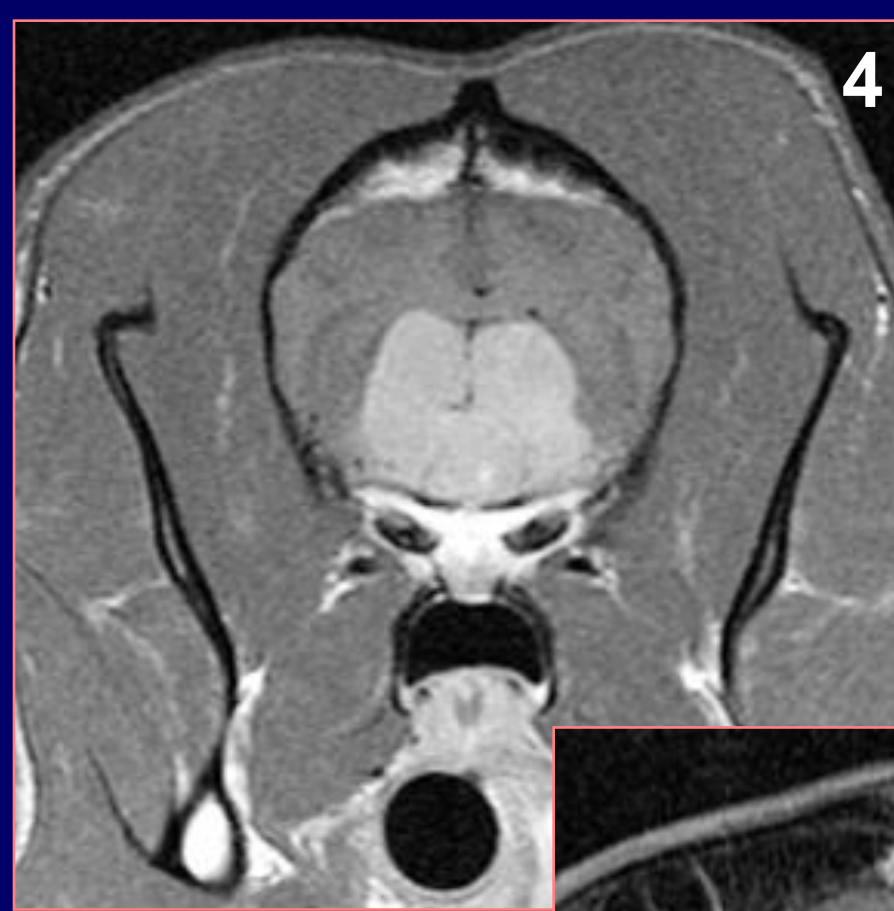




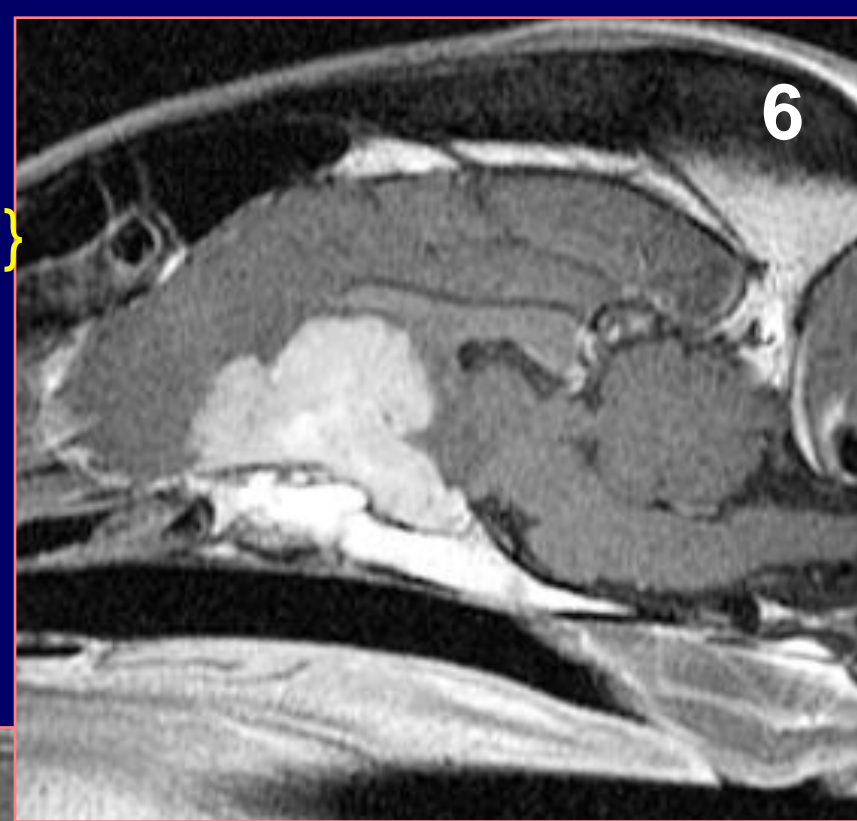
Dx:

History: Young male with increasing somnolence and irritability





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Dx: