WHAT ARE THE KEY SEQUENCES IN NEURORADIOLOGY IMAGING?

Or – How do I evaluate a plain MRI of the head?

This lecture is to be used for educational purposes only.
Images “borrowed” from the World Wide Web.
Eliel Ben-David, M.D.

Three Key Questions

1. Is it real?
2. Is it bad?
3. What is it?

Is it real? - True Pathology vs. Artifact

zipper artifact

herringbone artifact

zebra stripes

Moire fringes

central point artifact

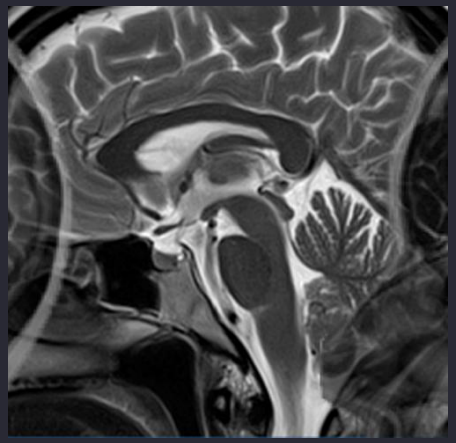
RF overflow artifacts

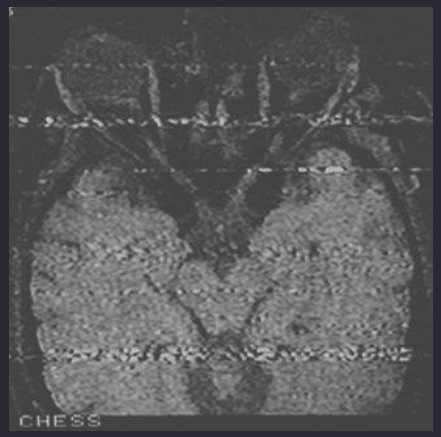
inhomogeneity artifacts

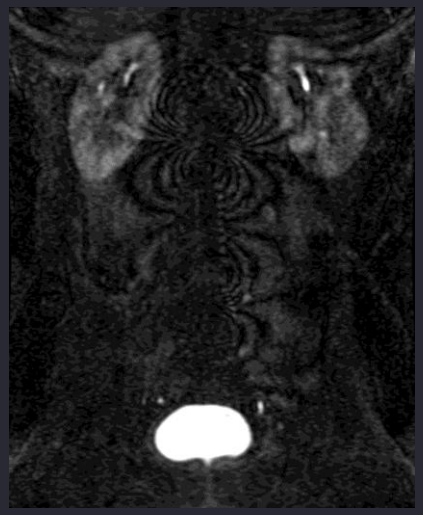
cross-talk artifact

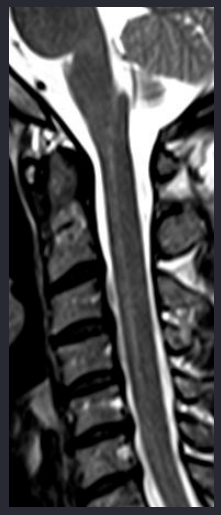
cross excitation

phase-encoded motion artifact









entry slice phenomenon

black boundary artifact

magic angle effect

magnetic susceptibility artifact

chemical shift artifact

dielectric effect artifact

Gibbs artifact/truncation artifact

zero-fill artifact

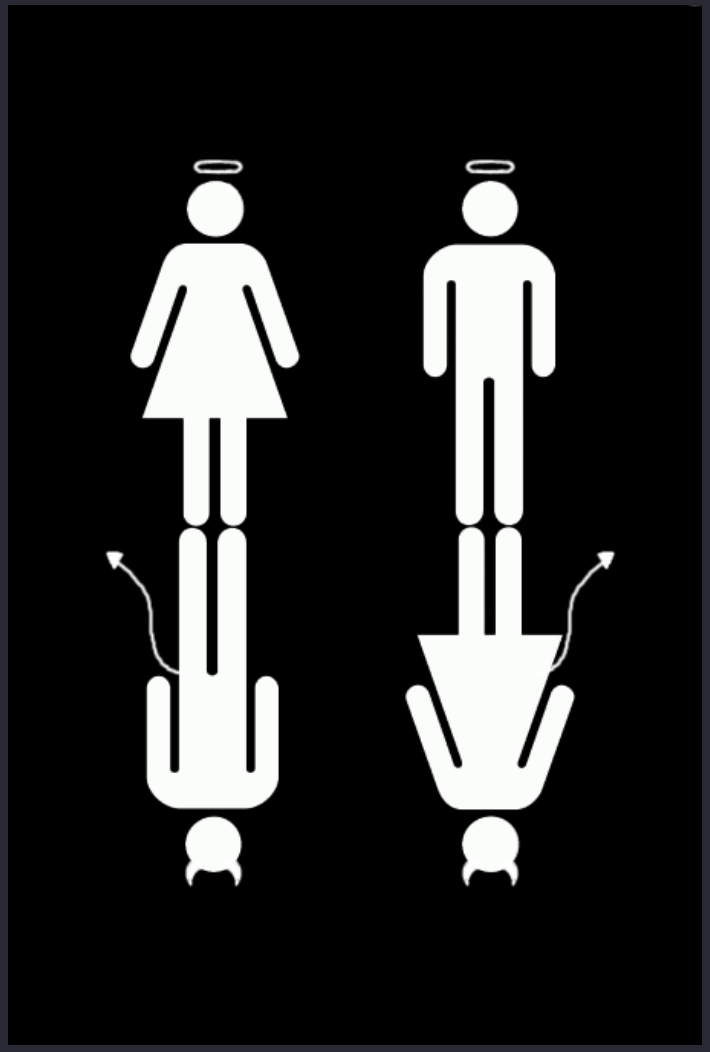
aliasing/wrap around artifact

11. Know Thy Artifact

- MR hardware and room shielding
- MR software
- Patient and physiologic motion
- Tissue heterogeneity and foreign bodies
- Fourier transform and Nyquist sampling theorem

http://radiopaedia.org/articles/mri-artifacts

Is it bad? – Normal or Abnormal



http://headneckbrainspine.com/index.php

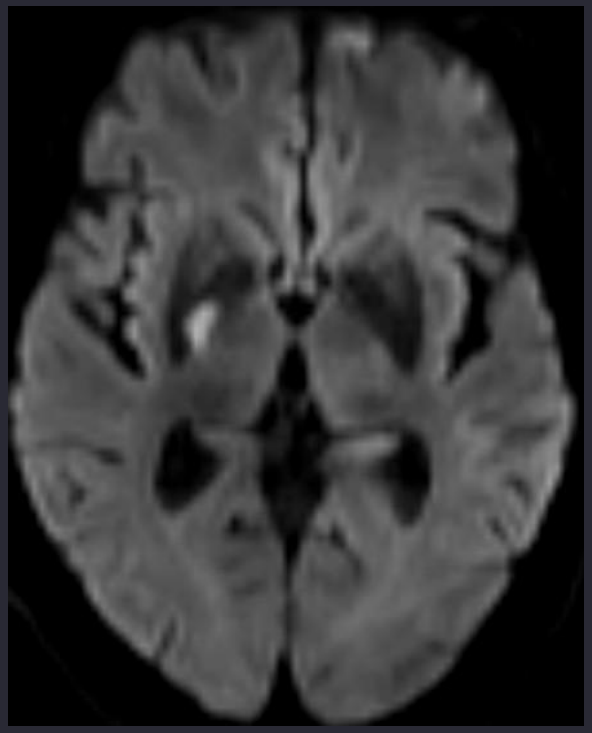
What is it?

- Take what lives there and make it abnormal.
- Know the regional pathology/pathophysiology.
- Compare unknown to known.
- How do these pathologies appear on MRI?

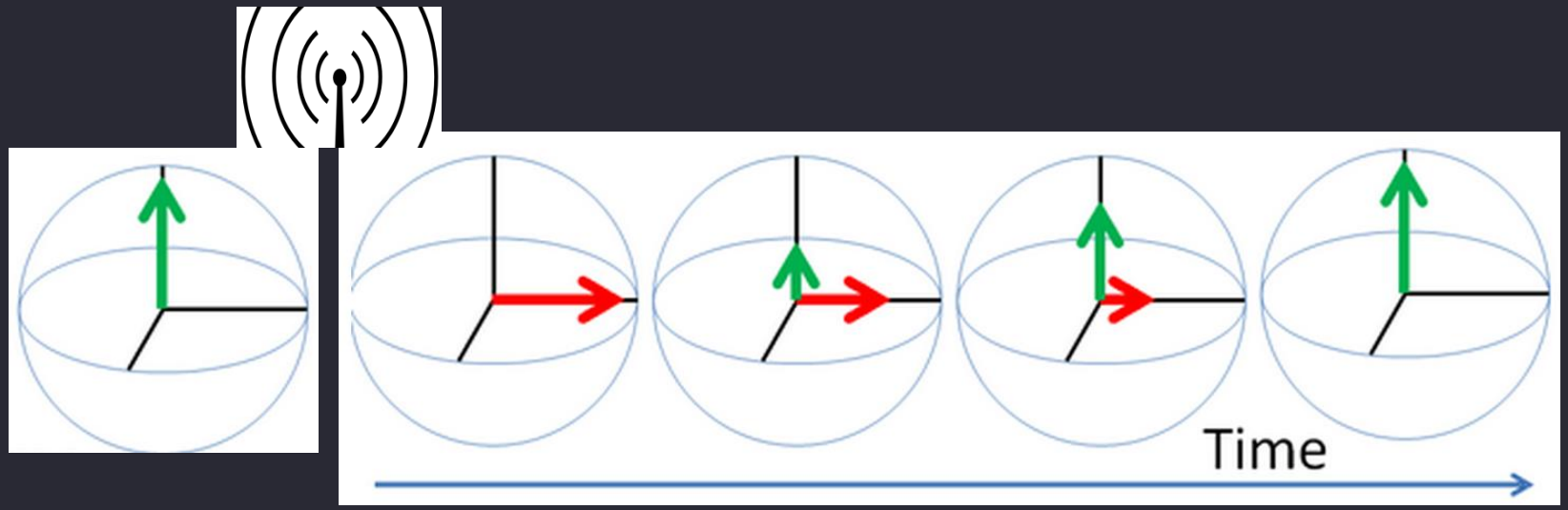
Contrast

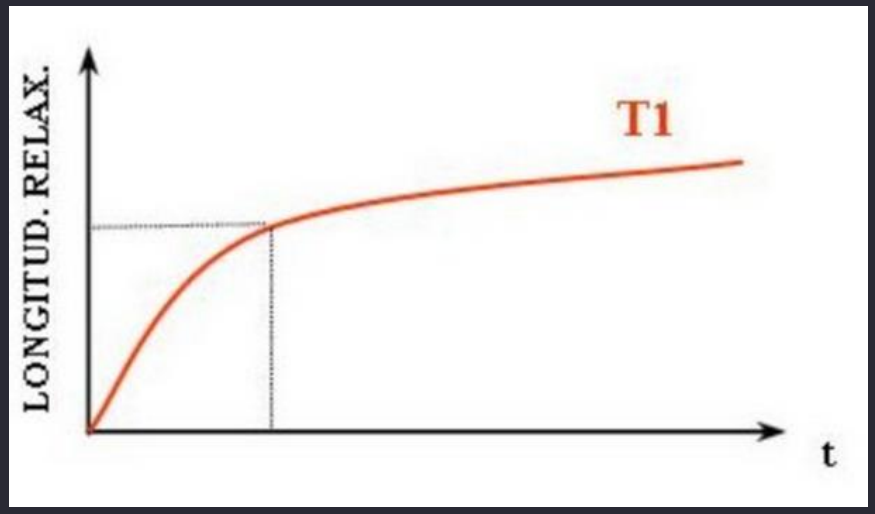
- Tissue definition/Spatial resolution
- Conspicuity of pathology

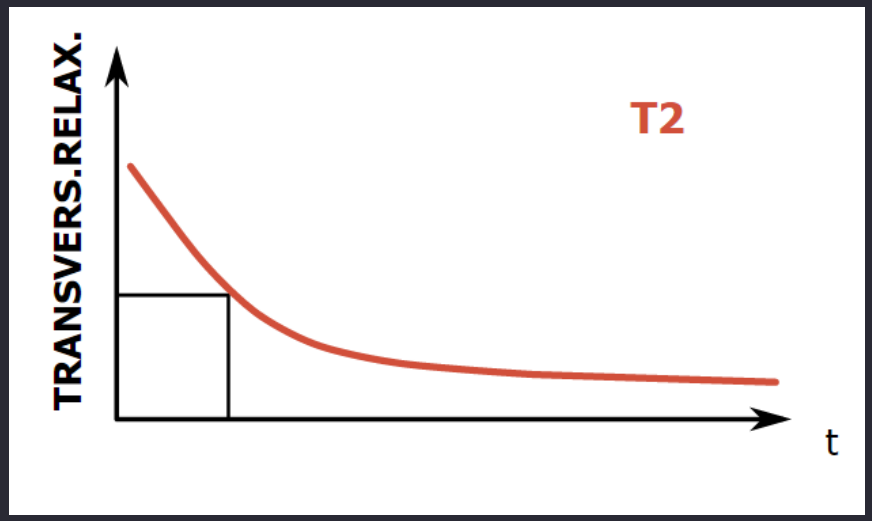
Where is it easier to identify the stroke?



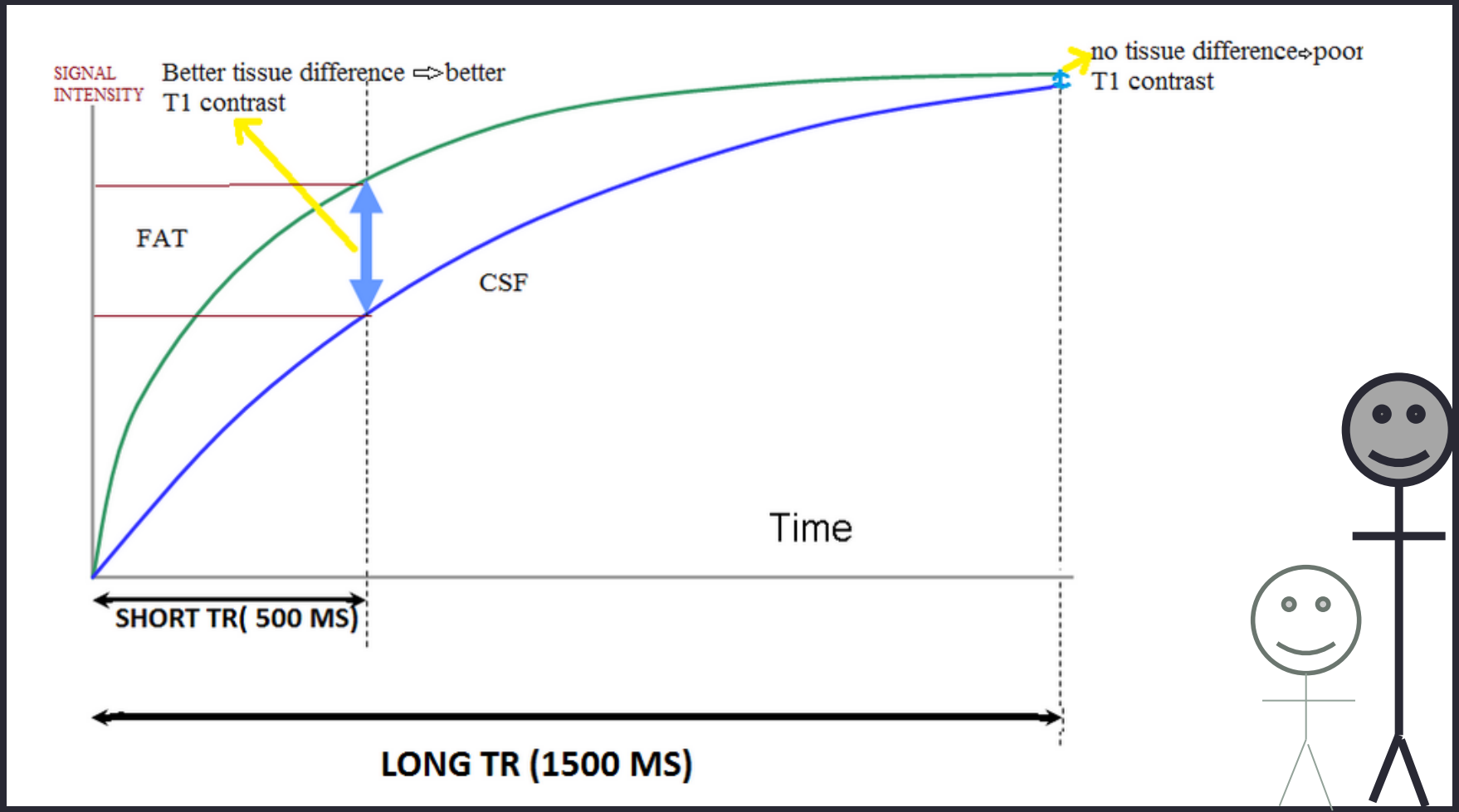
Basic Contrasts





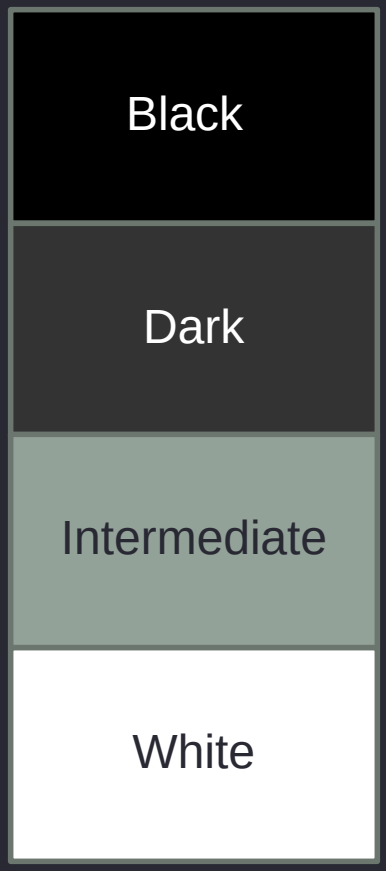


T1 contrast


SIGNAL INTENSITY
Better tissue difference ⇨better T1 contrast
no tissue difference⇨poor T1 contrast
FAT
CSF
Time
SHORT TR(500 MS)
LONG TR (1500 MS)

Basic Neuro Sequences

- Four Shades of Gray – T1



No protons / excited protons
- Air
- Dense Calcification/Cortical Bone

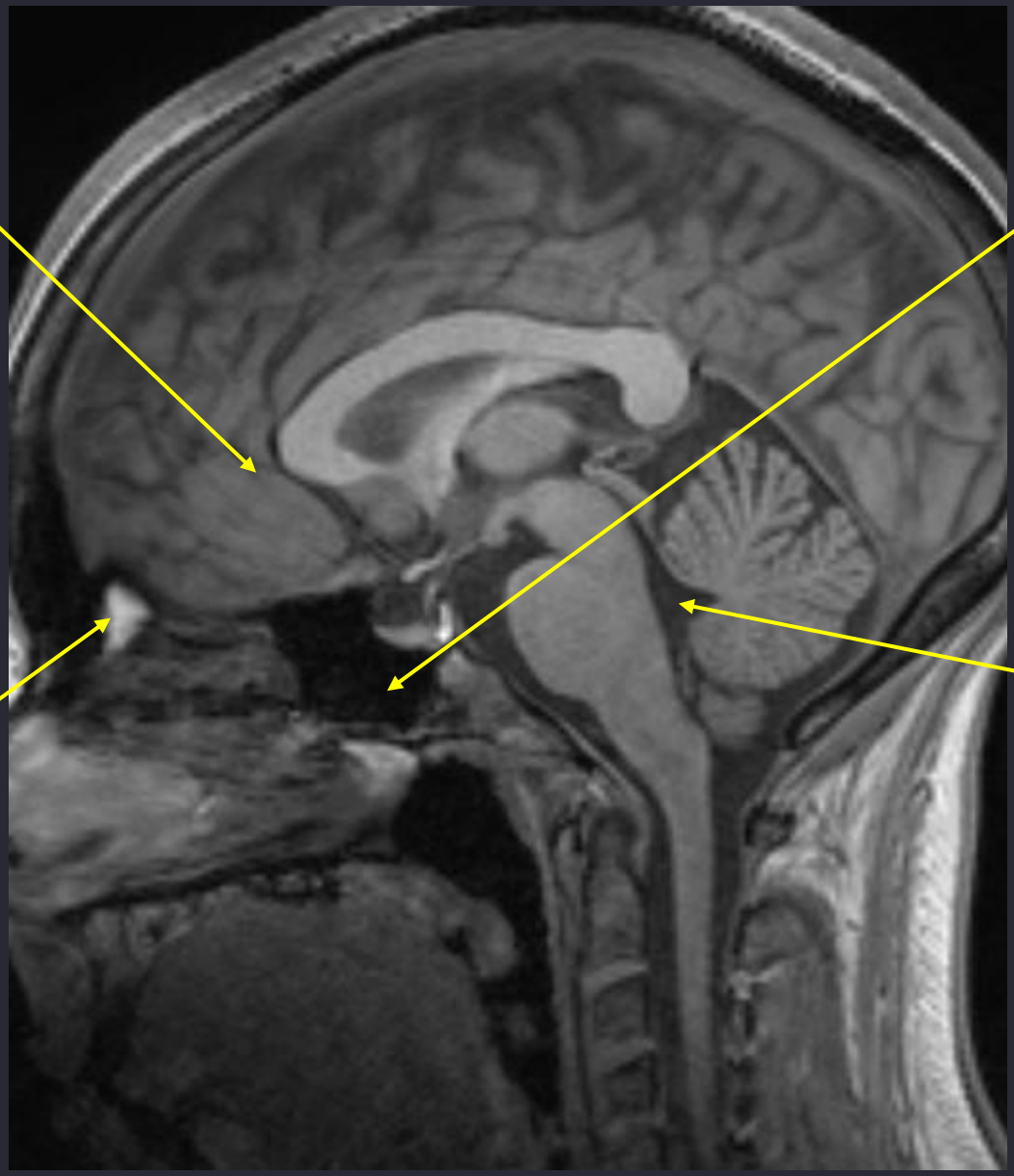
Fluid (CSF)

(Protein)
Brain Tissue GM
WM

Fat
Gadolinium
Methemoglobin

Intermediate

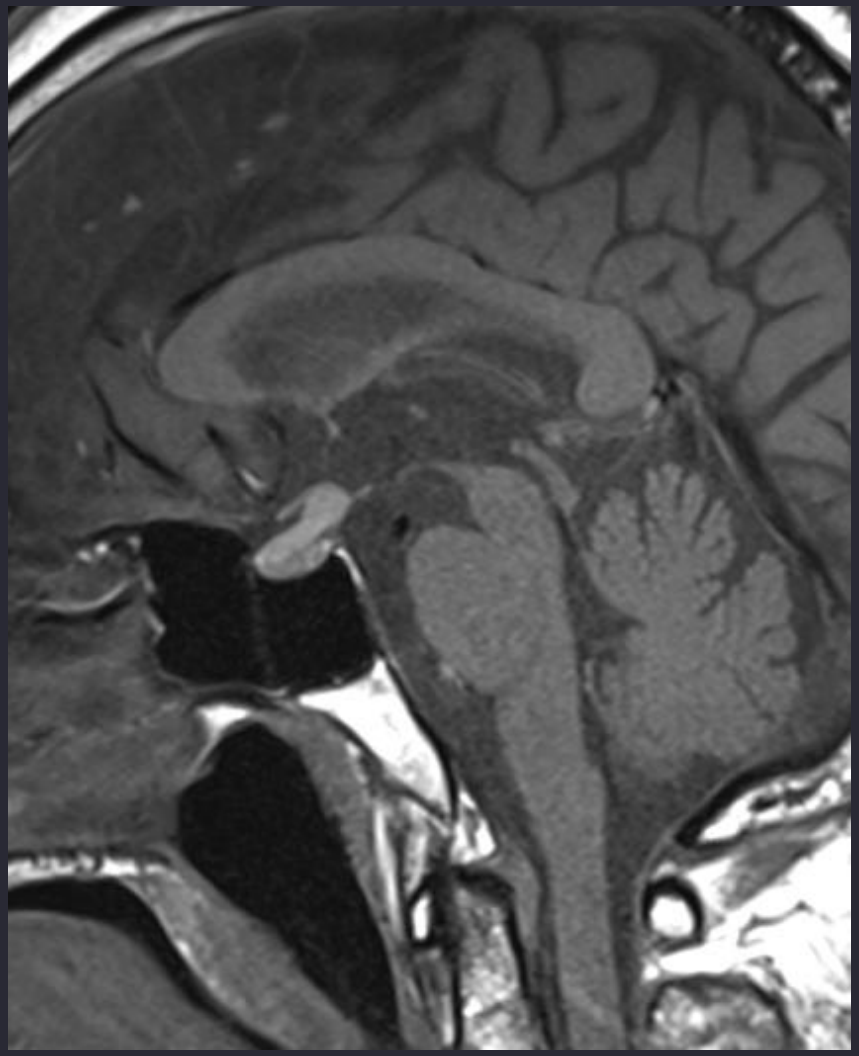
White

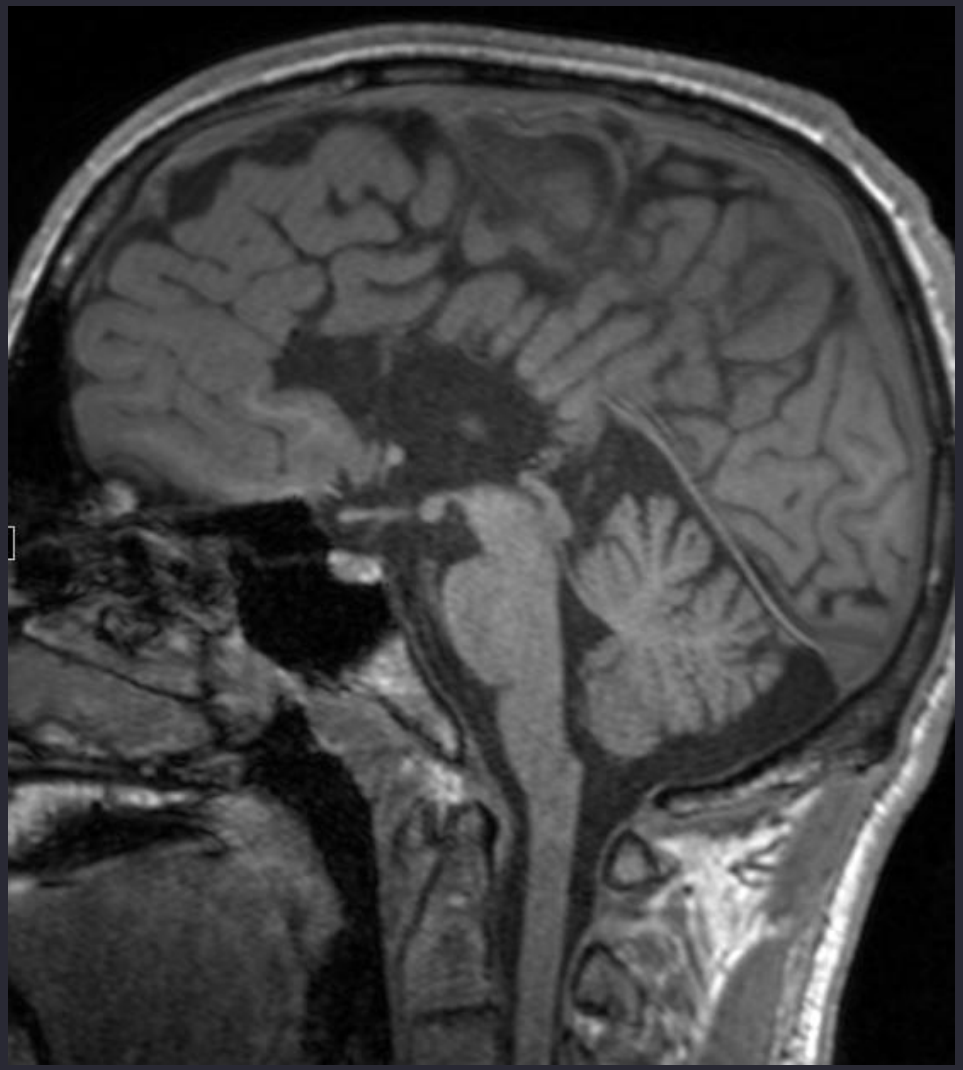


Black

Dark

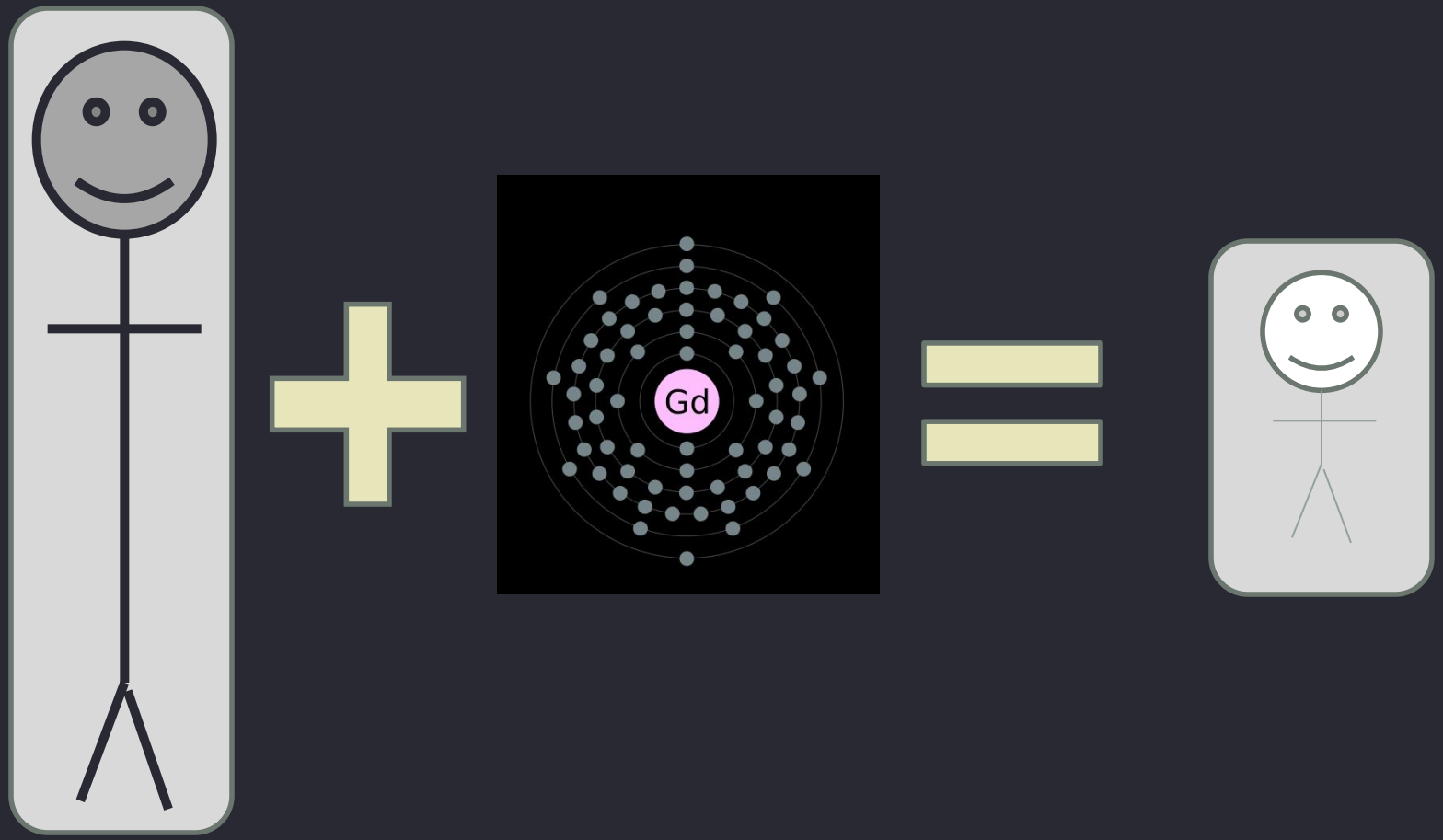
Sagittal T1

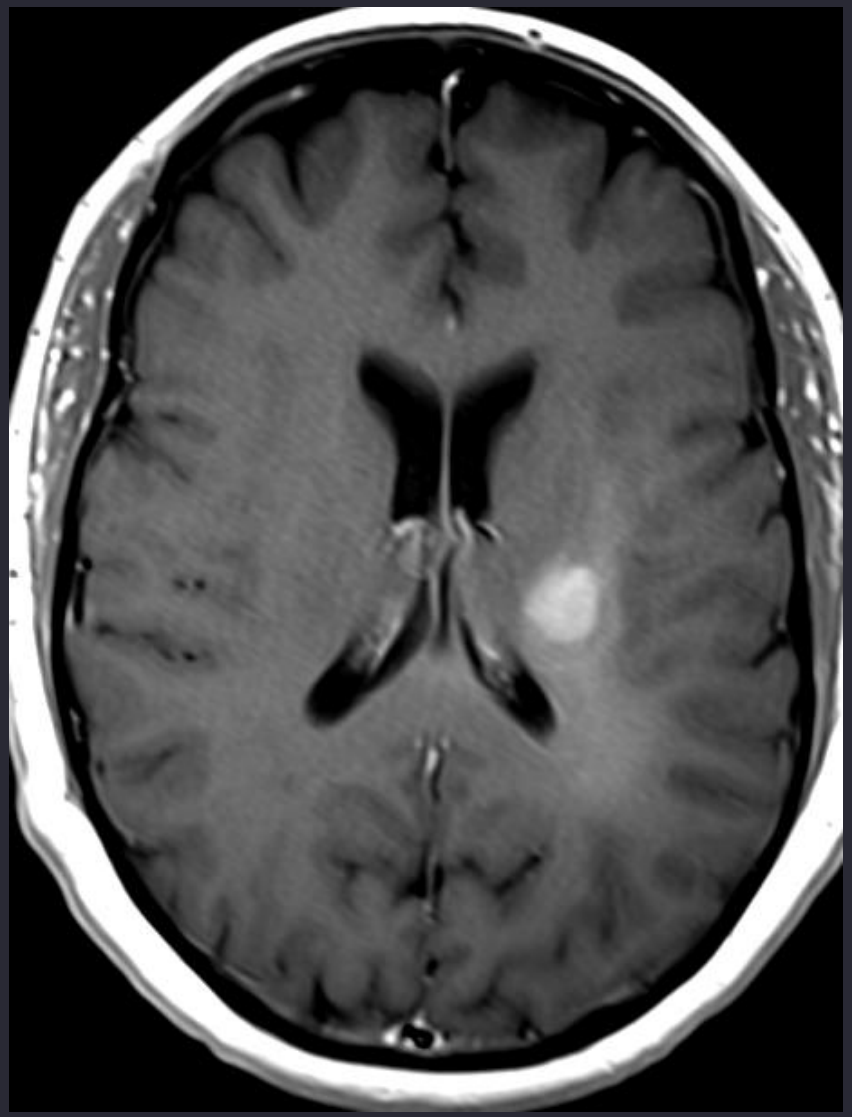




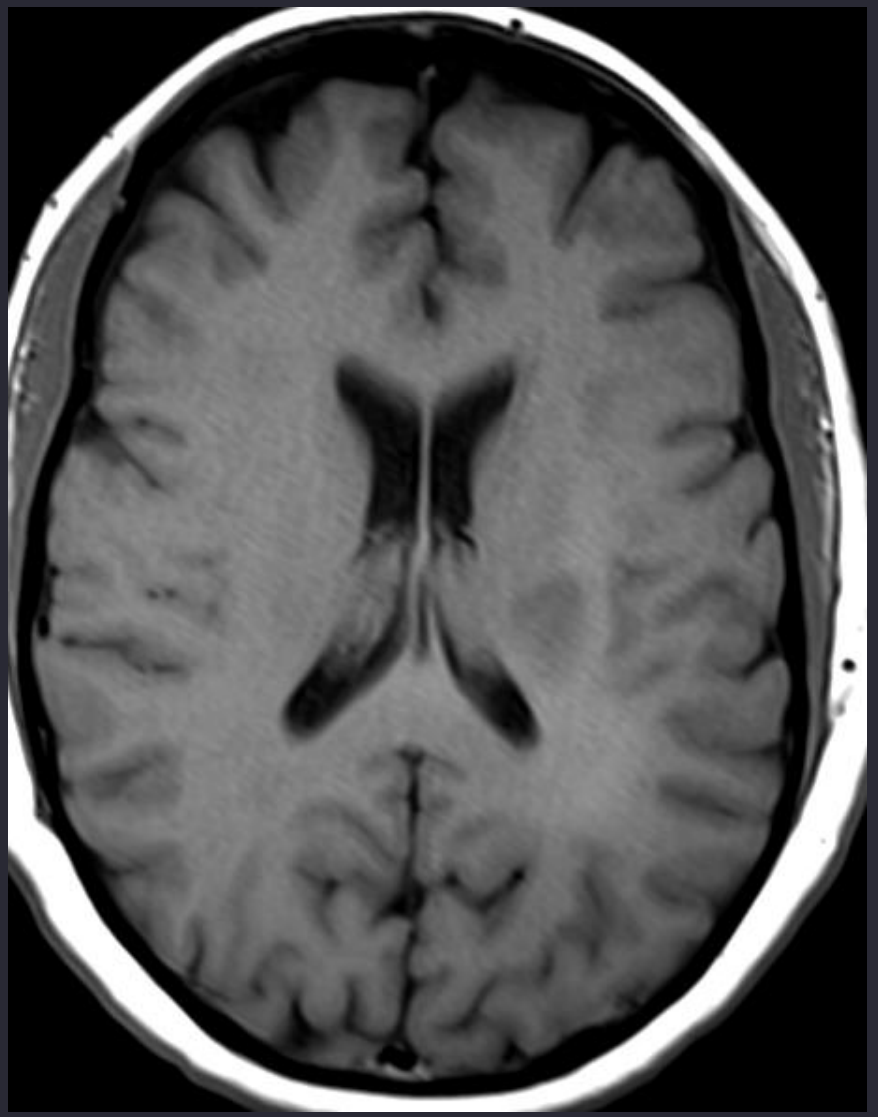
Sagittal T1

T1 contrast



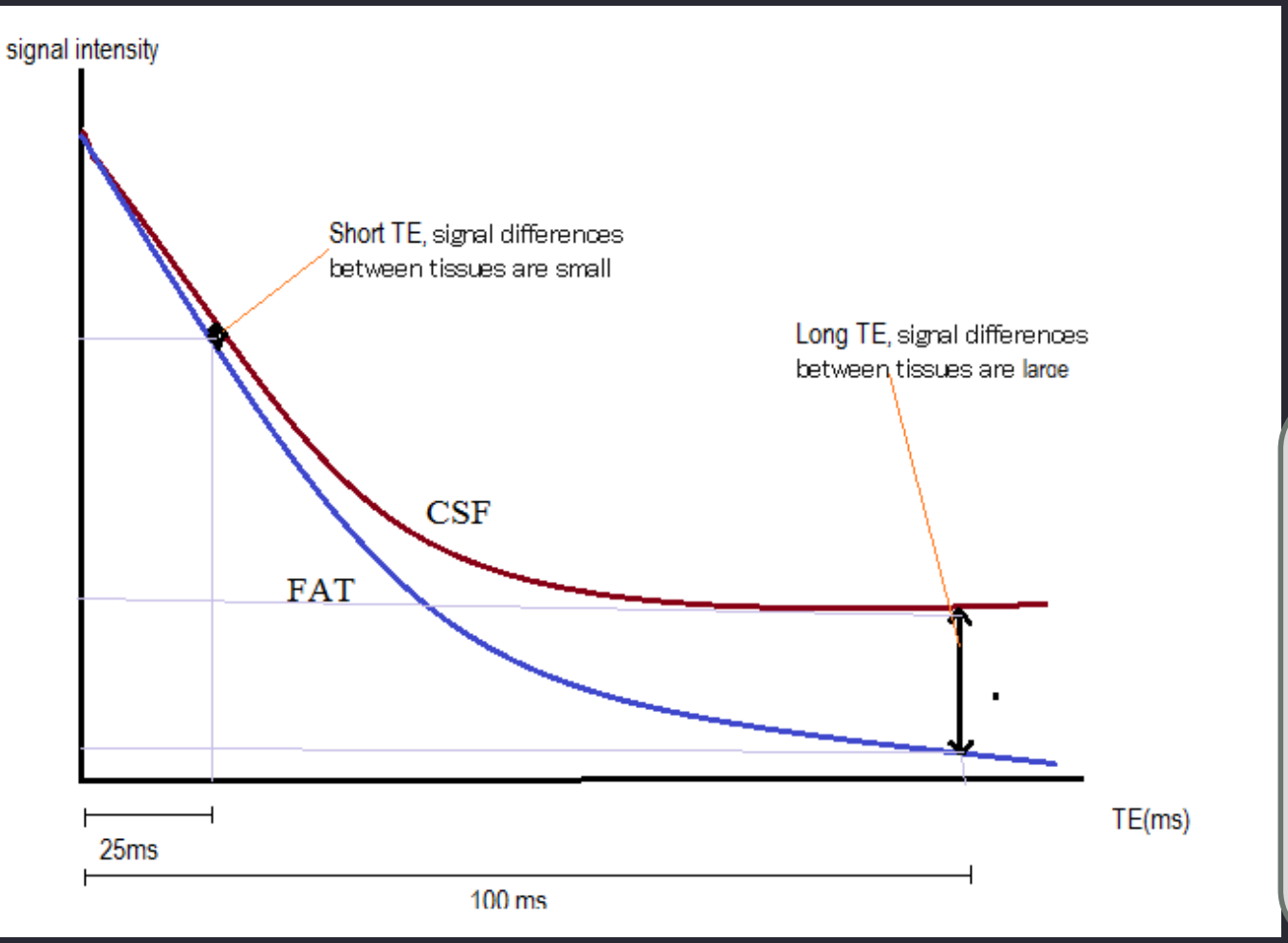


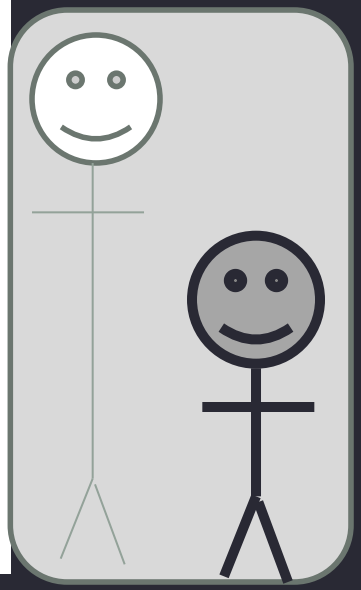
T1+Gd



T1

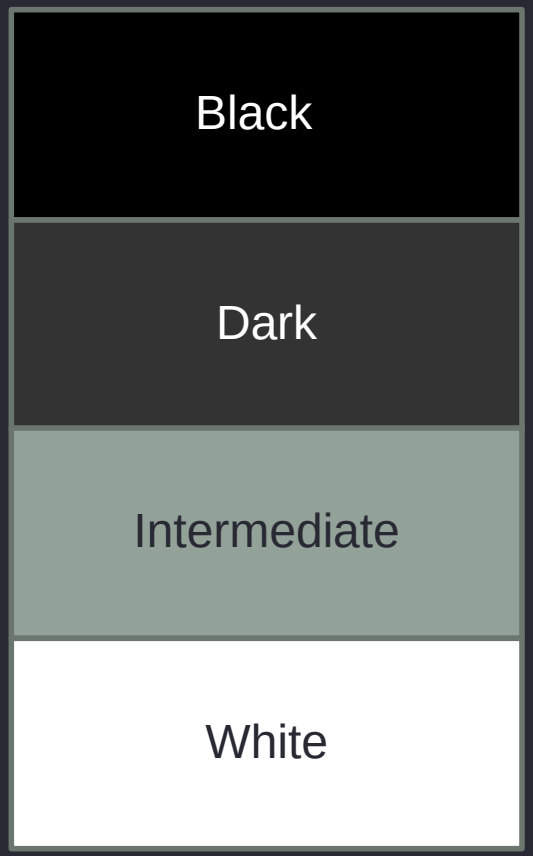
T2 contrast


signal intensity
Short TE, signal differences between tissues are small
Long TE, signal differences between tissues are large
CSF
FAT
TE(ms)
25ms
100 ms



Basic Neuro Sequences

- Four Shades of Gray – T2



No protons / excited protons
- Air
- Dense Calcification
- Flow voids

(Protein)
Bound water tissues (muscle)

Brain Tissue
WM
GM

Free water
Fat
Oxyhemoglobin

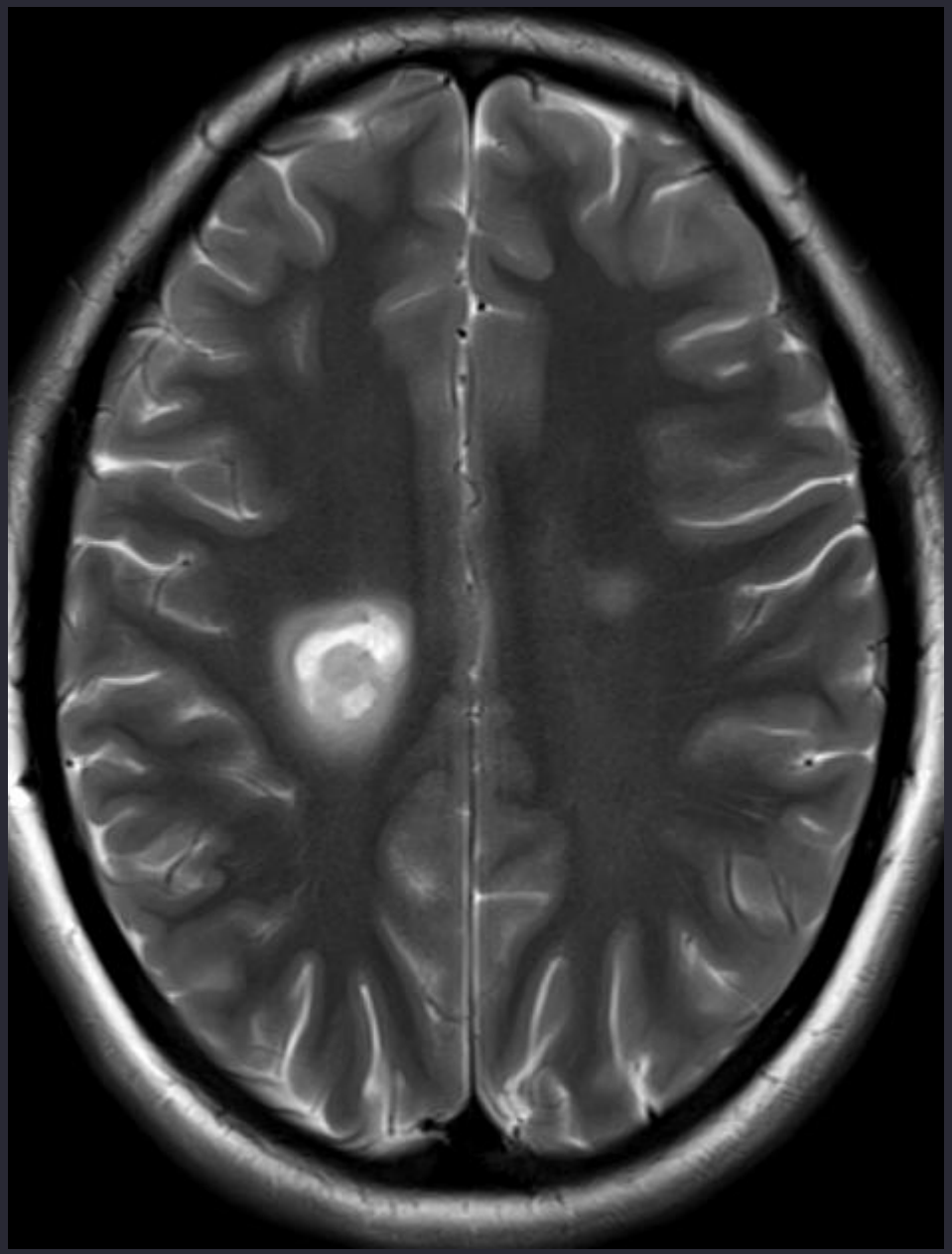
Intermediate

Black

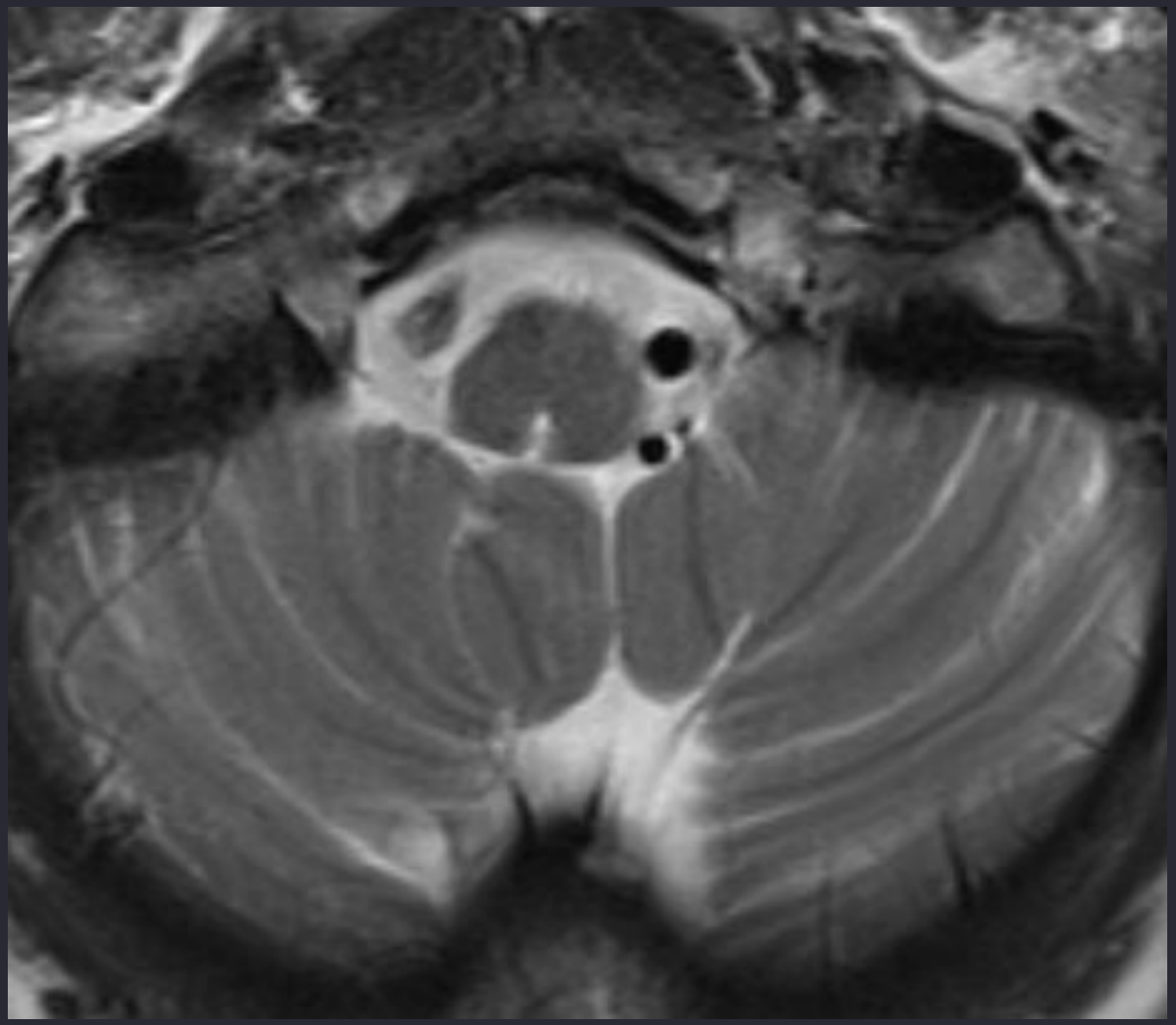
White

Dark

T2

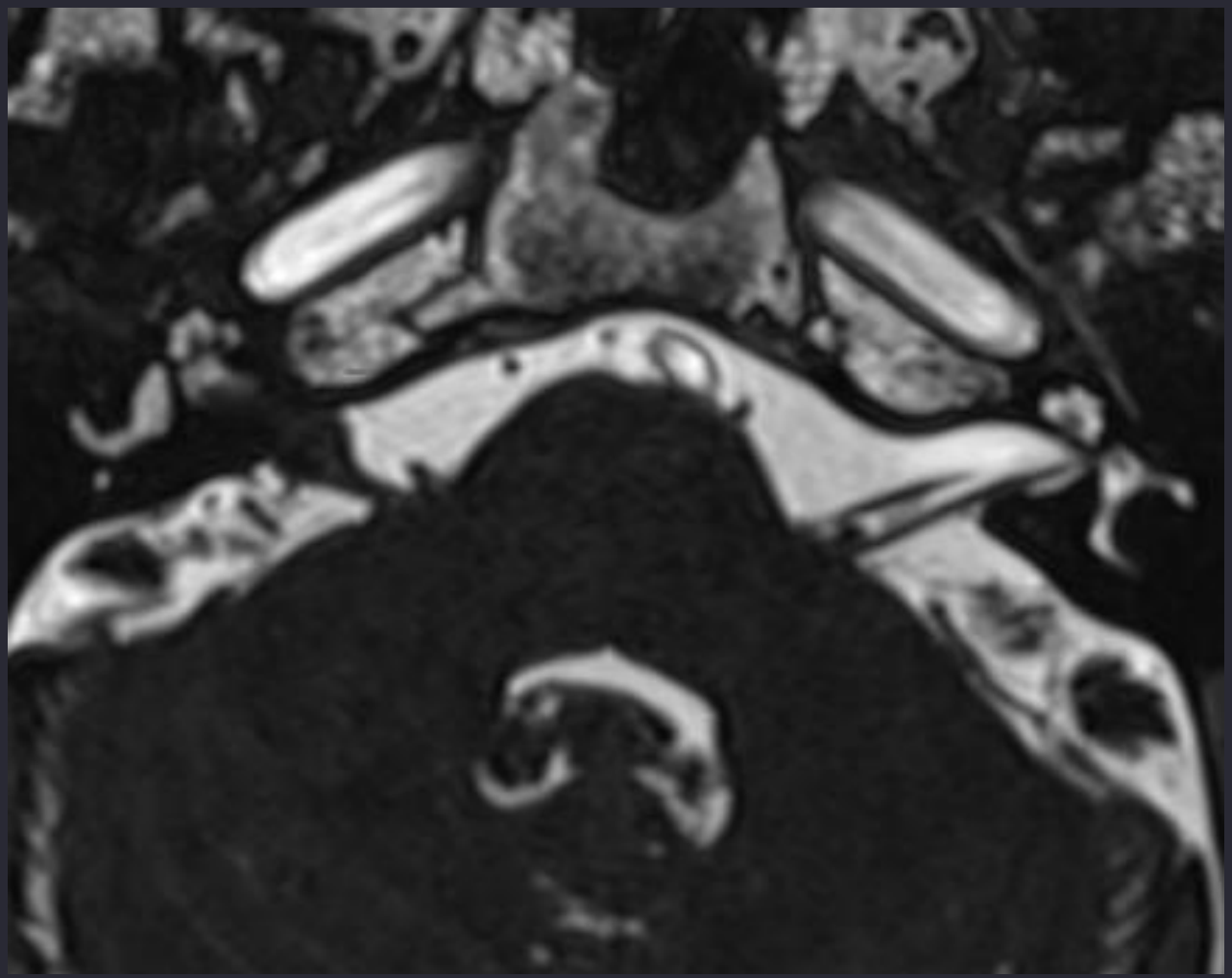


T2



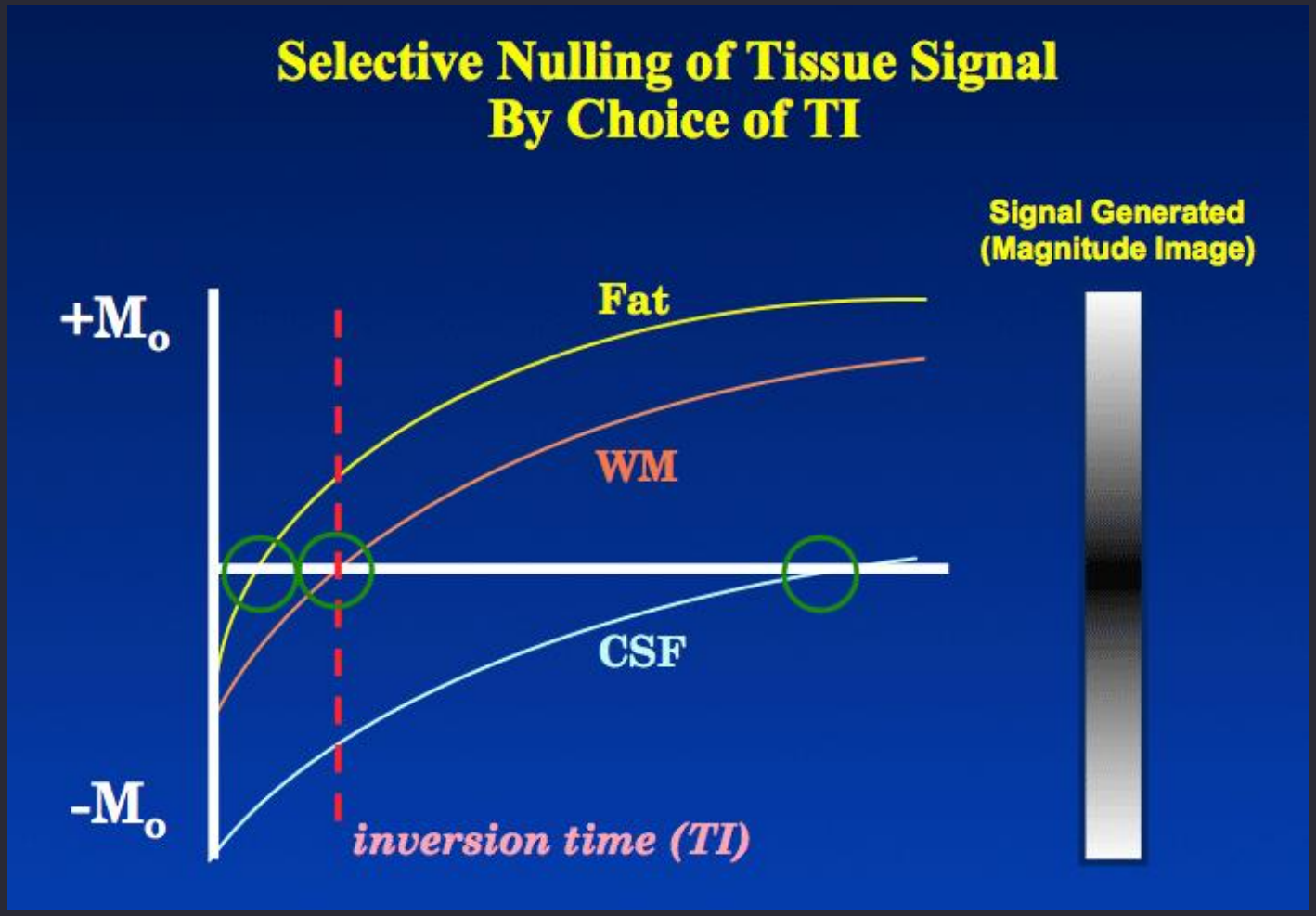
T2

3D T2 imaging

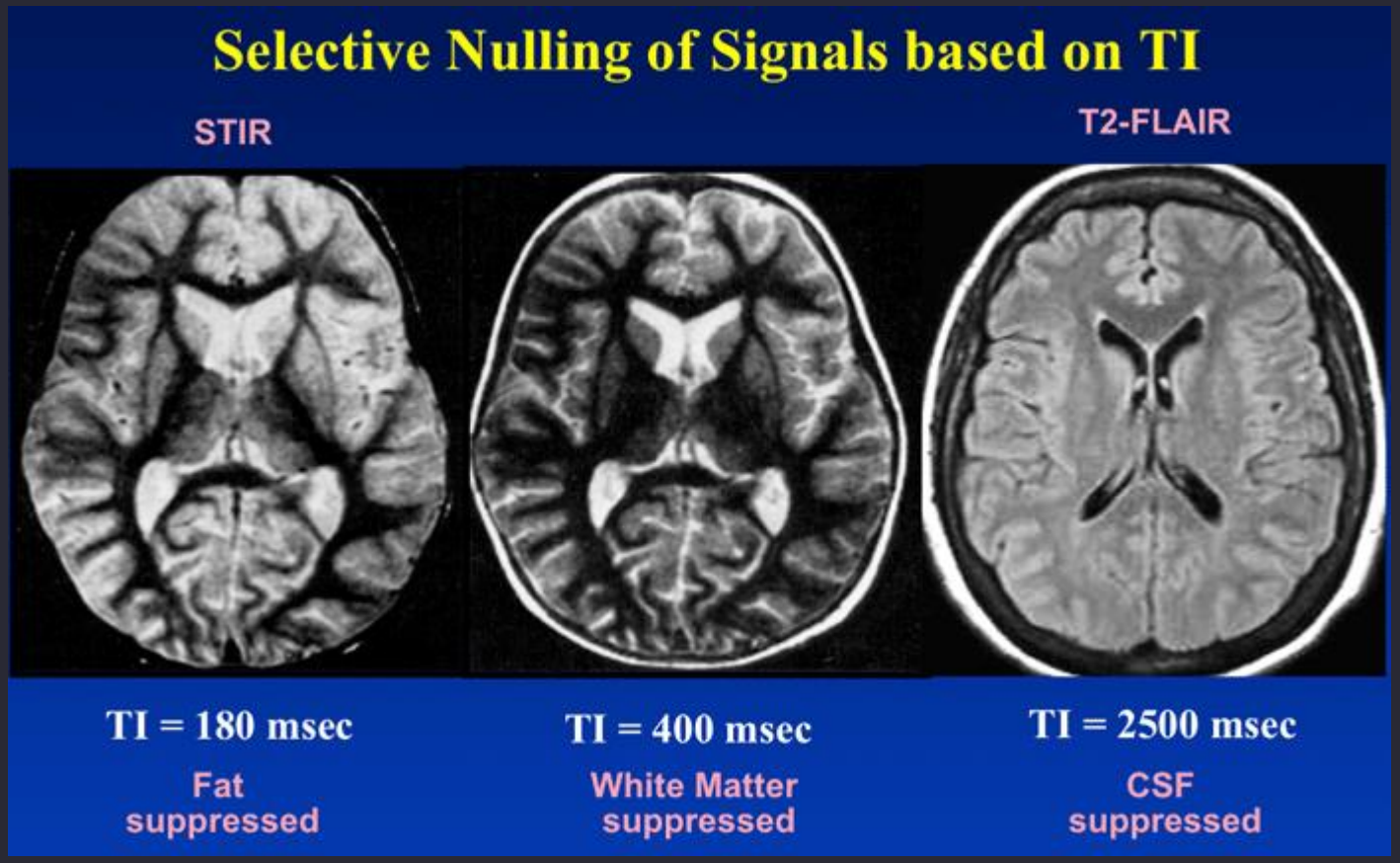


CISS/FIESTA

FLAIR / STIR

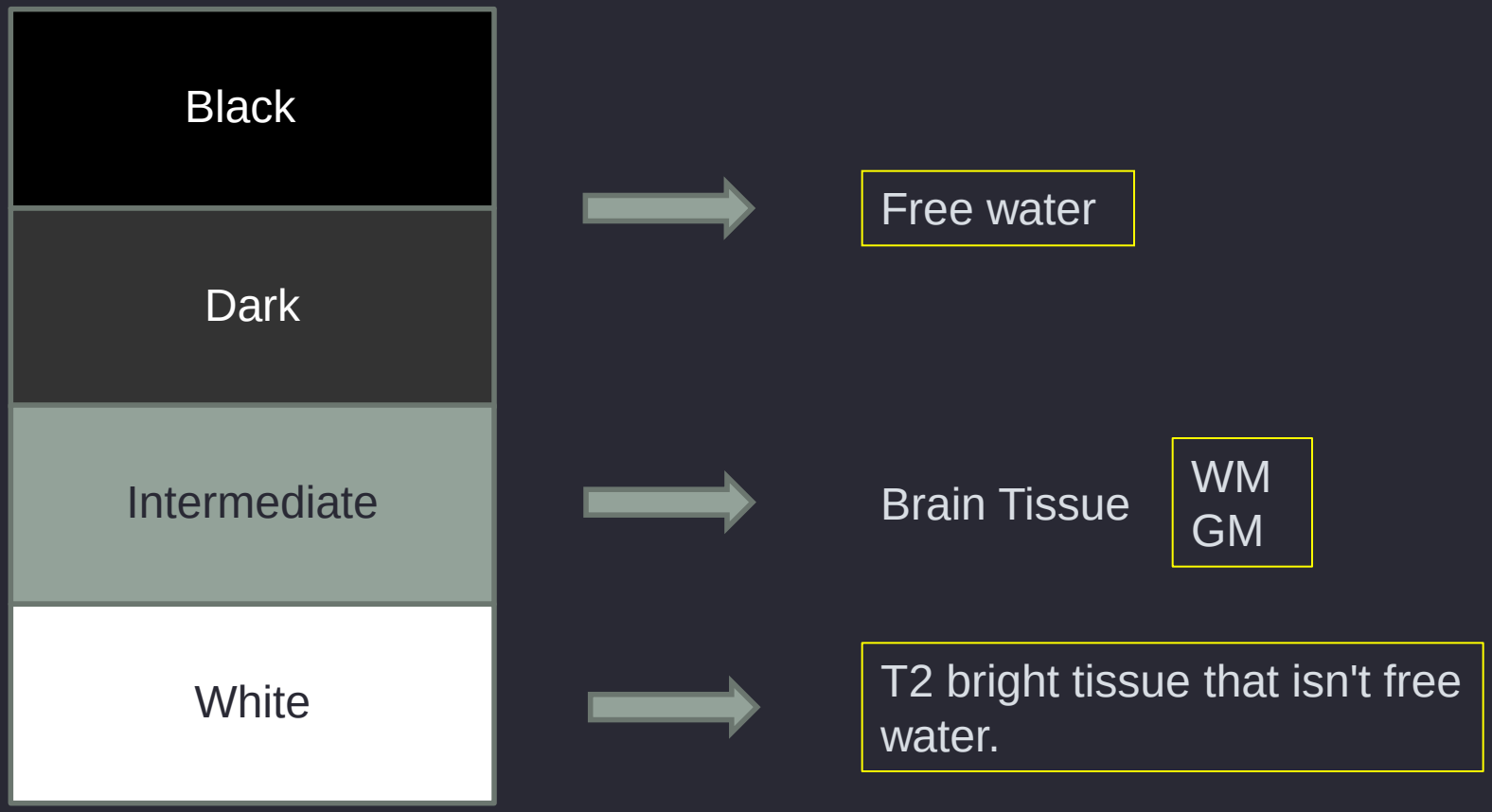

Selective Nulling of Tissue Signal
By Choice of TI
Signal Generated
(Magnitude Image)
+M$_o$
-M$_o$
Fat
WM
CSF
inversion time (TI)

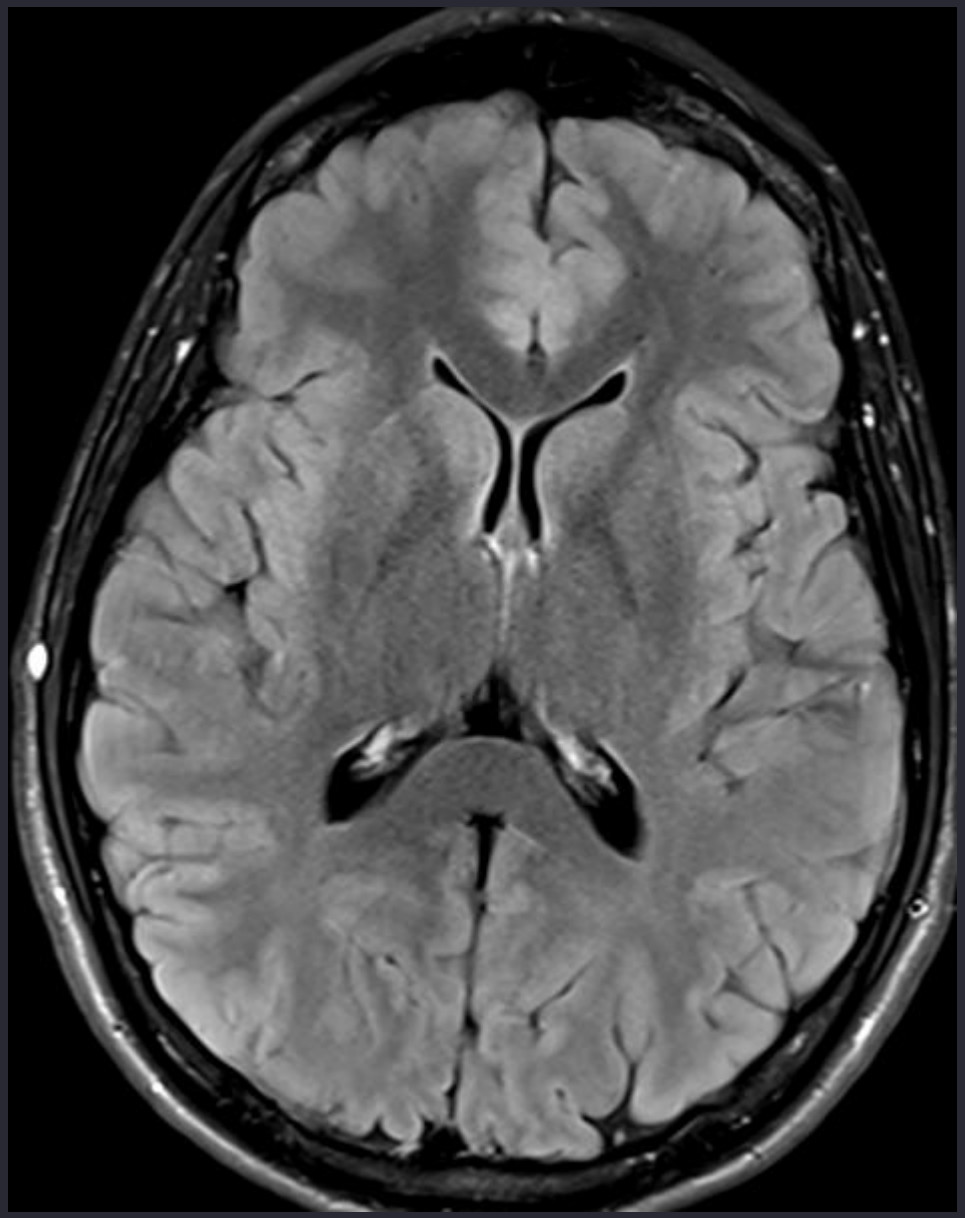
FLAIR / STIR


Selective Nulling of Signals based on TI
STIR
T2-FLAIR
TI = 180 msec
Fat suppressed
TI = 400 msec
White Matter suppressed
TI = 2500 msec
CSF suppressed

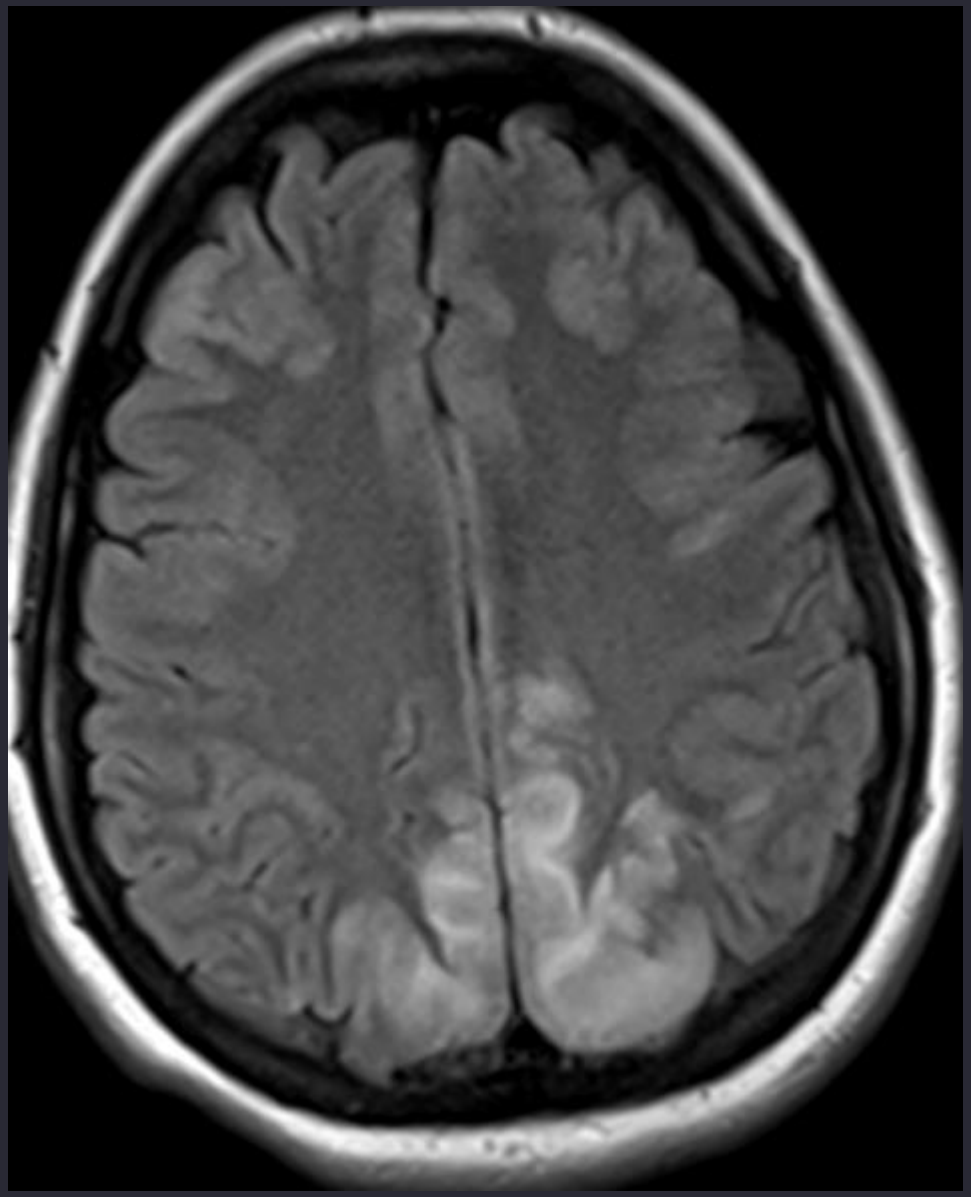
Basic Neuro Sequences

- Four Shades of Gray – FLAIR

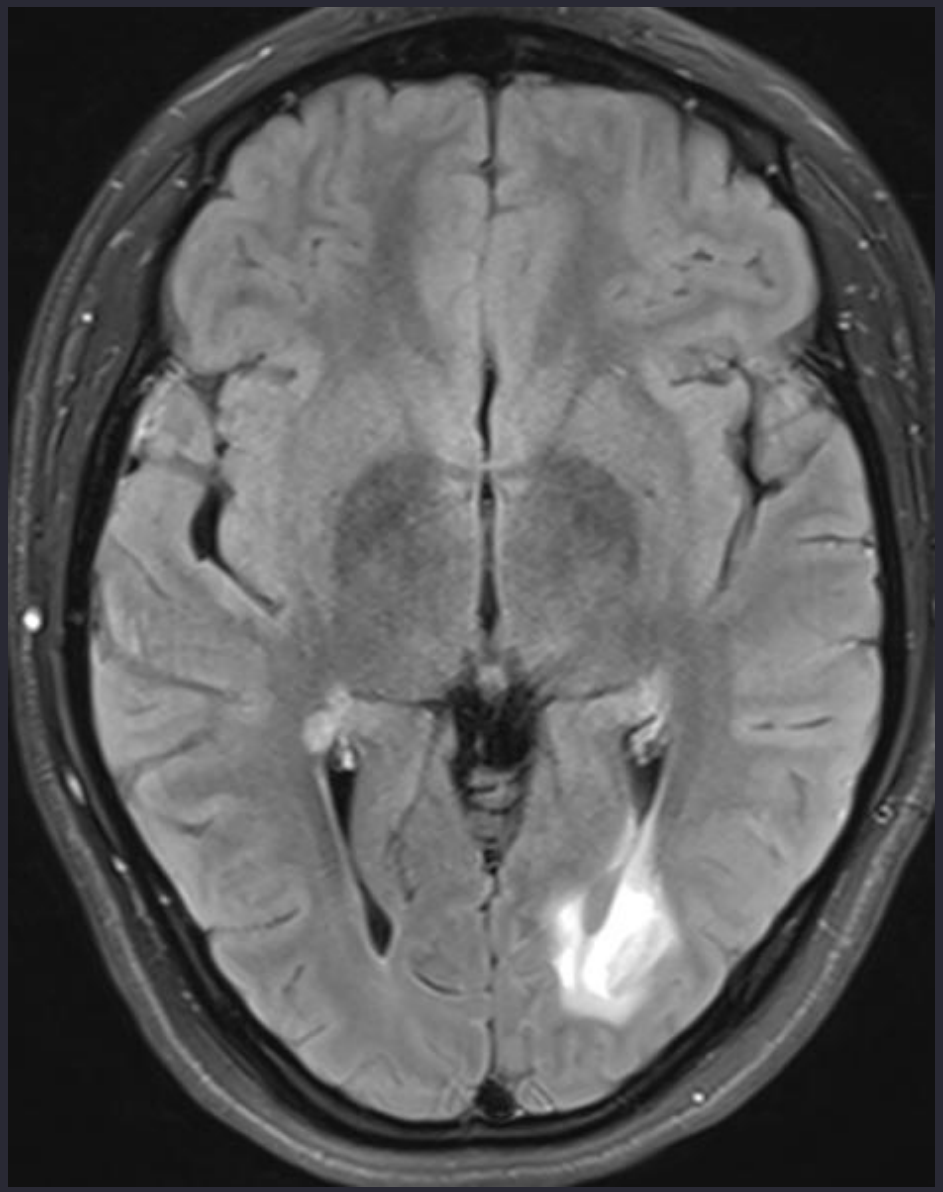




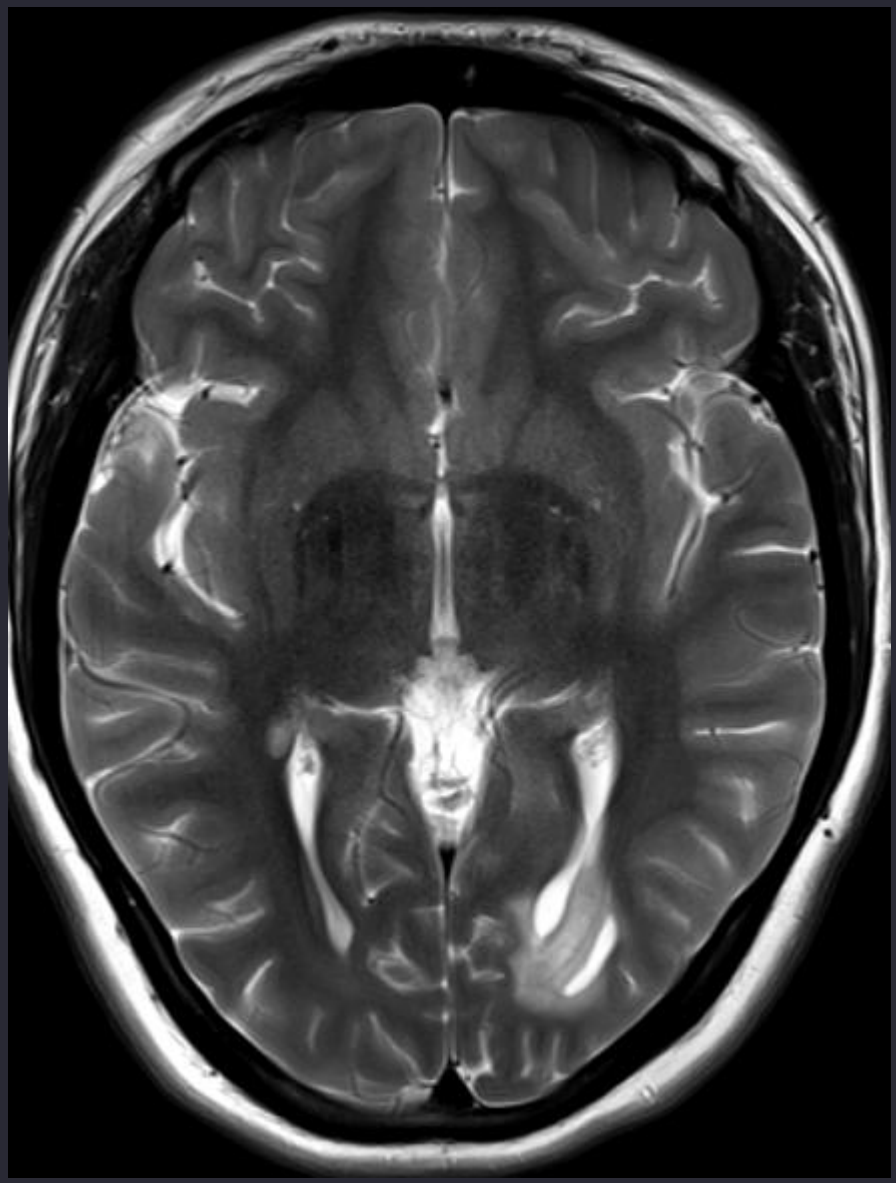
FLAIR



FLAIR



FLAIR

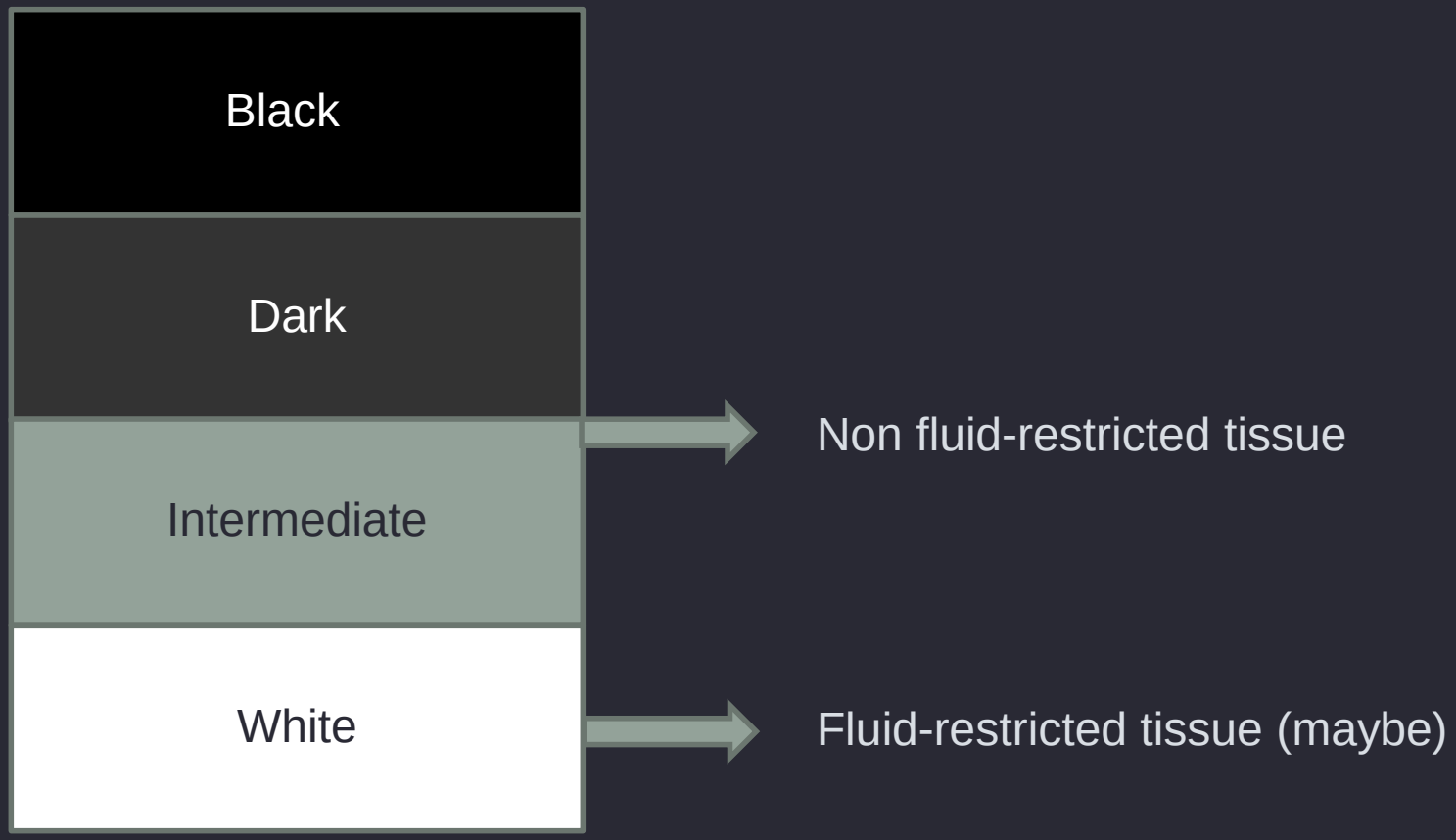


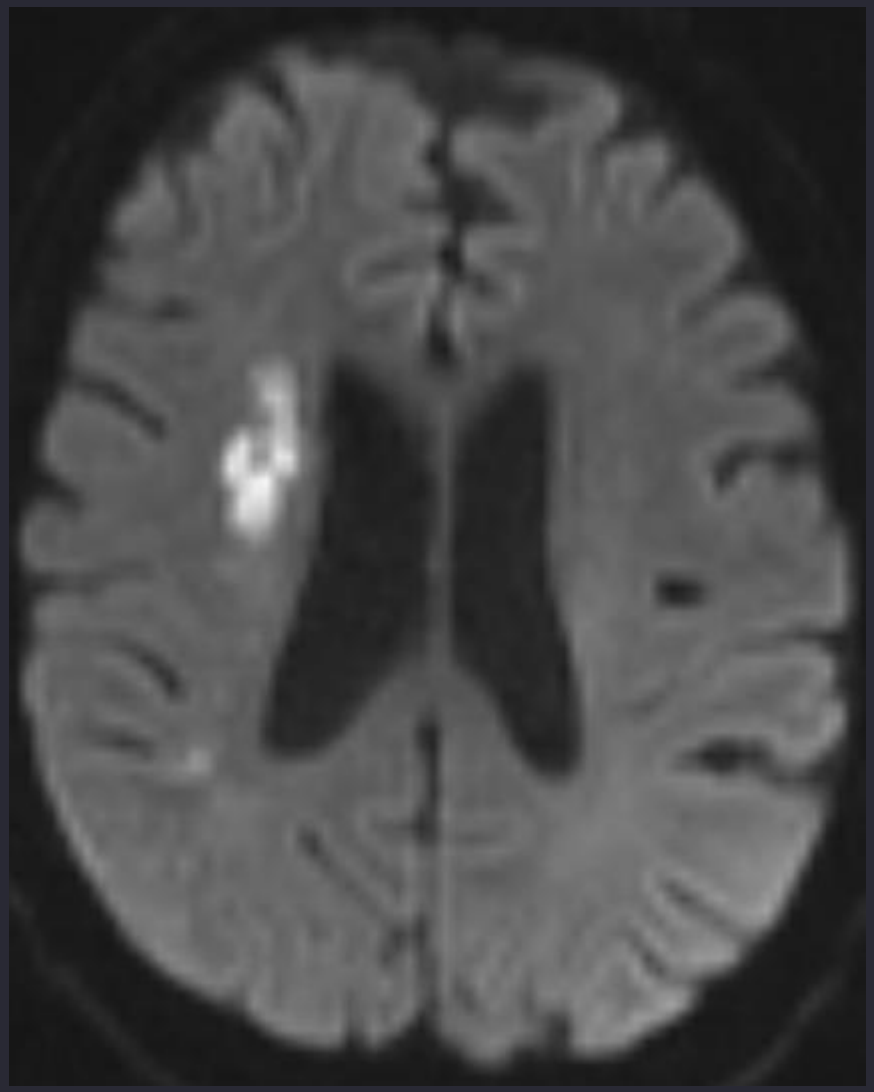
T2

STIR

T2

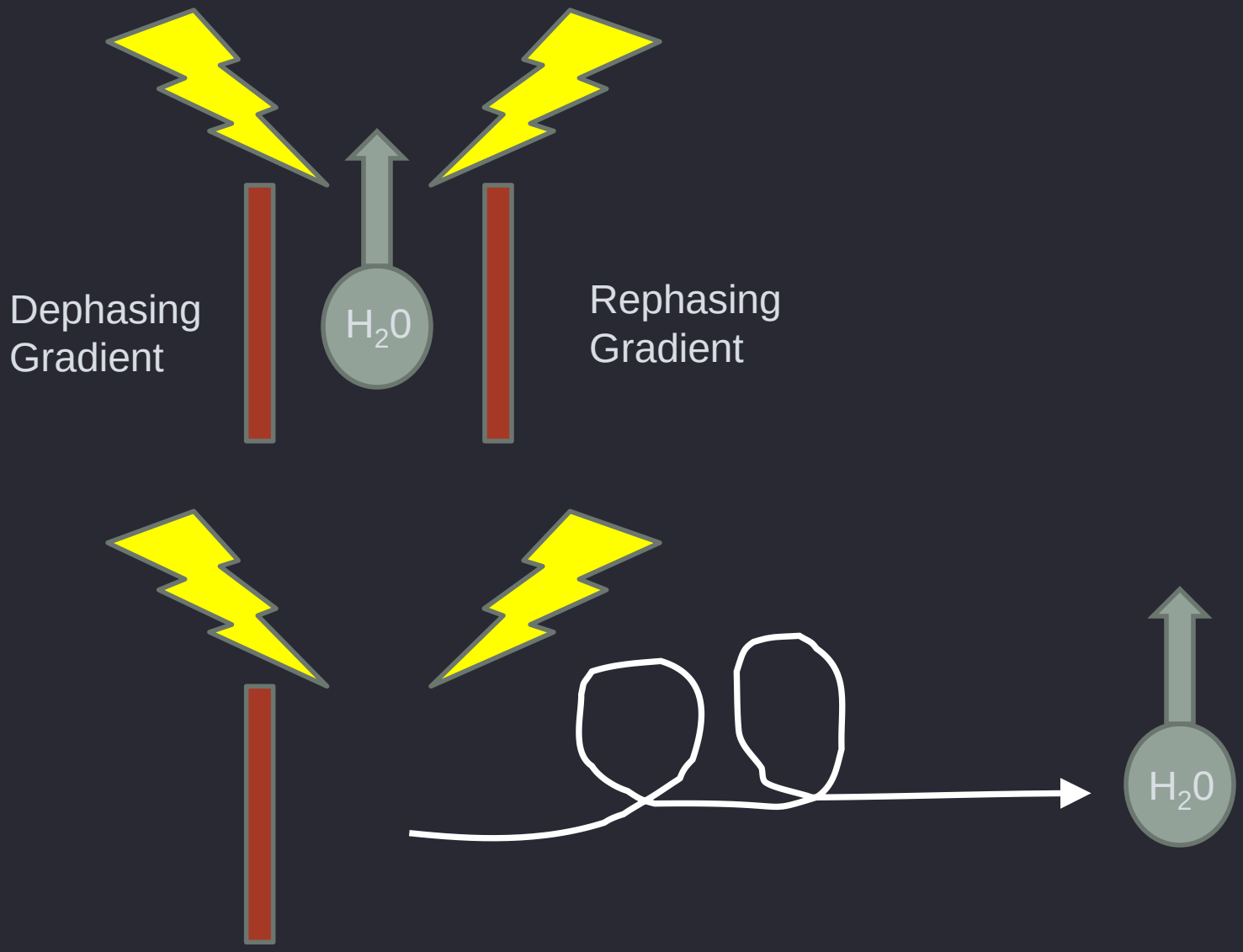
Diffusion Weighted Imaging



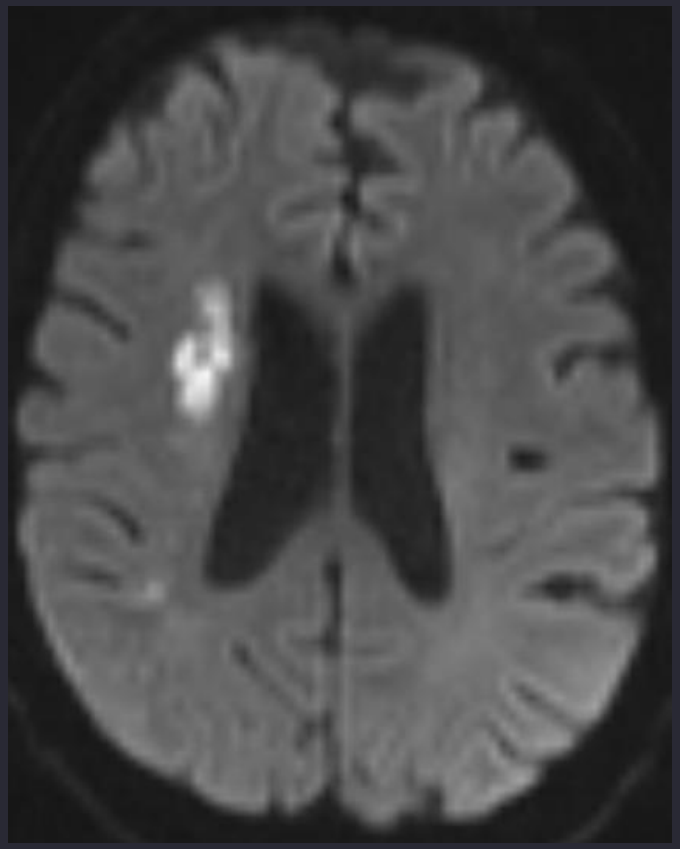


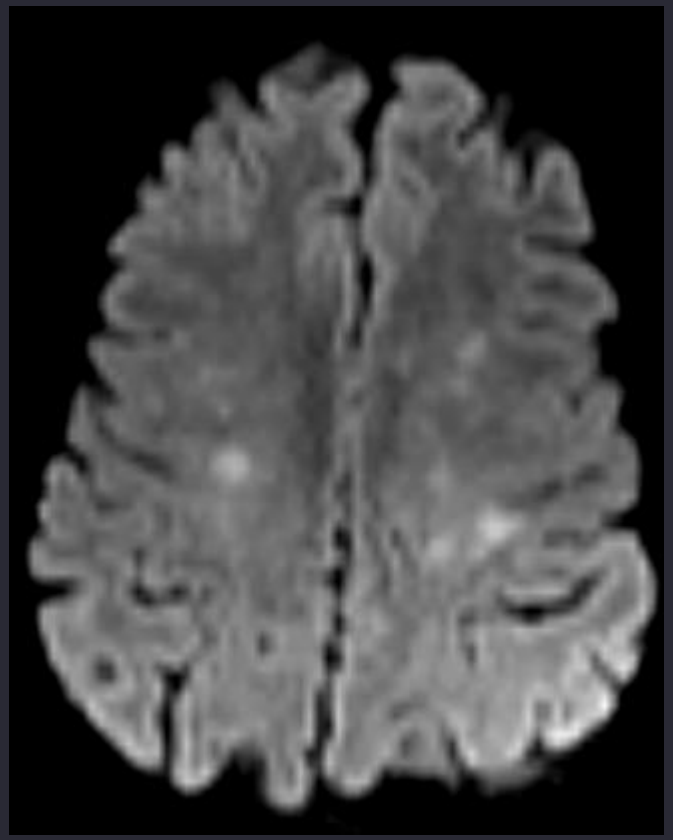
DWI

Diffusion Weighted Imaging



Not all that shines is gold



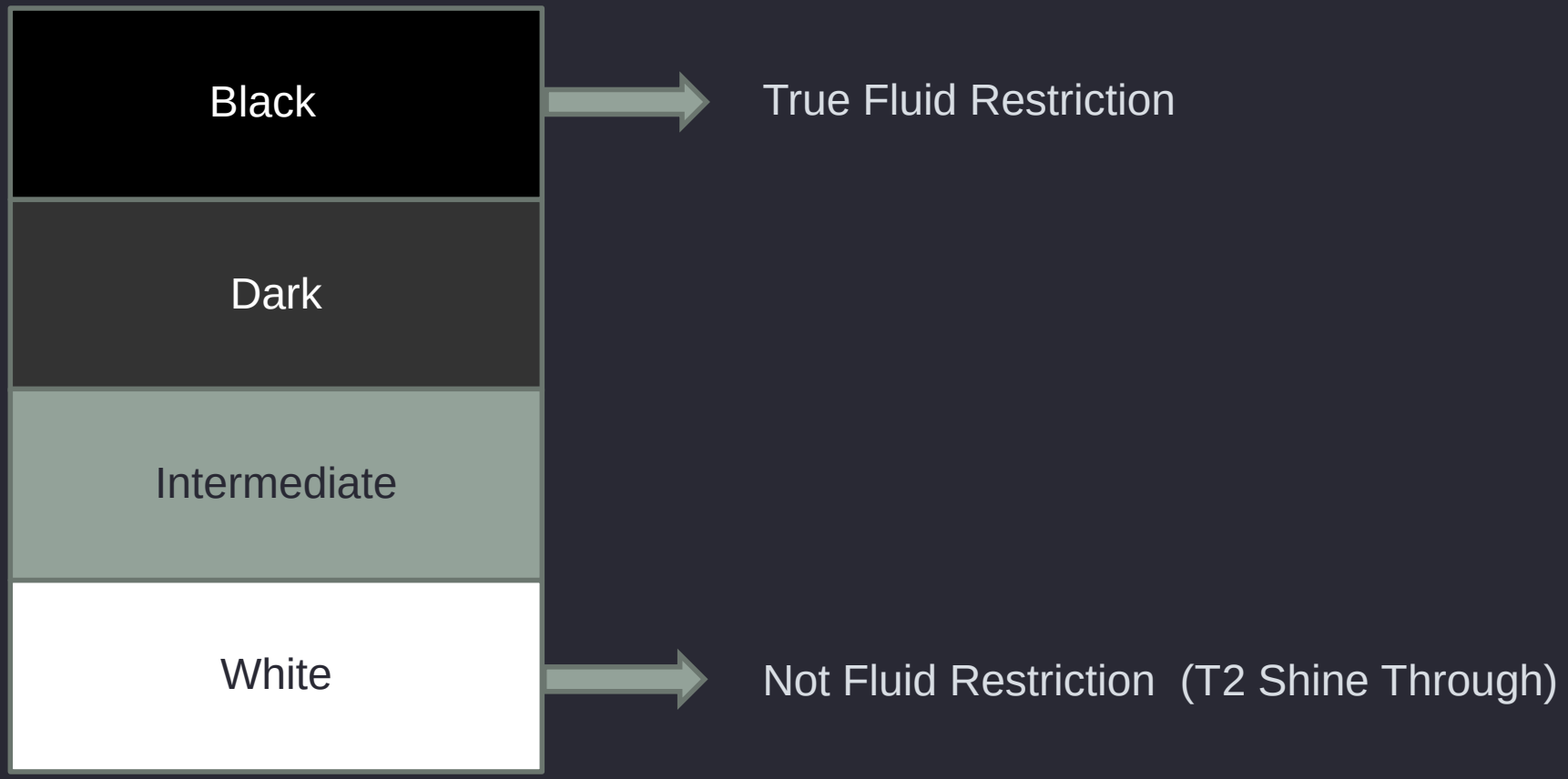


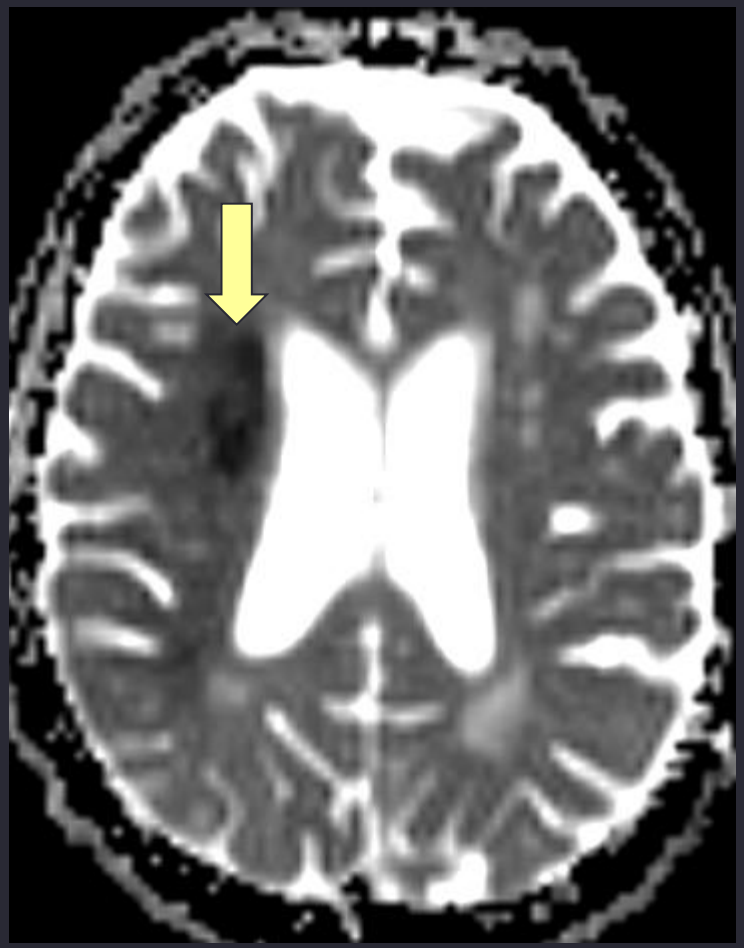
DWI

Diffusion Weighted Imaging - ADC

Apparent Diffusion Coefficient – ADC MAP

- A measure of magnitude of diffusion

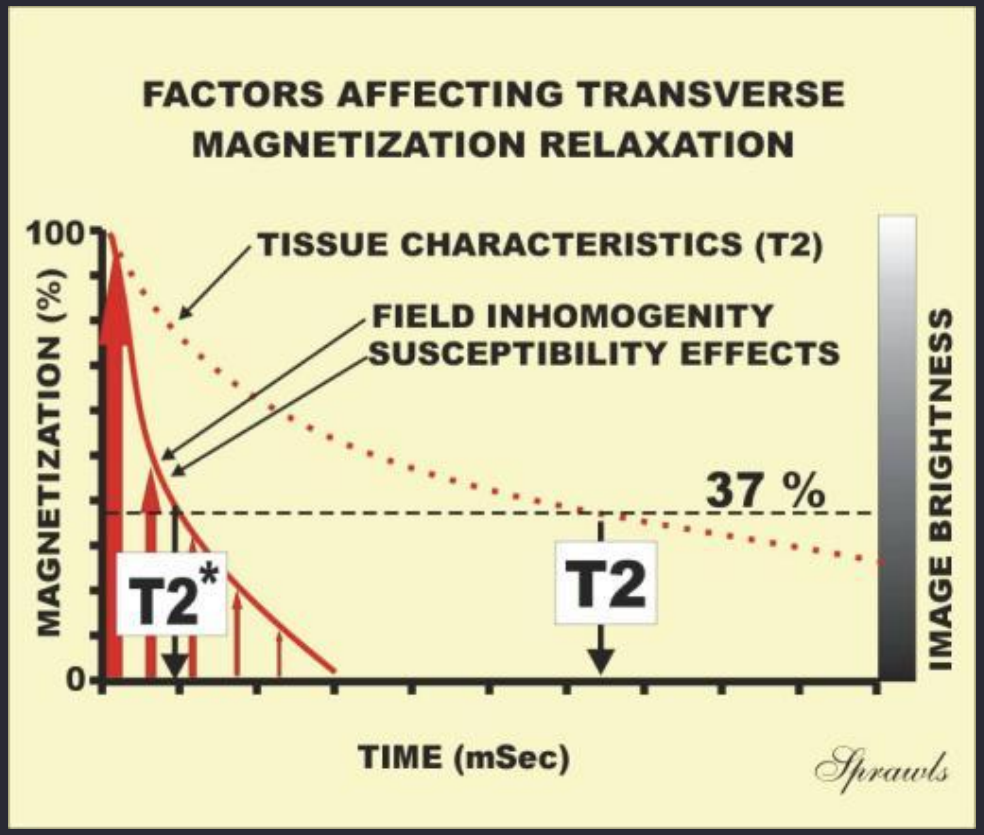




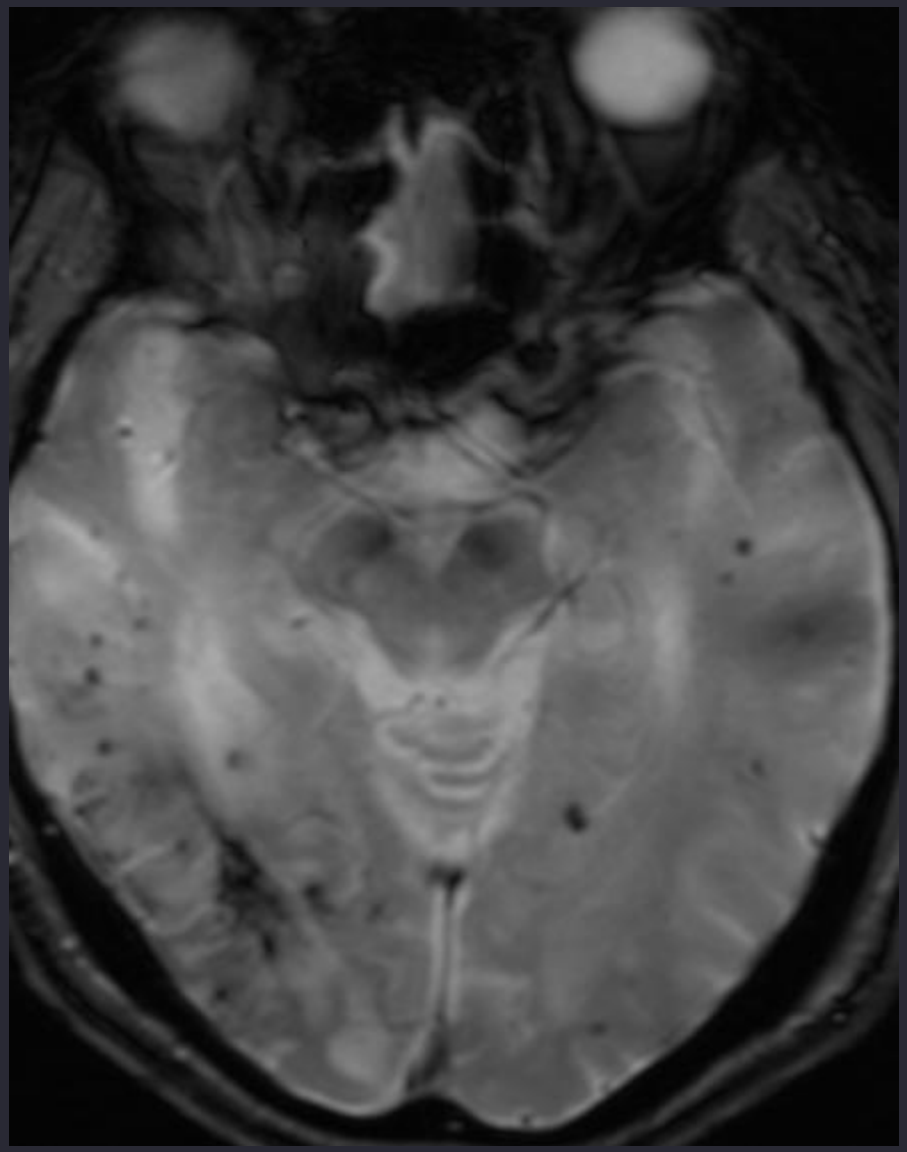
ADC

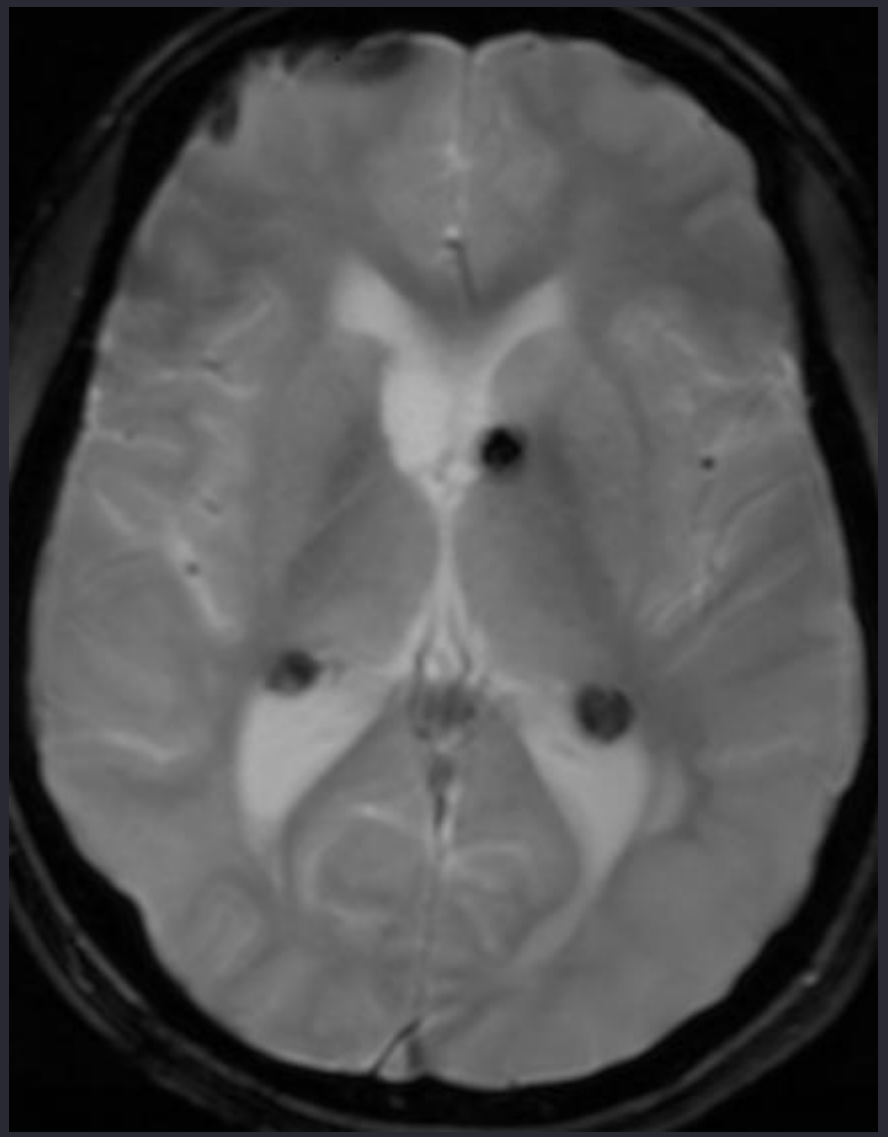
T2* Images

Imaging of tissues which cause non-homogeneous magnetic susceptibility effects



- Calcium
- Hemosiderin





T2*

Summary

Know your:

- Physics
- Neuroanatomy
- Artifacts

Ask yourself:

- Is it real?
- Is it bad?
- What is it?

Sequences

- T1 Gd
- T2
- FLAIR
- DWI
- T2*

http://www.einstein.yu.edu/labs/michael-lipton/education-training/introducing-mri/

http://radiopaedia.org/articles/mri-artifacts

http://headneckbrainspine.com/index.php