Brant and Helms Club Neuroradiology

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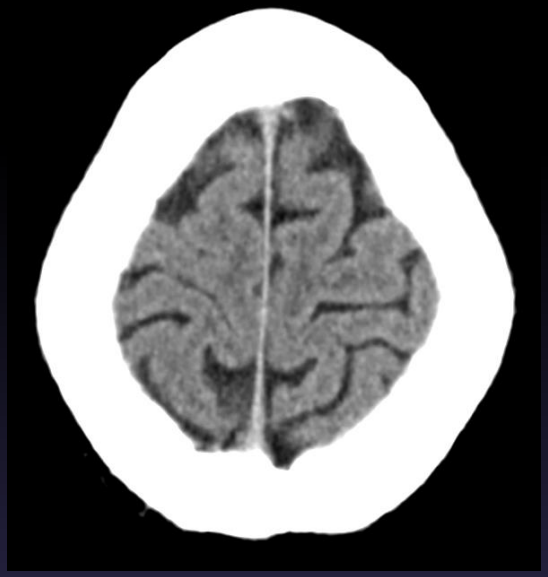
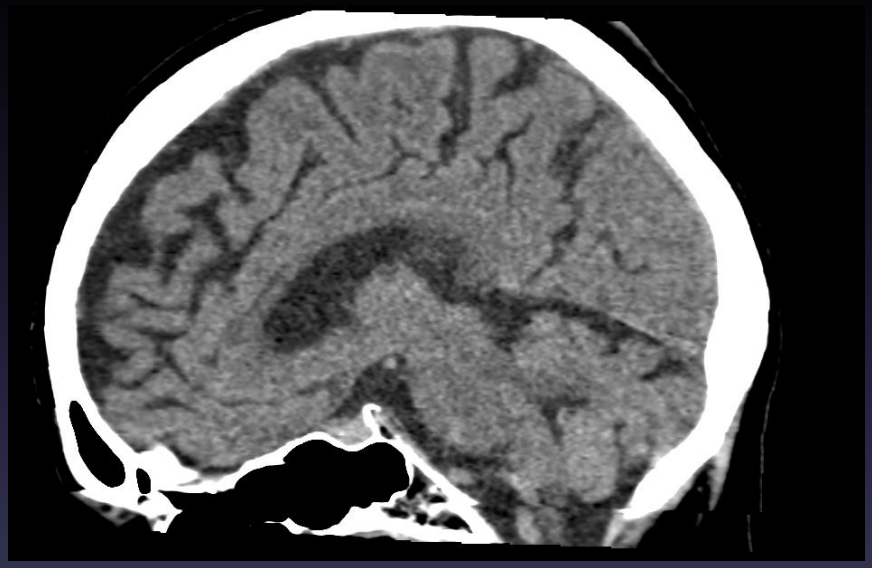
OBJECTIVES

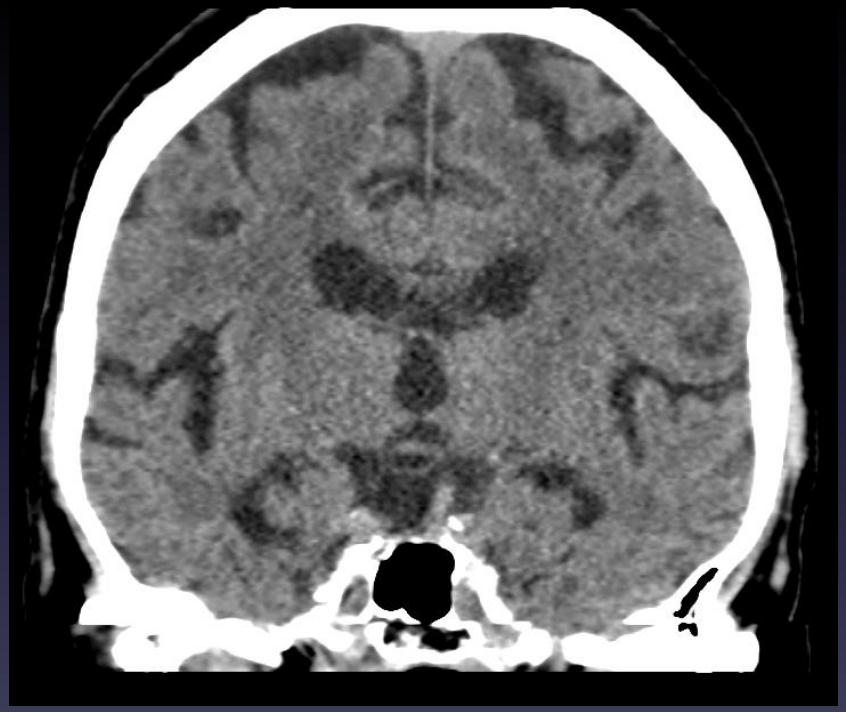
- Apply basic imaging anatomy to learn a search pattern
- Learn a basic 4 step approach to analysis of emergency head CT
- Learn the features of some basic concepts illustrated by:
  - Intracranial hemorrhage
  - Cerebral infarction
  - Hydrocephalus
- Learn briefly about additional modalities in emergency neuroradiology
- Practice taking cases using the 4 step approach

Basic CT Anatomy



Multiplanar Reformats





Head Sample Search Pattern

- Brain Parenchyma
  - Gray/White Junction, Volume loss, Acute changes, Chronic changes
  - **Intracranial hemorrhage**, Mass, or **Evolved Territorial Infarction**
- Ventricles & Sulci
- Extra-axial spaces, Basilar Cisterns, & Midline Shift
- Paranasal Sinuses, Mastoid Air Cells & Orbits
- Skullbase, visible vessels, soft tissues, & calvarium

Spine Sample Search Pattern

- Bone Marrow Signal
- Alignment, Vertebral body heights, Intervertebral discs
- Prevertebral & Paravertebral Soft tissues
- Cord
- Oropharynx / Airway
- Limited posterior Fossa
- Limited chest / abdomen / pelvis
- Skin/Subcutaneous

Brant and Helms' 4 step checklist

- Midline
- Symmetry
- Basal Cisterns
- Ventricles

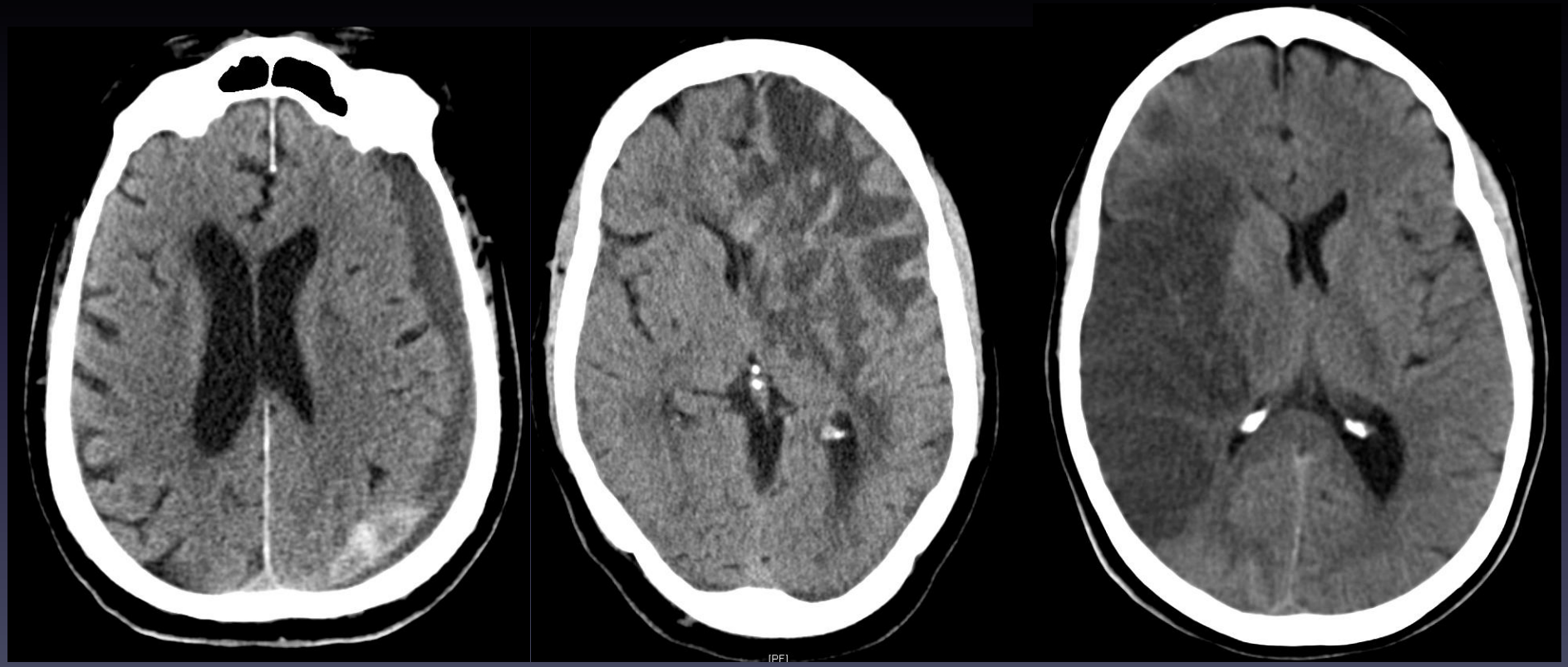
1. Look For Midline Shift

- Midline should be in the Middle!

- Midline Shift: Lesion is always on the side from which midline displaced
- No "sucking" brain wounds

If You See Midline Shift, Next Ask Why?

Subdural Hematoma	GBM With Vasogenic Edema	MCA Infarction With Cytotoxic Edema



2. Check For Symmetry

Check to make sure grey-white differentiation is preserved

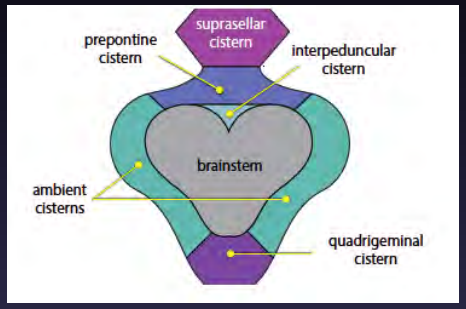
Obscured left grey-white differentiation?

Stroke window: Obscured right lentiform nucleus?

FINDING	CAUSE
Global Sulcal Widening	Global Atrophy
Global Sulcal Narrowing	Diffuse Cerebral Edema
Asymmetric Sulcal Narrowing	Local Mass Effect vs. proteinaceous, infectious or cellular material filling sulci

Asymmetric mild left sulcal effacement, and left insular ribbon → left MCA infarct

3. Check Basal Cisterns



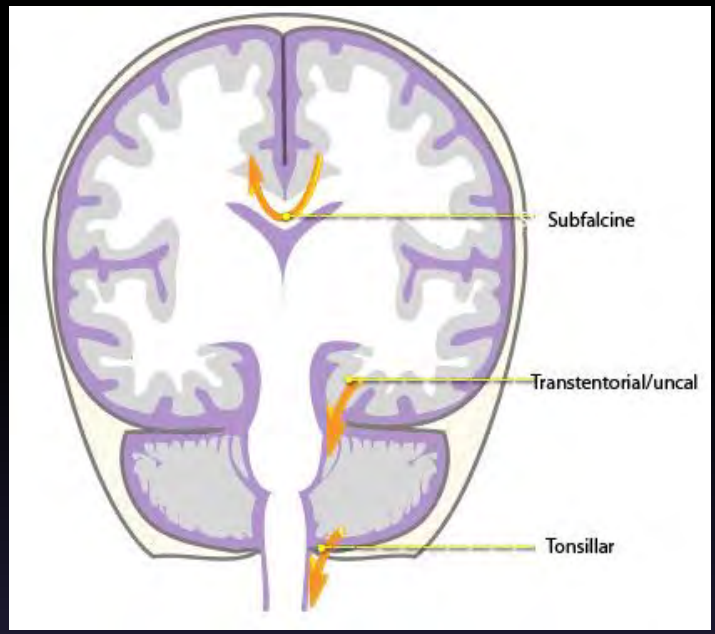
Jake Mandell MD, Core Radiology

Suprasellar cistern: looks like a Star of David

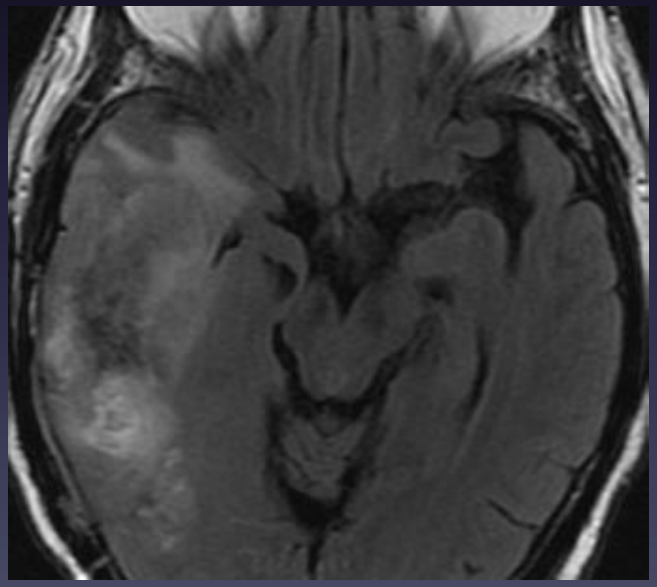
Quadrigeminal plate cistern: looks like a smile

Herniation

1. Subfalcine
2. Uncal (transtentorial)
3. Tonsillar (downward cerebellar)



Adapted from: Jake Mandell, MD, Core Radiology



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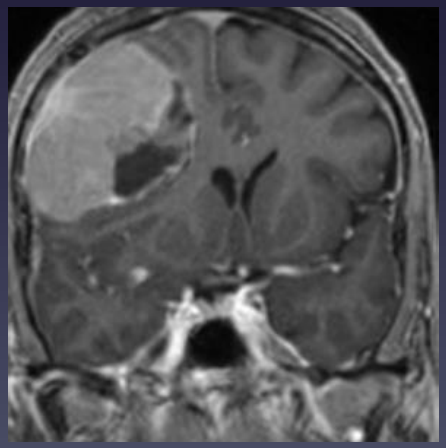
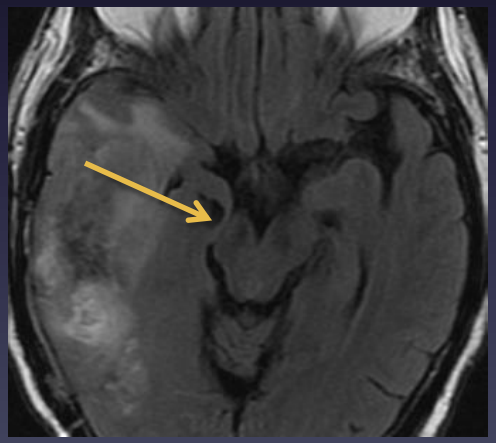


Gregory Wrubel, MD, Core Radiology

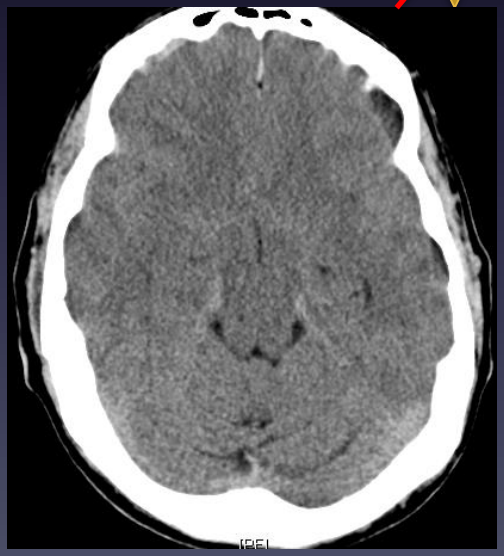
Basal Cisterns, continued

- Opacification → Subarachnoid Hemorrhage
- Distortion → suggests intracranial mass
- Effacement or Asymmetry → Herniation or cerebral edema

Intraparenchymal, subarachnoid, and subdural hemorrhage from Pcomm aneurysm



Absent star: effacement of suprasellar cistern



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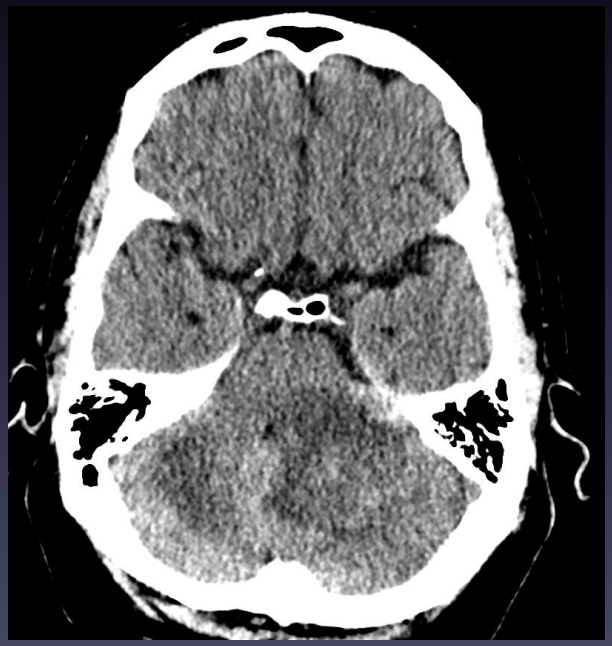
4. Check Ventricles

- Start with 4th ventricle in the posterior fossa – PF mass effect can lead to life threatening herniation, hydrocephalus
- Look for asymmetry or shift, which may indicate a mass



Courtesy Paul Bunch, MD

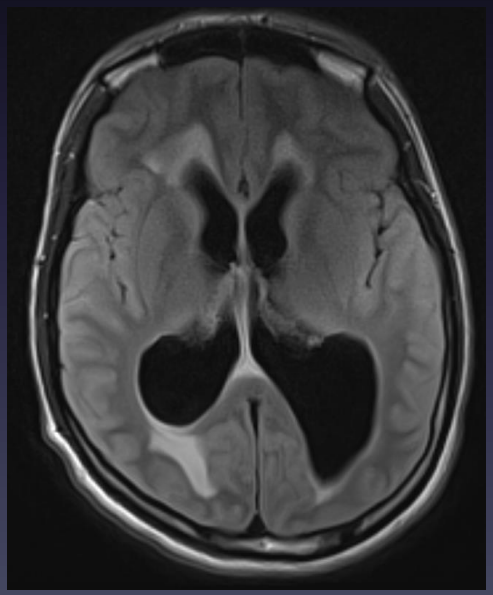
Ventricles, continued….

- Next, assess overall size of ventricular system
- Atrophy vs. hydrocephalus: are the ventricles and sulci proportionately enlarged?
- Temporal horns dilate in early hydrocephalus

ATROPHY

Ventricle enlargement ≈ sulcal widening

HYDROCEPHALUS



Ventricle enlargement >> sulcal widening

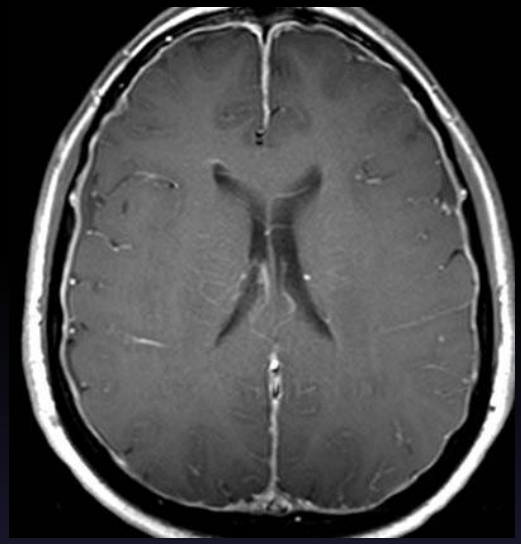
1. Intracranial Hemorrhage

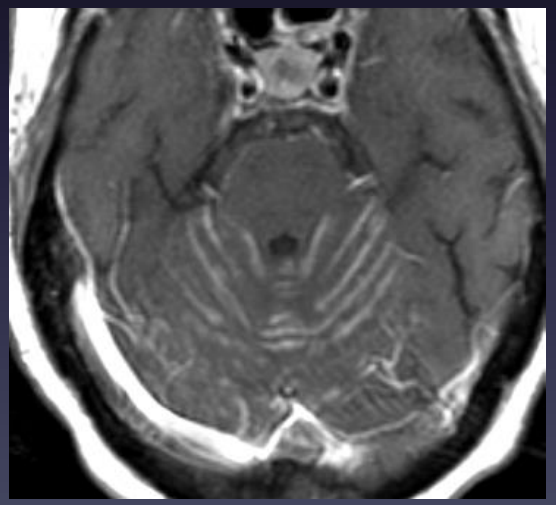
- Intraparenchymal
- Subarachnoid
- Subdural
- Epidural

Intraparenchymal hemorrhage

Meninges: SAH, SDH and EDH

- Dura = pachymeninges:
  - Outermost
  - Thick, adherent to the inner table of the skull.
  - Dura Mater = Tough Mother
- Arachnoid membrane:
  - Between dura and pia
  - Attached to the inside of the dura and surrounds the brain and spinal cord.
- Pia = leptomeninges:
  - Thin, directly adherent to the brain.





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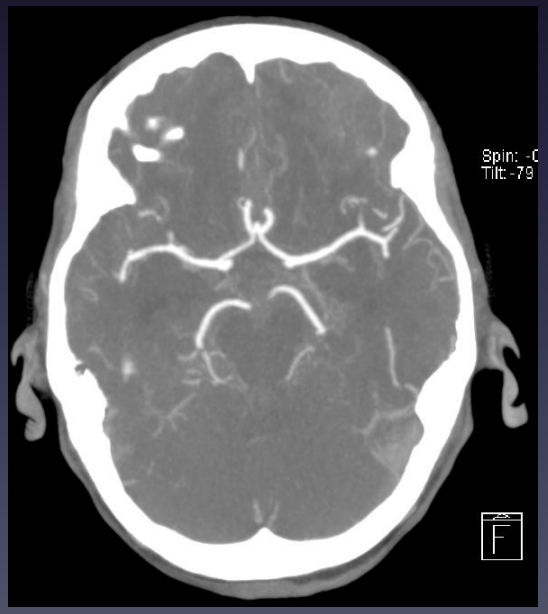
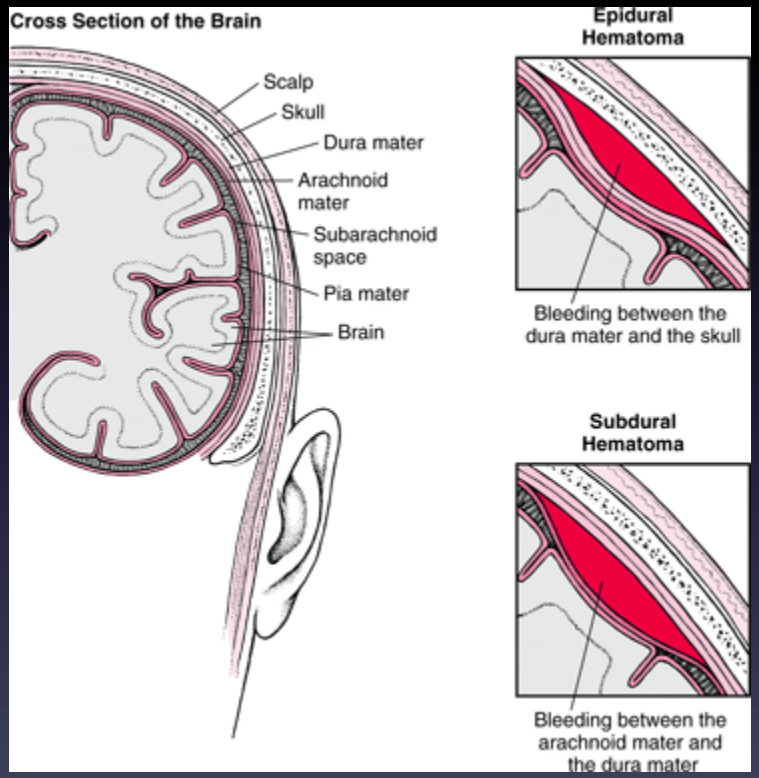
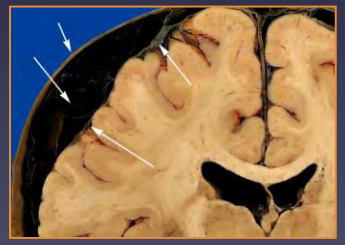
Subarachnoid Hemorrhage



Case courtesy Paul Bunch, MD

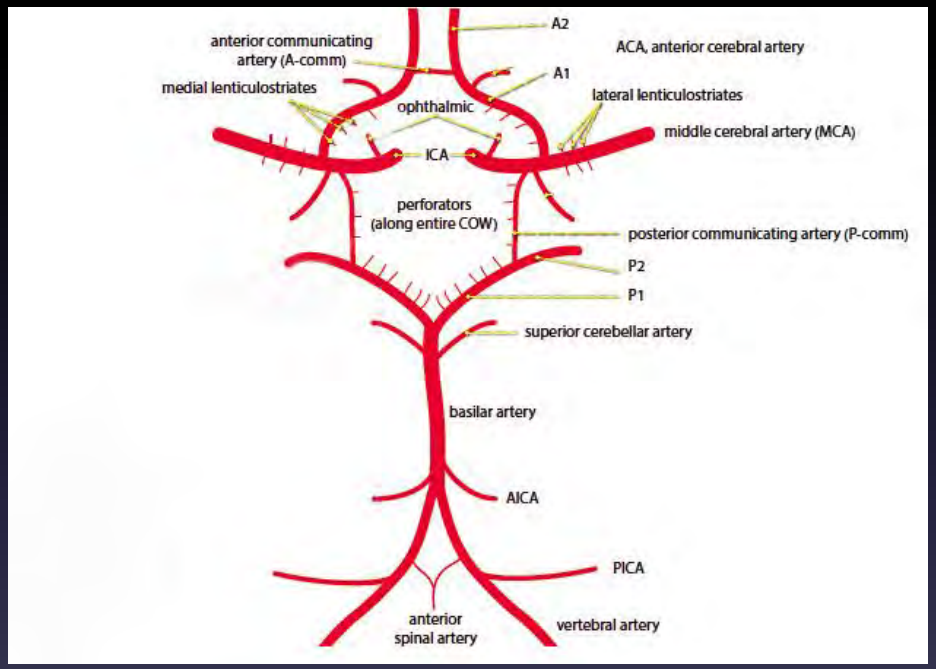
Epi- and Subdural Hematoma

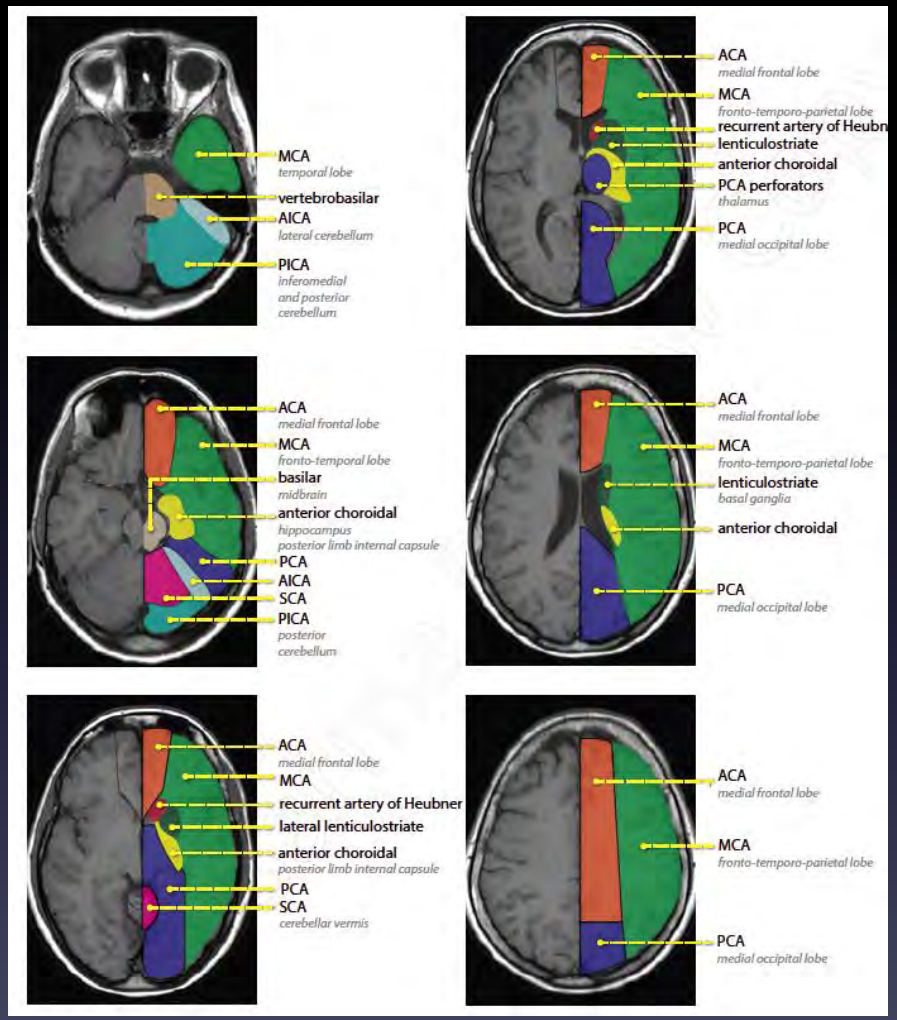




CD-ROM Neuropathology. Ellison D, Love S, et al. (eds). London: Mosby International,1998

2. Infarction: Vascular Territories





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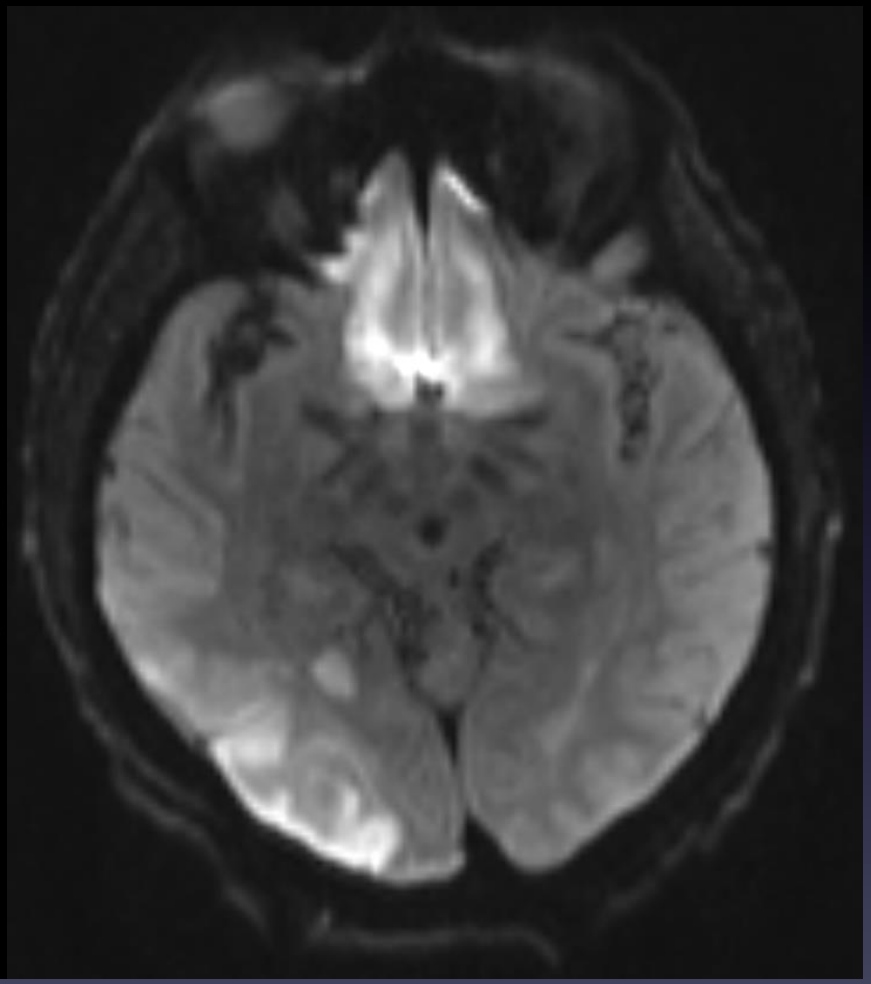
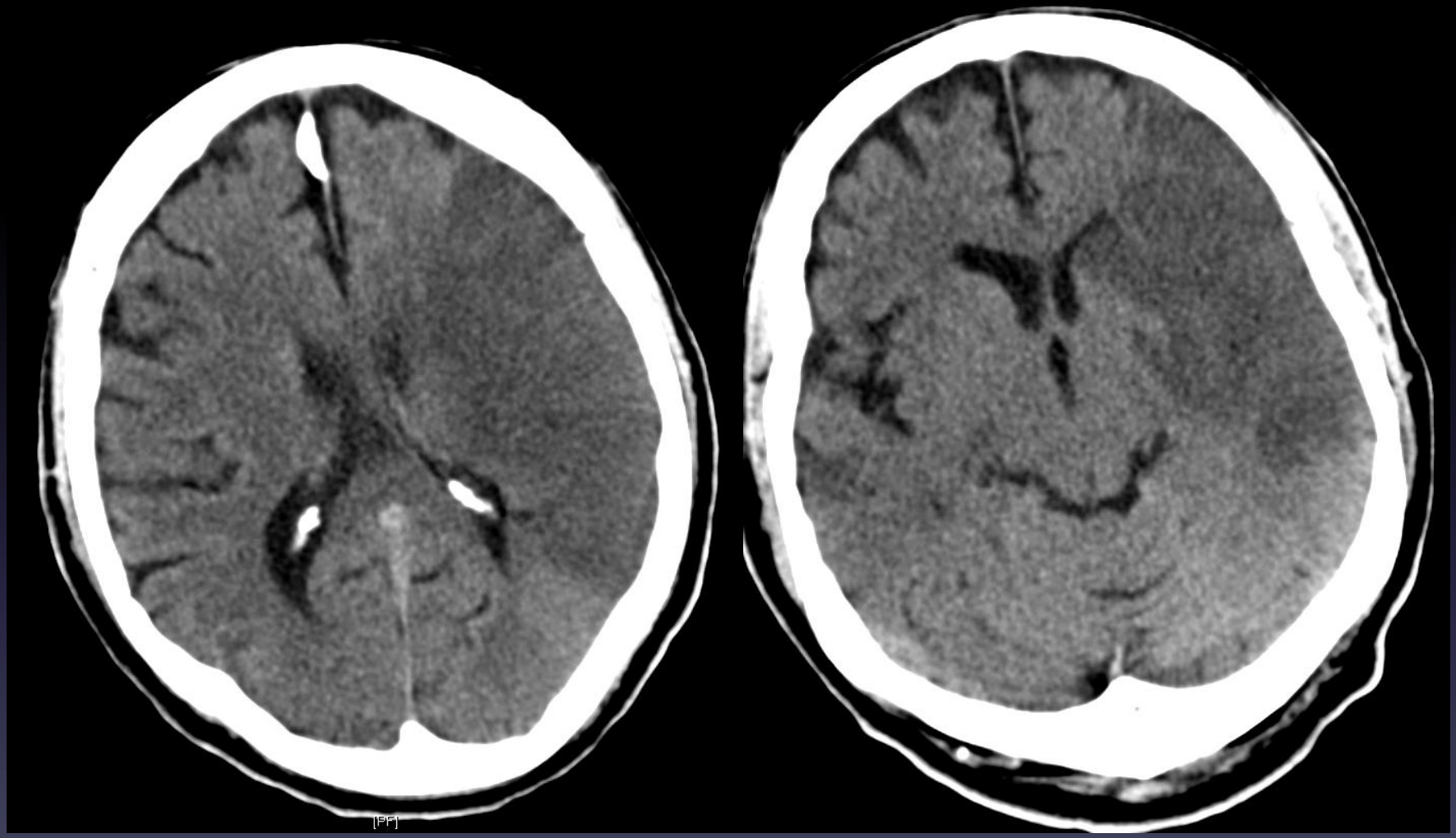
Territorial Infarction



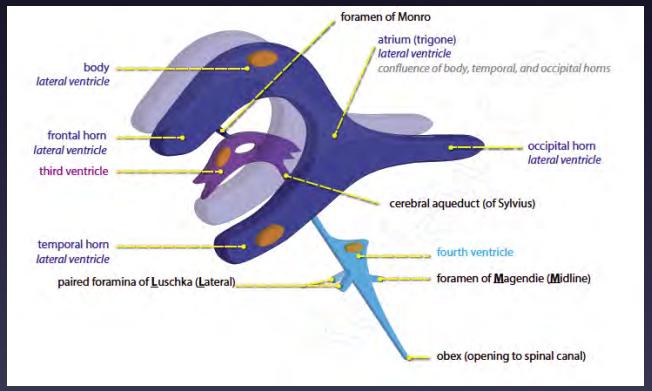
Territorial Infarction



Territorial Infarction

3. Hydrocephalus

- Communicating
- Non-communicating



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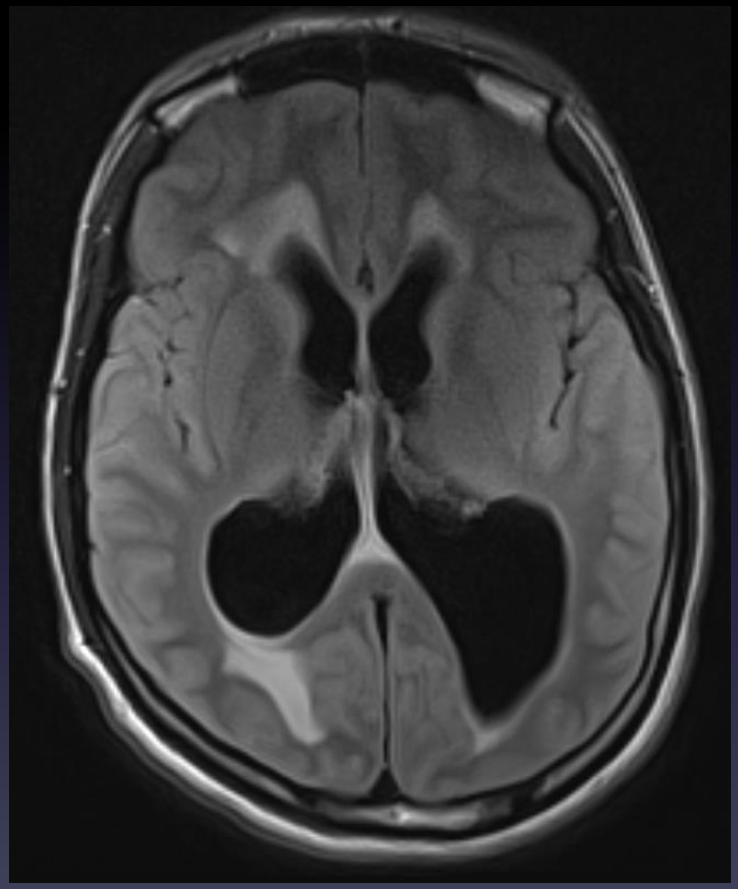

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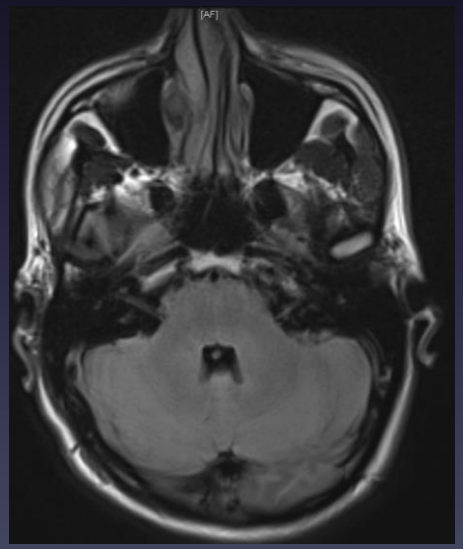
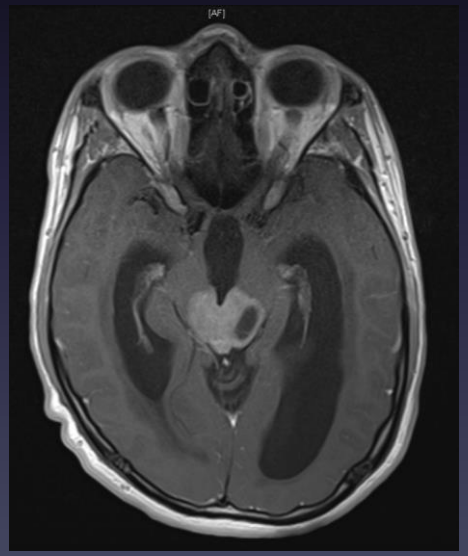




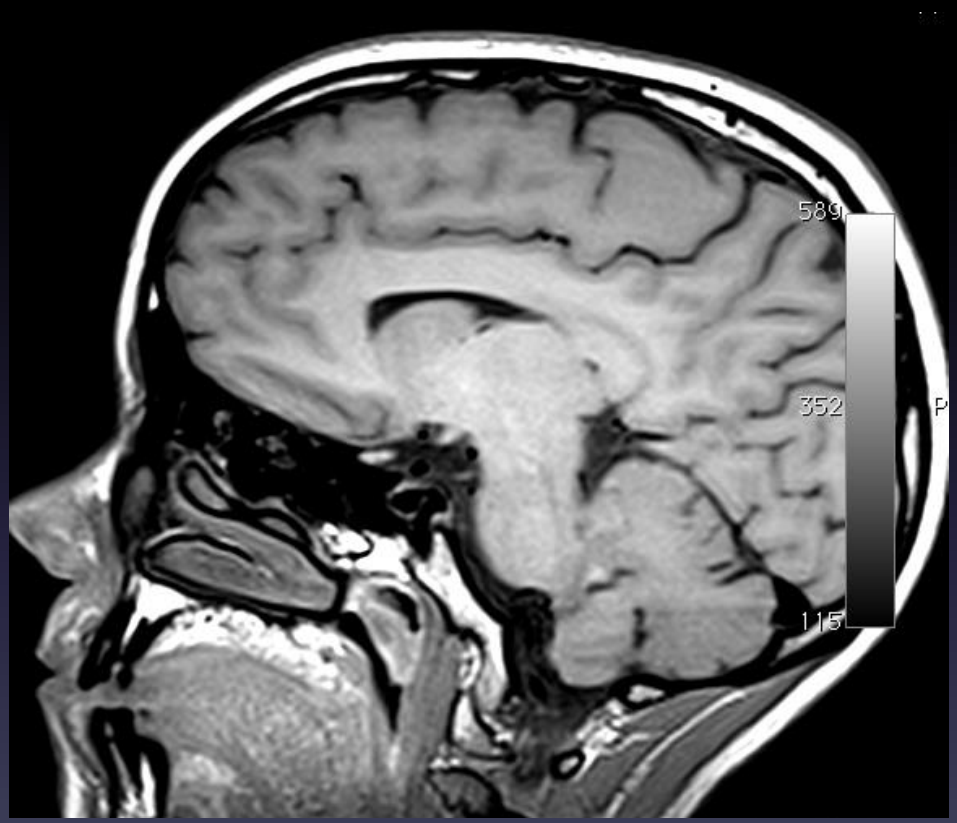
Case courtesy Paul Bunch, MD

Imaging Modalities

- Usually Non-contrast (I-) CT Head
  - aka CT Head Without
  - Fast, relatively cheap, no harm done
- When to use contrast for CT
  - If you're considering giving contrast for CT, consider MR instead.
  - Abscess, Tumor
  - CTA / CTV – to evaluate for cause of bleeding, infarct

MR… The Basics!

- T1
- T2
- FLAIR
- T1 Post
- DWI / ADC
- PD
- GRE / SWI
- DTI



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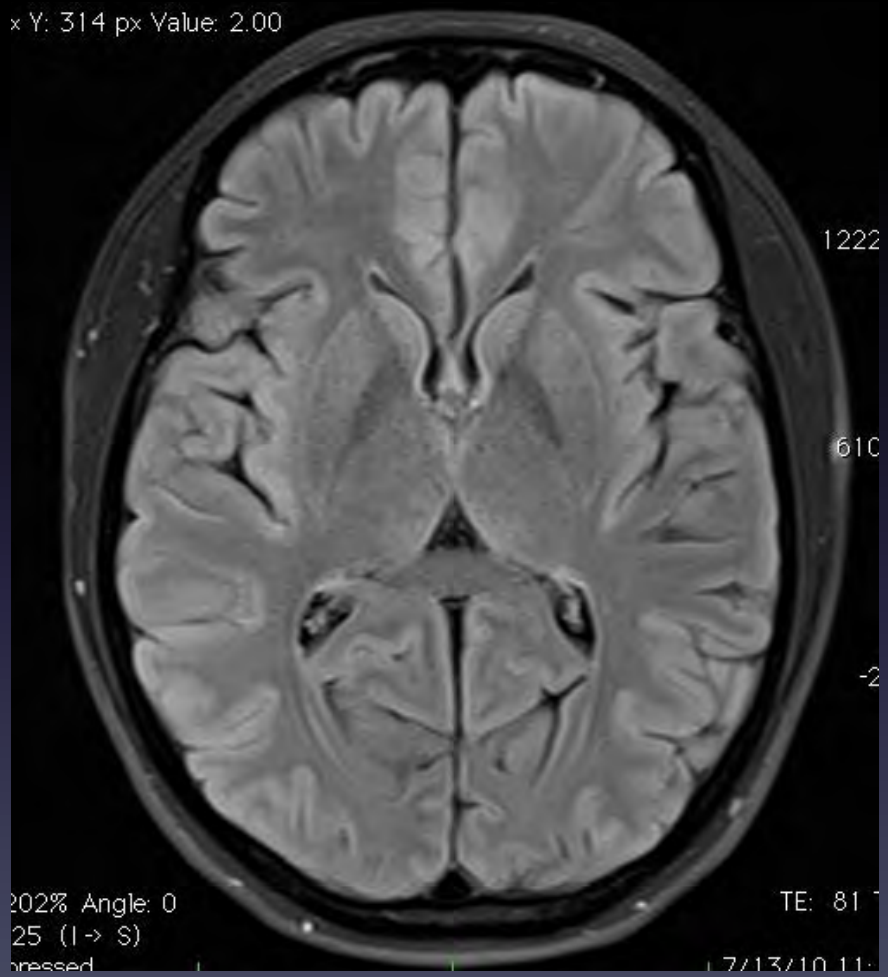

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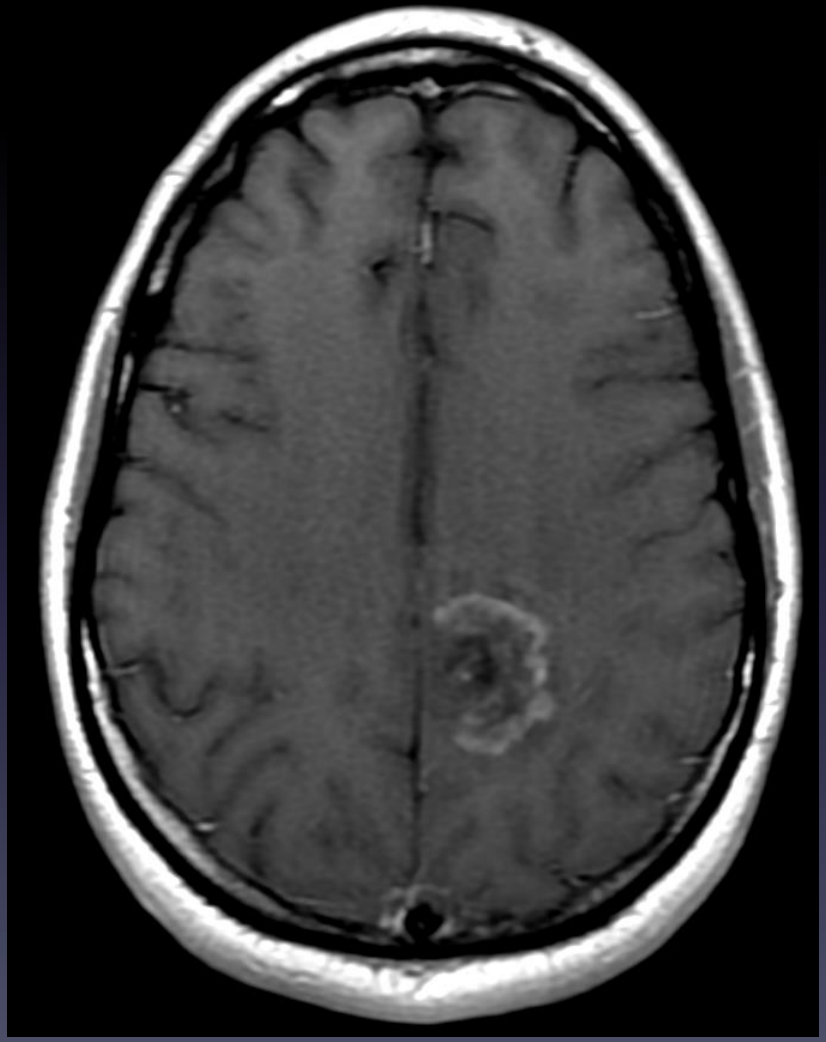

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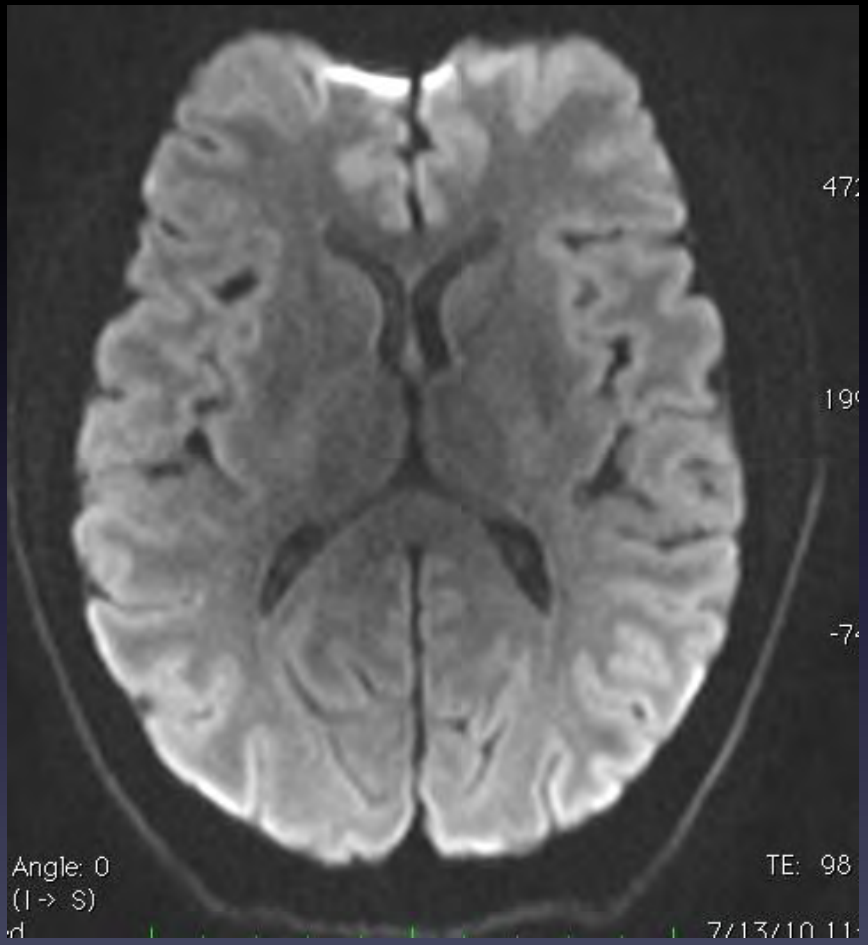

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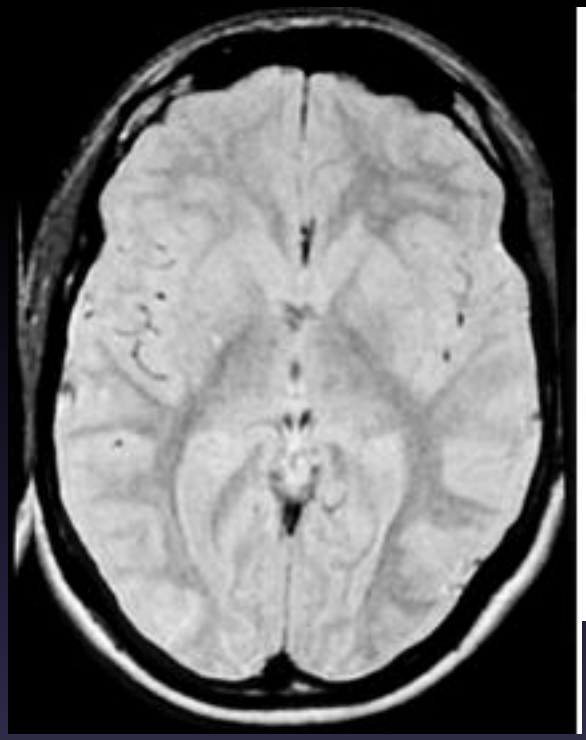
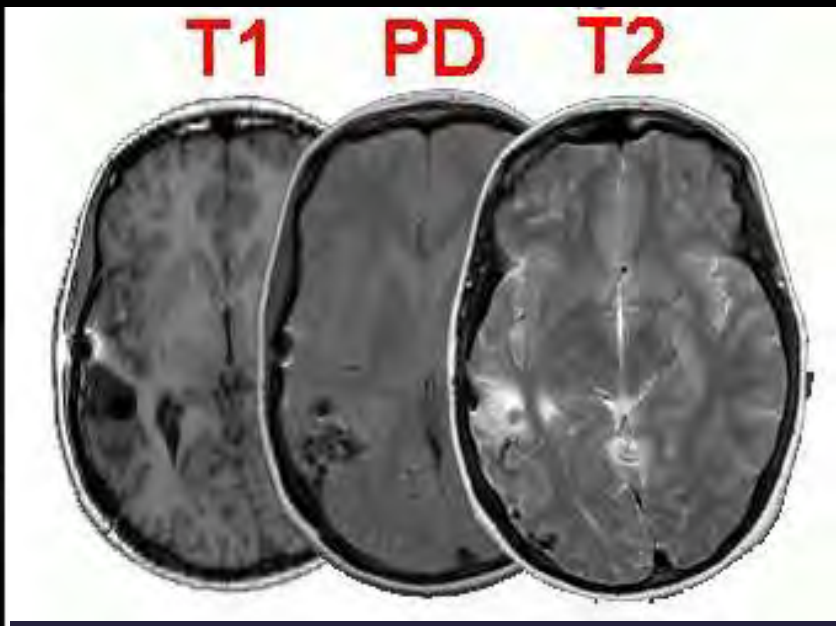


http://jnnp.bmj.com/content/69/4/494.full



http://www.mccauslandcenter.sc.edu

Short TE – like T1
Long TR – like T2

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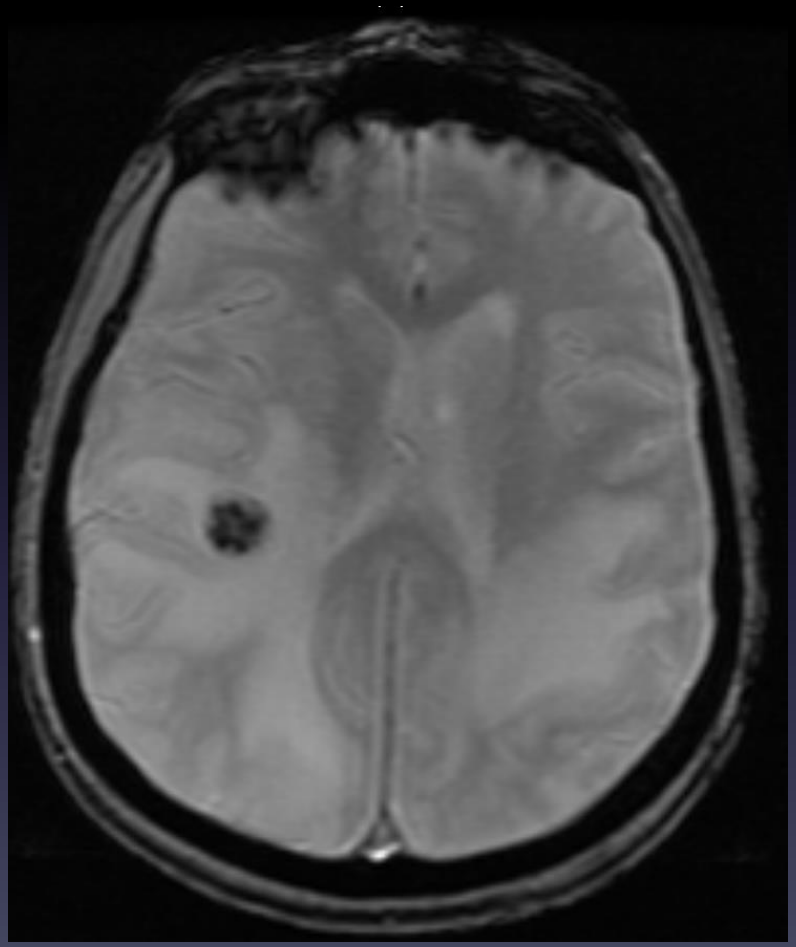

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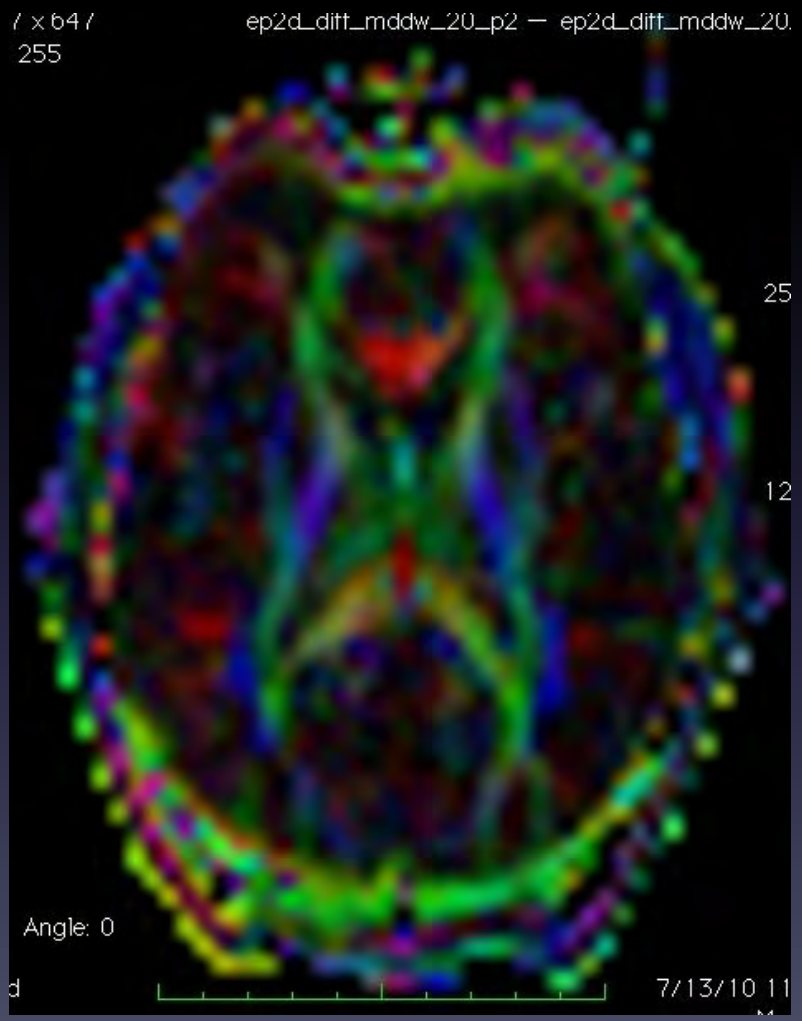


Emergency CT Checklist Review:

1. Midline shift
2. Symmetry/Asymmetry – sulci, gray-white
3. Basal cisterns – effaced? Opacified?
4. Ventricles – shifted? Effaced? Enlarged?

Case 1

Case 1

Case 1

3 days after presentation

Case 2

Case 3 - AMS

10/25/09

9/18/09

Case 4

Case 5

Case 6

Case 7

Case 7

Case 8 - CTA

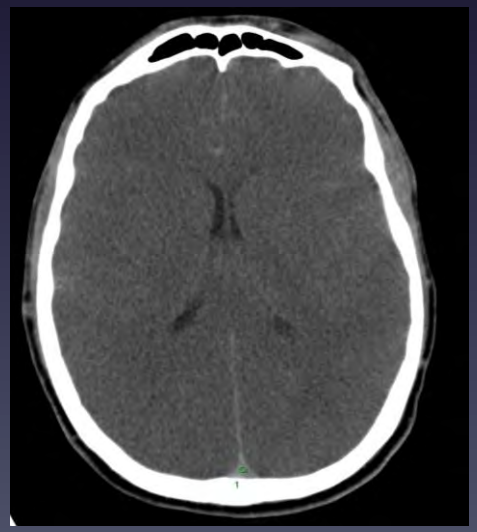
Pre-contrast

Post-contrast delayed phase

Case 9

Courtesy of Jeremy Wortman, MD

Case 10



Case 10

Case 10

"The increase in intracranial pressure and the brain swelling that accompany cerebral edema narrow the subarachnoid spaces and displace CSF. The increased intracranial pressure causes engorgement and dilatation of the superficial (pial) venous structures. The resultant subarachnoid spaces become relatively devoid of the hypoattenuated CSF and fill with a larger fraction of meninges and blood vessels than in the normal state, potentially increasing their CT attenuation."

"With development of cerebral edema, the attenuation of the brain parenchyma decreases concurrently… This decrease in attenuation is indicative of cerebral edema and likely contributes to the pseudo-SAH appearance by increasing the conspicuity of the distended vasculature within the basal cisterns."

Given CA, Burdette JH, Elster AD, Williams DW (2003). *Pseudo-Subarachnoid Hemorrhage: A Potential Pitfall Associated With Diffuse Cerebral Edema*. AJNR 24: 254-256

Special thanks

- To Jake Mandell MD, author of Core Radiology, for allowing us to use his excellent figures