There is blood in the head…now what?

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Objectives

- Recognize, diagnose and differentiate various intracerebral hemorrhage (ICH) on CT scan: parenchymal, subarachnoid, intraventricular, cerebral venous sinus thrombosis (CVST)
- List the differential diagnosis for each type of spontaneous ICH (sICH)
- Practice using the severity scoring system for ICH and subarachnoid hemorrhage (SAH)
- Discuss guidelines for the initial management of patients with ICH

sICH

- ~8,000 per year in the US
- Black and Mexican American are at high risk
- Incidence increased with age
- Early-term mortality 30-40%
- Need novel treatments
- Need improved application of established approaches**

Stroke. 2022;53:e282–e361

Pathophysiology of ICH

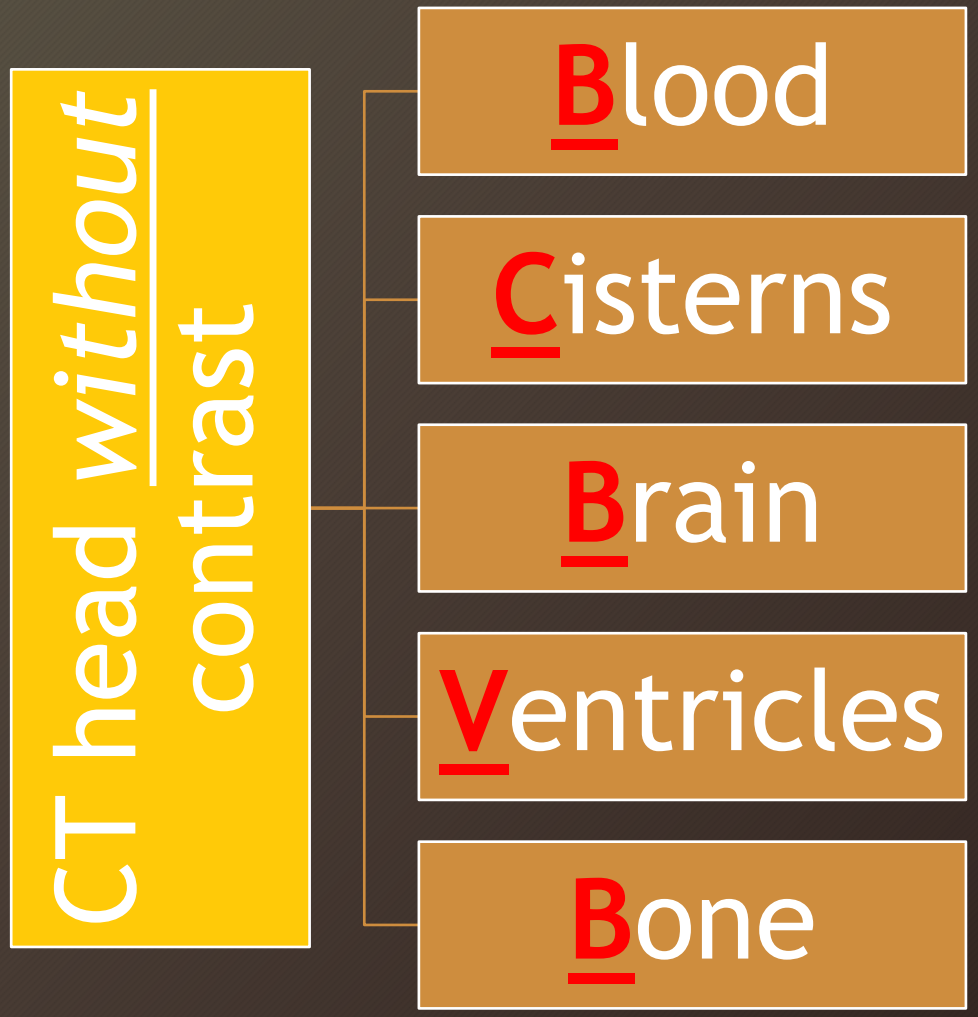
Primary Injury

Secondary Injury

- Cerebral edema
- Inflammation
- Biochemical toxicity of blood products (hemoglobin, iron, thrombin)

Which view are you looking at?

Blood Can Be Very Bad



- 66 yo female with PMH significant for Bell's palsy and chronic right facial weakness
- No medications
- Acute onset severe headache while gardening, rural hospital ED
- GCS 15; CT head with right cerebellar hemorrhage
- Unresponsive, repeat CT with worsening hemorrhage, herniation
- Intubated, levetiracetam, mannitol
- EMS transport to MMC
  - MAP 50
  - NS bolus, norepinephrine

- MAP 70 on 0.05 mcg/kg/min norepinephrine
- Intubated
- Bilateral pupils 4 mm and fixed
- Extensor posturing
- Neurosurgical evaluation

Severity Grading: ICH Score

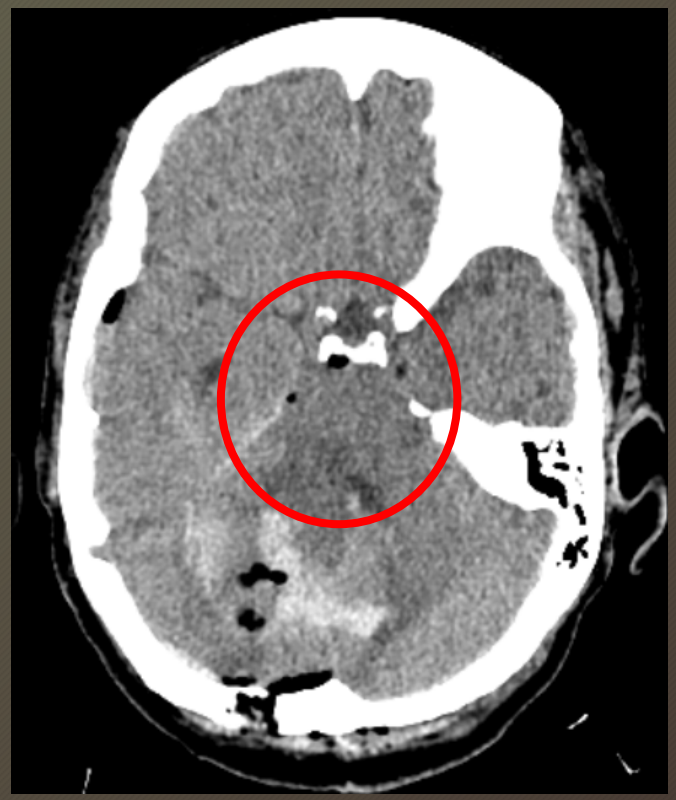
Features	Finding	Points
GCS	3-4	2
	5-12	1
	13-15	0
Age	>=80	1
	<80	0
Location	Infratentorial	1
	Supratentorial	0
ICH volume	>=30 cc	1
	<30 cc	0
Intraventricular blood	Yes	1
	No	0
ICH Score		0-6 points

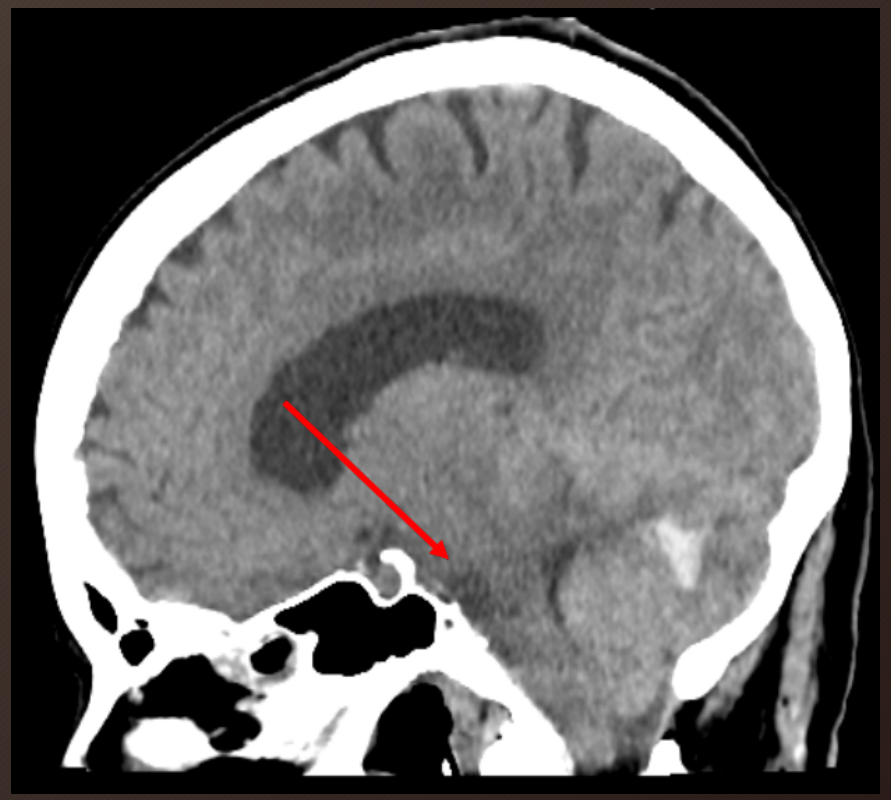
ICH Score	30-Day Mortality
0	0%
1	13%
2	26%
3	72
4	97
5	100%
6	100%

Immediate considerations

- Airway (avoid hypoxemia, which drugs,HOB etc)
- BP ← Limit hematoma expansion
- ICP (EVD, hyperosmolar therapy)
- Coagulopathy ← Limit hematoma expansion
- Seizure activity
- Temperature

- Emergent craniectomy, hematoma evacuation and EVD placement
- ICPs 8-10*
- Weaning norepinephrine (postoperative pressure 117/60)





Acute BP lowering

- Continuous smooth and sustained BP, avoid peaks and large variability
- Initiate treatment within 1 hour and reach target within 2 hours of ICH onset
- ICH of mild to moderate severity with BP 150-220 should have the BP lowered to 130-150 with a target of 140

Harmful: Lowering BP to <130 in patients presenting >150

Neuromonitoring and Hyperosmolar therapy

- EVD for hydrocephalus and altered LOC
- No evidence to support prophylactic hyperosmolar therapy
- Bolus hyperosmolar therapy may be considered for elevated ICP
  - Hypertonic saline or mannitol?
- There is no benefit to ICP or edema with corticosteroids, do not administer

Surgical Interventions

- Supratentorial ICH 20-30 cc + GCS 5-12: consider minimally invasive hematoma evacuation with or without thrombolytic therapy
- MIS evacuation of IVH
- Craniotomy with hematoma evacuation
- Craniectomy

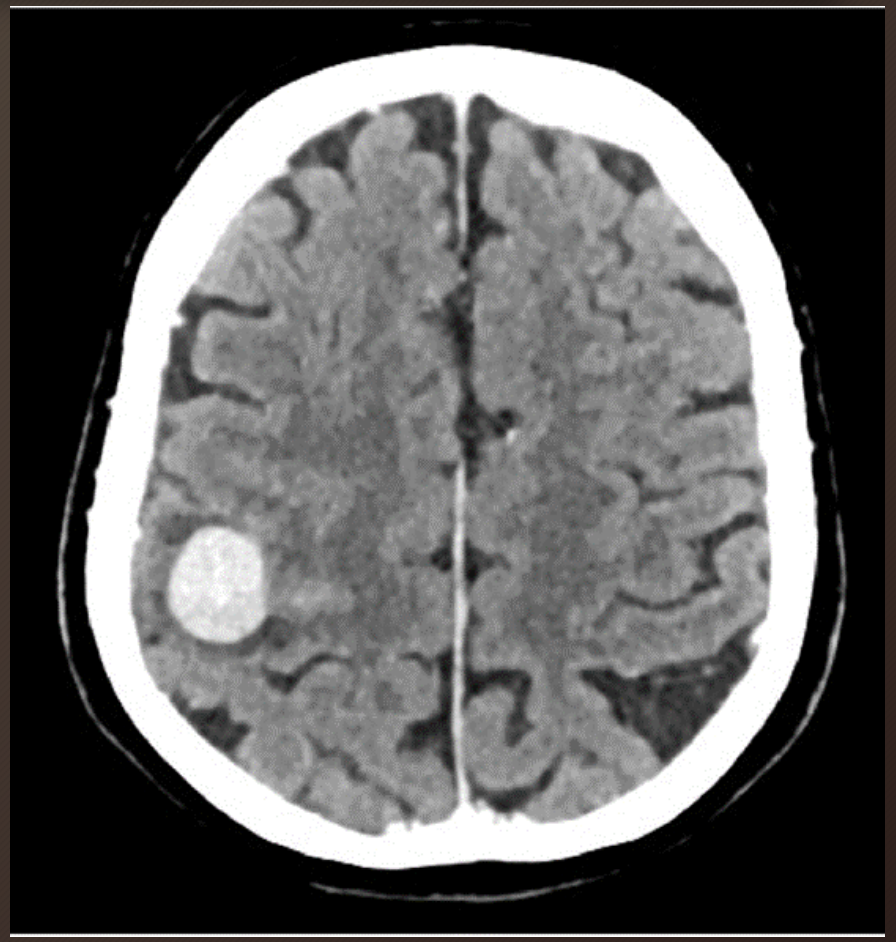
Anti-epileptic drugs

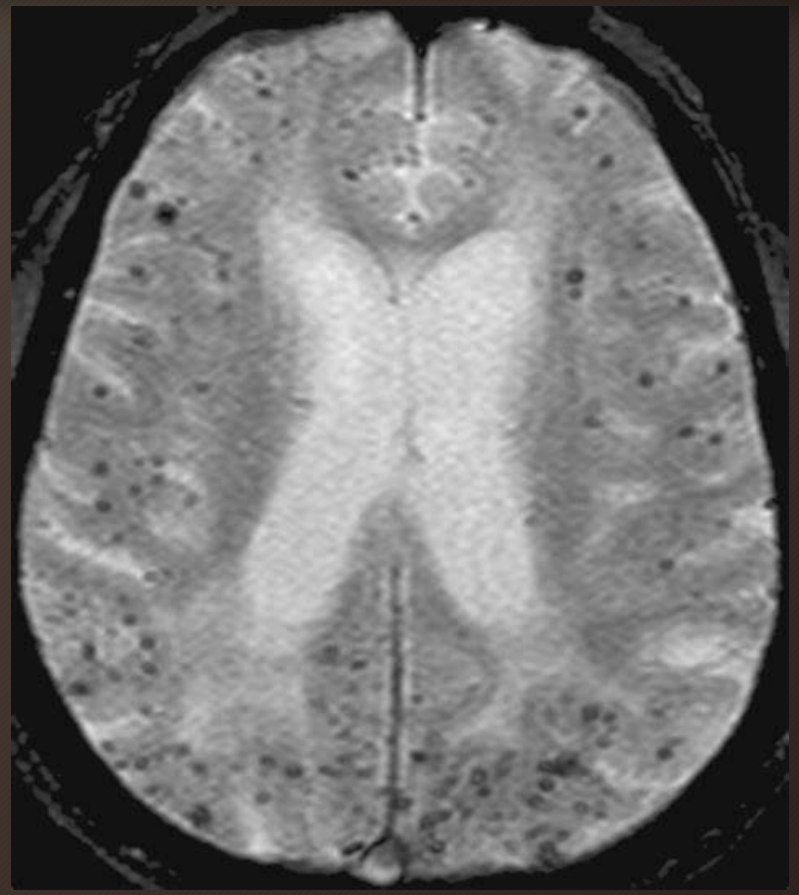
- Confirmed EEG seizures in patients with impaired LOC
- Clinical seizures
- cEEG for those with fluctuating mental status or suspicion of seizure
- No prophylaxis

Table 1. Spontaneous Intraparenchymal Hemorrhage (IPH) Etiology

	Treatment
Primary IPH	
Hypertension	BP control, trial enrollment for evacuation[a]
Cerebral amyloid angiopathy	BP control, trial enrollment for evacuation[a]
Secondary IPH	
Coagulopathy	Reversal, remainder as per primary IPH
AVM/AVF	Surgery, embolization, or radiosurgery
Cavernous malformation	Surgery
Distal/mycotic aneurysm	Embolization/surgery
Cerebral venous thrombosis	Anticoagulation and possibly thrombectomy
Moyamoya	Surgical revascularization
Vasculitis	Immunomodulatory medications
Hemorrhagic brain tumor/metastasis	Surgical resection as indicated
Hemorrhagic conversion of stroke	Expectant management

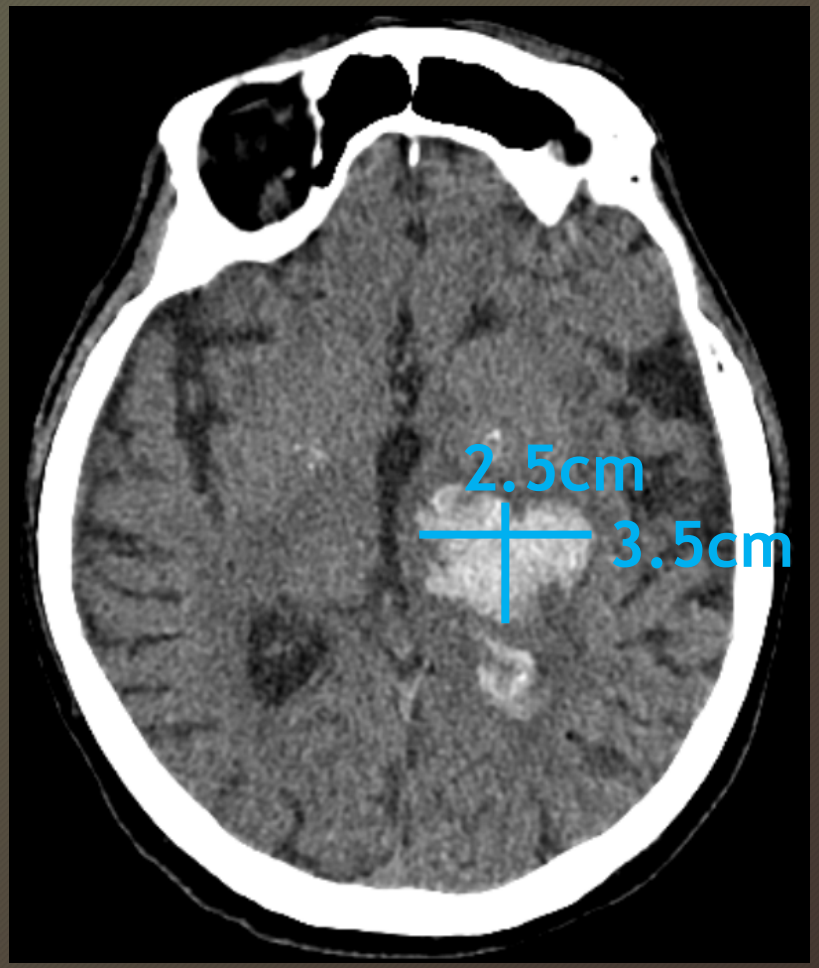
JAMA. 2019;321(13):1295-1303.





- 69 yo male
- HTN, hyperlipidemia, DM2
- Afib on apixaban
- aspirin, lisinopril, simvastatin, metformin
- 37.3 C, HR 78 (irregular), BP 189/89, SPO2 98% on room air
- GCS 15
- Right-sided weakness and mild dysarthria

ICH volume: ABC/2



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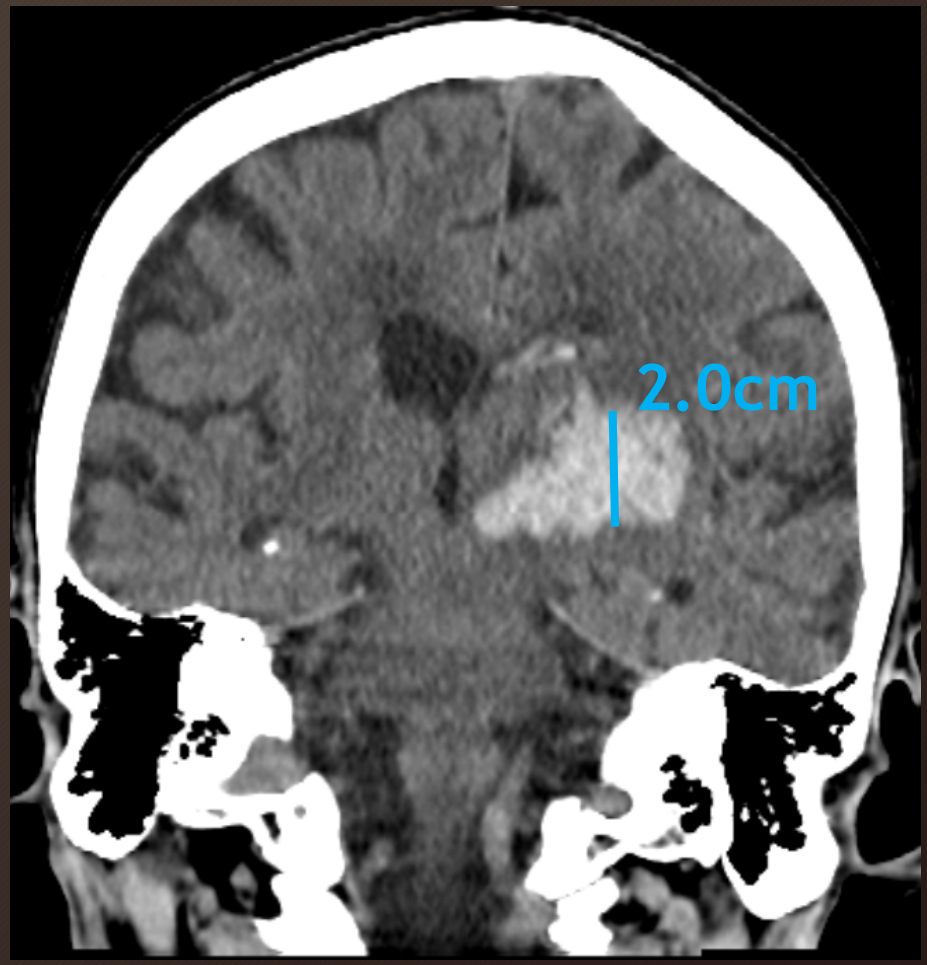
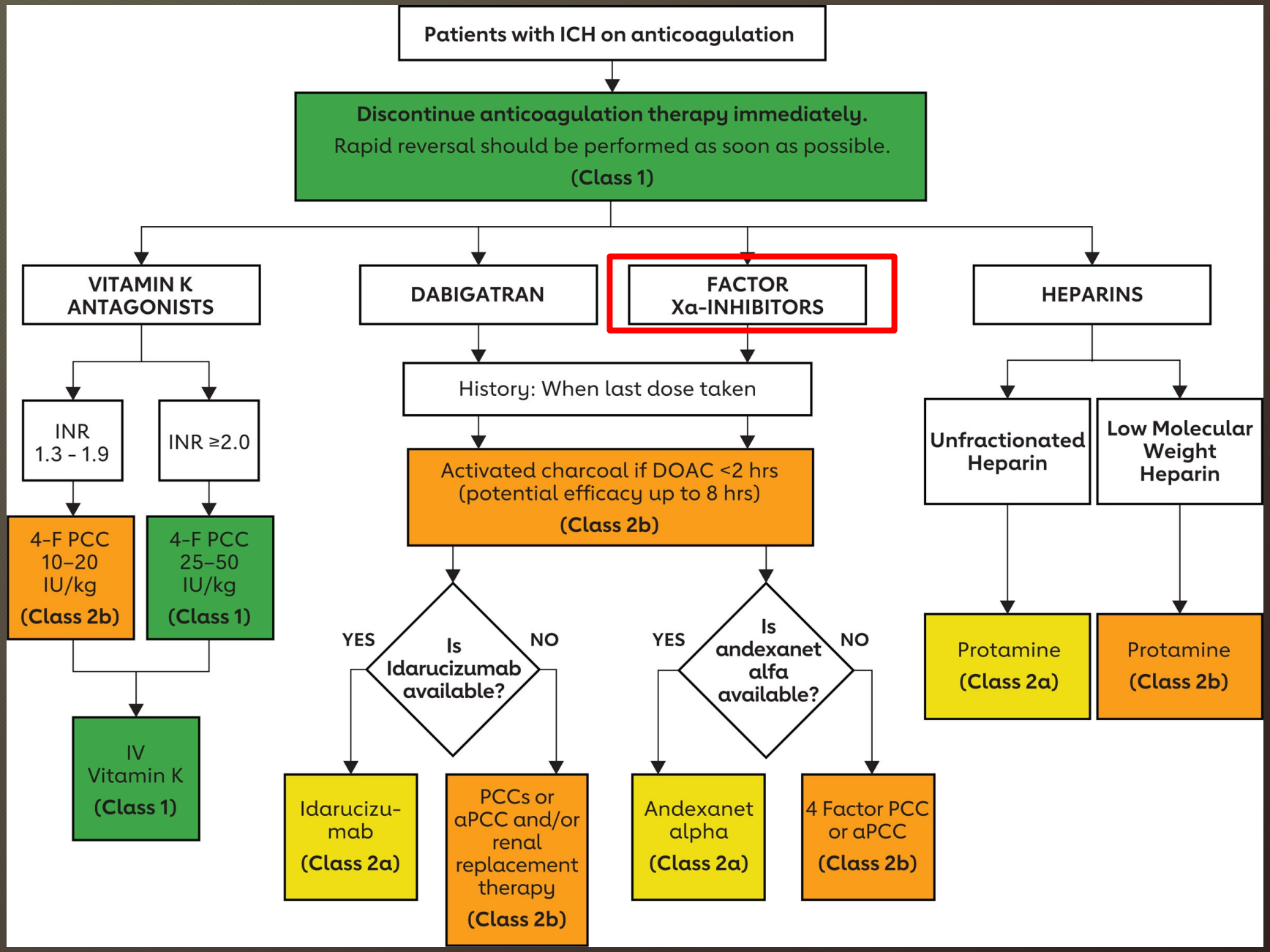


ICH Score

- GCS
- Age
- IVH
- Location
- Volume

ICH score=0

Hemostasis and Coagulopathy



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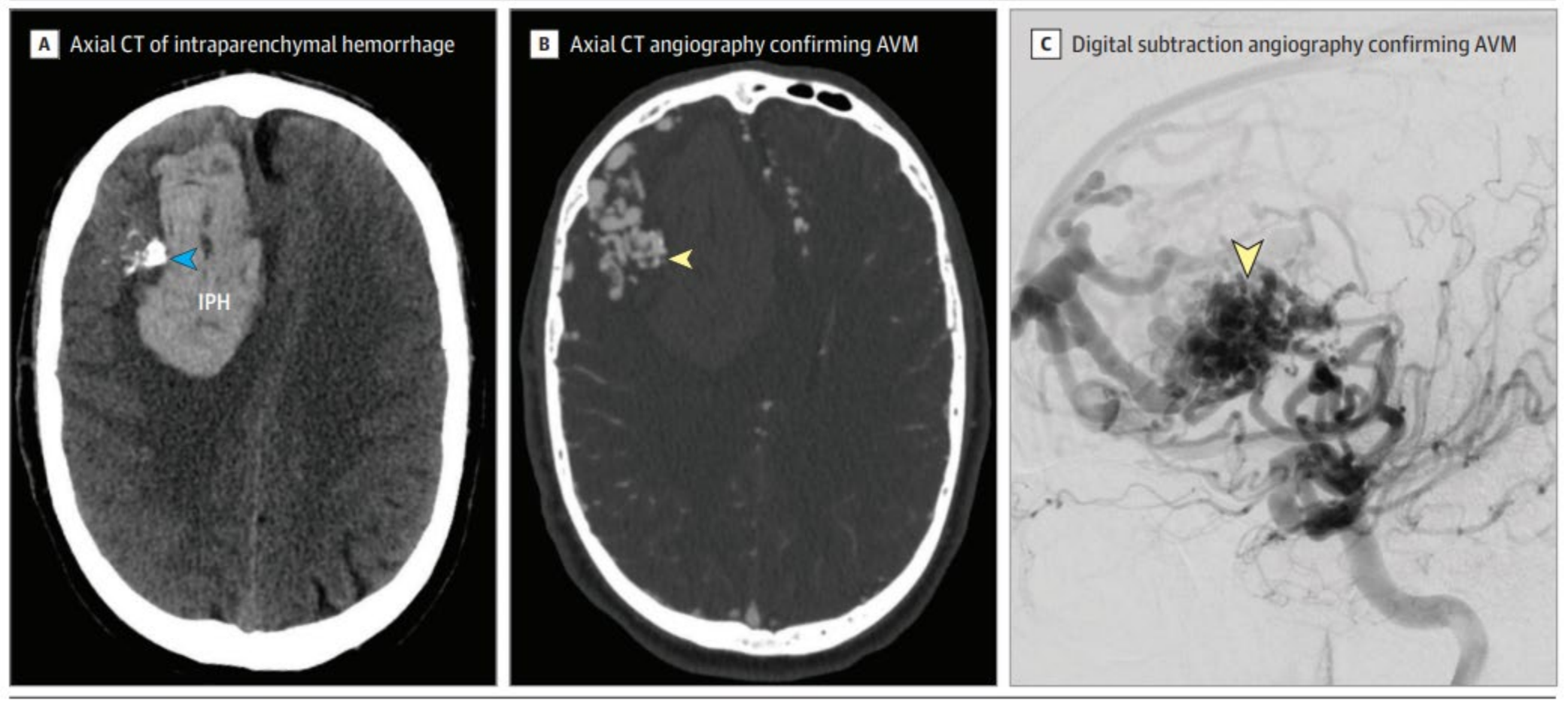
Antiplatelets

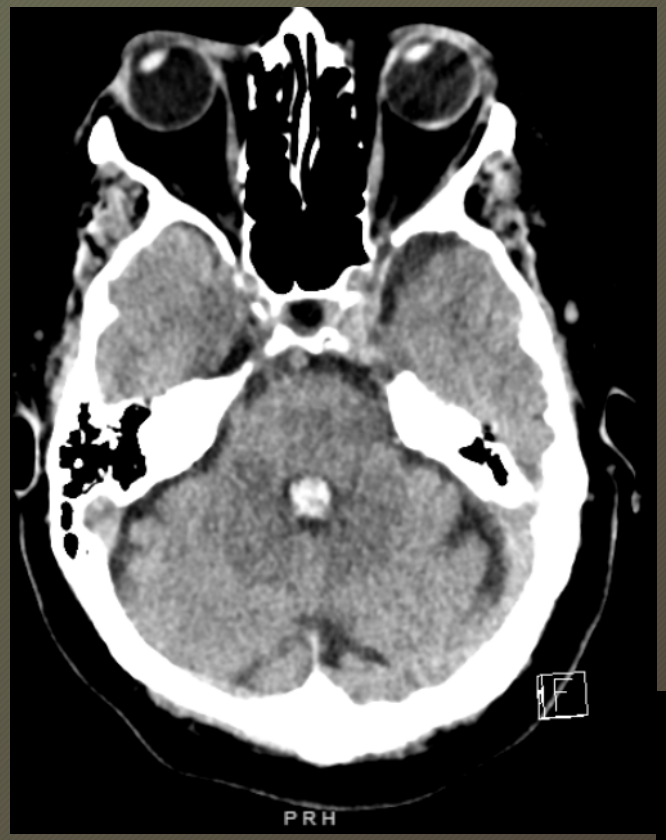
- Consider platelet transfusion for patients on aspirin who require neurosurgical intervention to reduce postoperative bleeding and mortality
- Effect of desmopressin for patients on antiplatelets is unclear

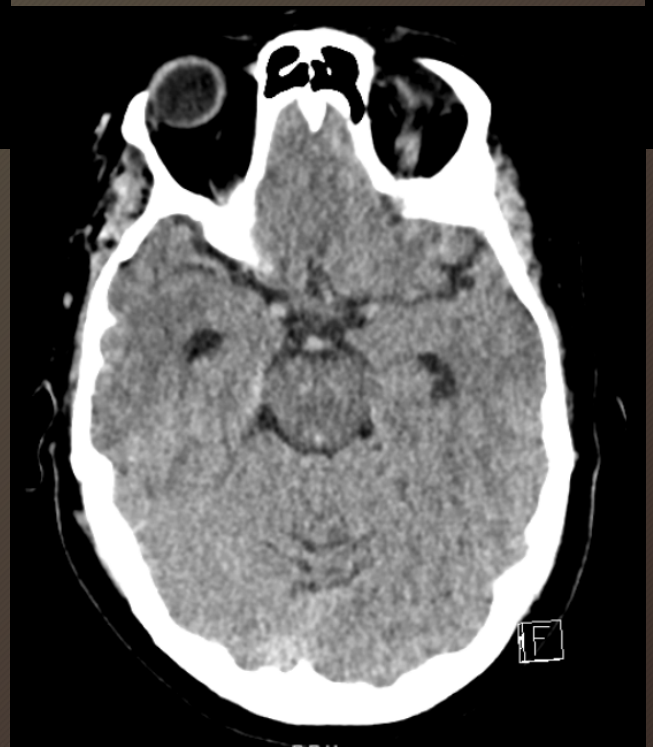
Harmful: platelet transfusions in patients not having surgery

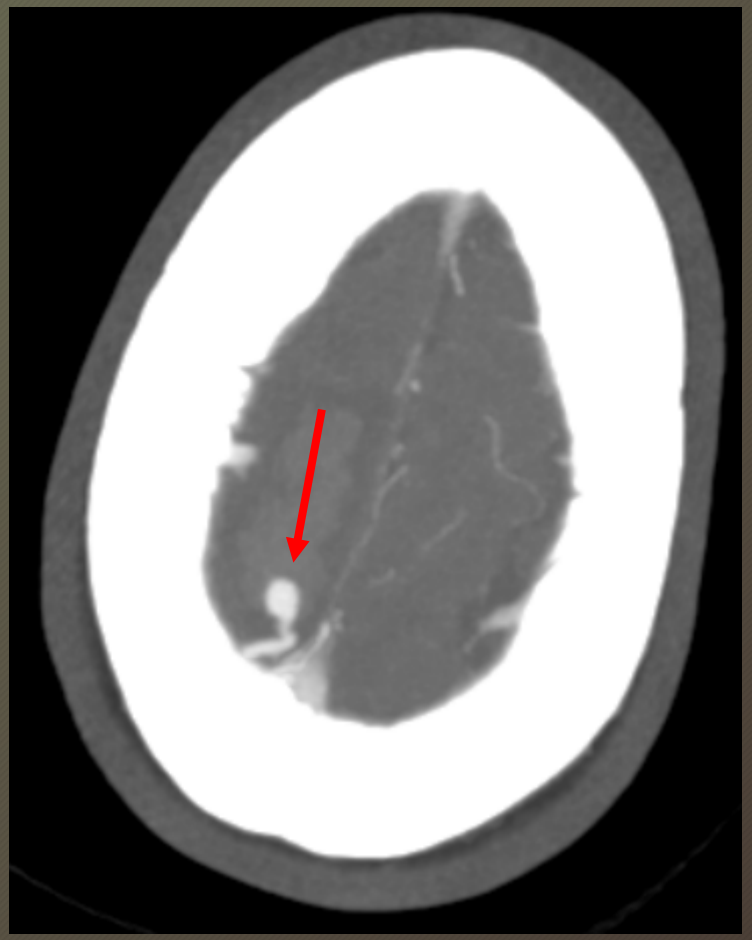
Other considerations

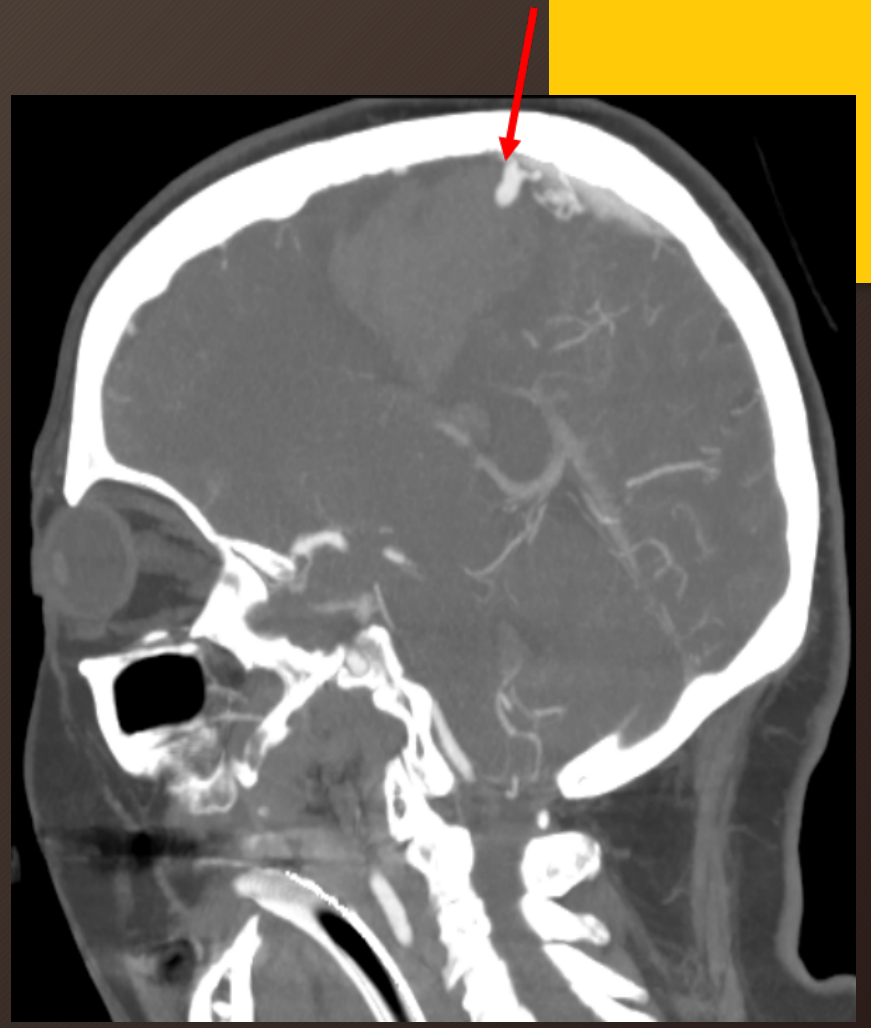
- **When to repeat neuroimaging?**
- **Who needs serial head CTs?**
- **Who needs a CT angiogram?**
  - Lobar and <70 yo
  - Deep/posterior fossa and <45 yo
  - Deep/posterior fossa, 45-70 yo, NO hx HTN
  - +/- CT venography
- **Who needs a cerebral angiogram (DSA)?**
  - Spontaneous IVH with no detectable parenchymal hemorrhage
  - Above is negative
- **Who needs MRI/A?**
  - Negative vascular imaging
  - Consider repeat 3-6 months


A Axial CT of intraparenchymal hemorrhage
IPH
B Axial CT angiography confirming AVM
C Digital subtraction angiography confirming AVM

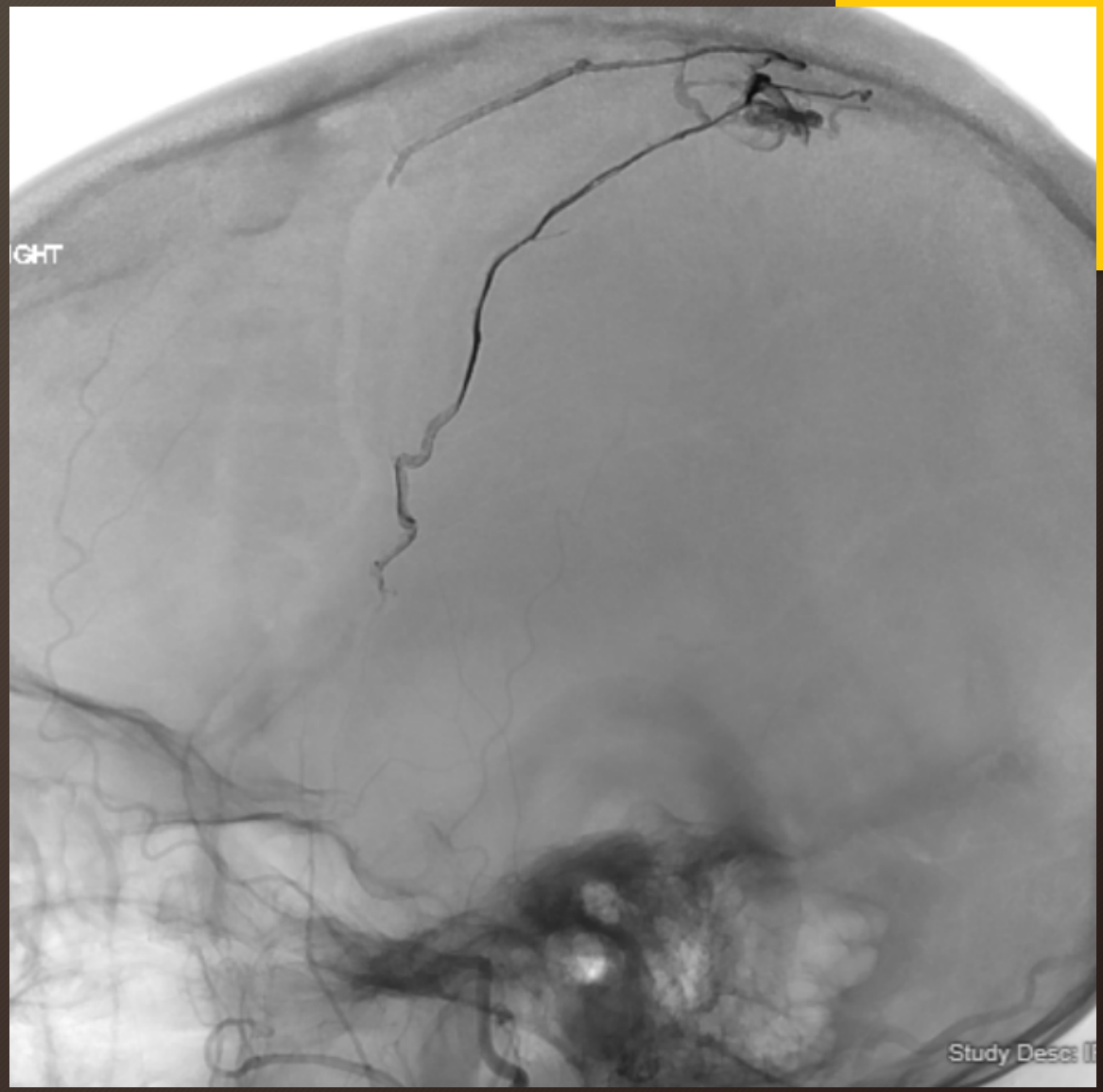

PRH



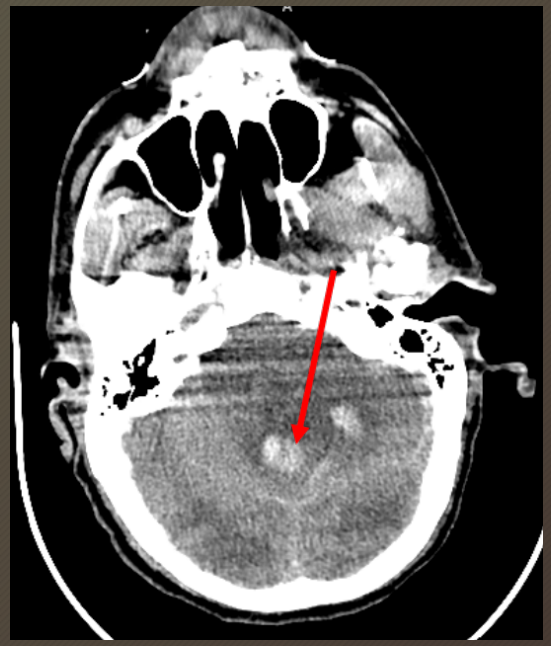
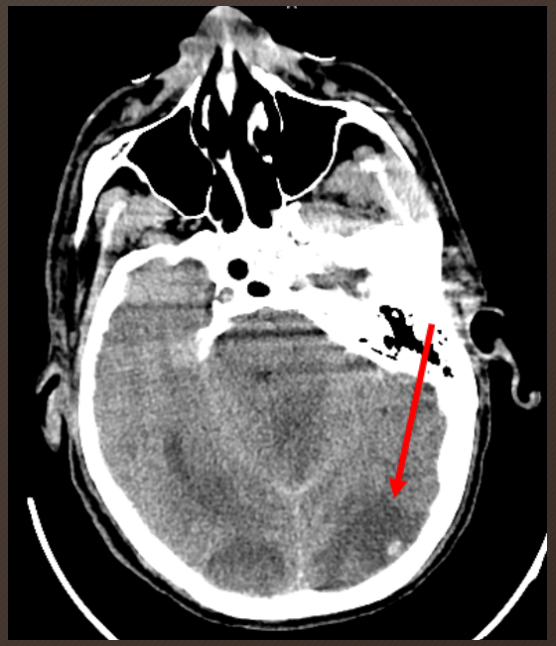


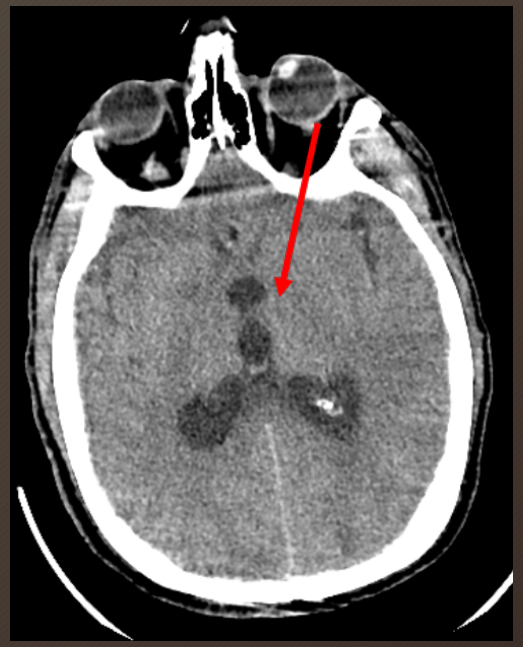



RIGHT



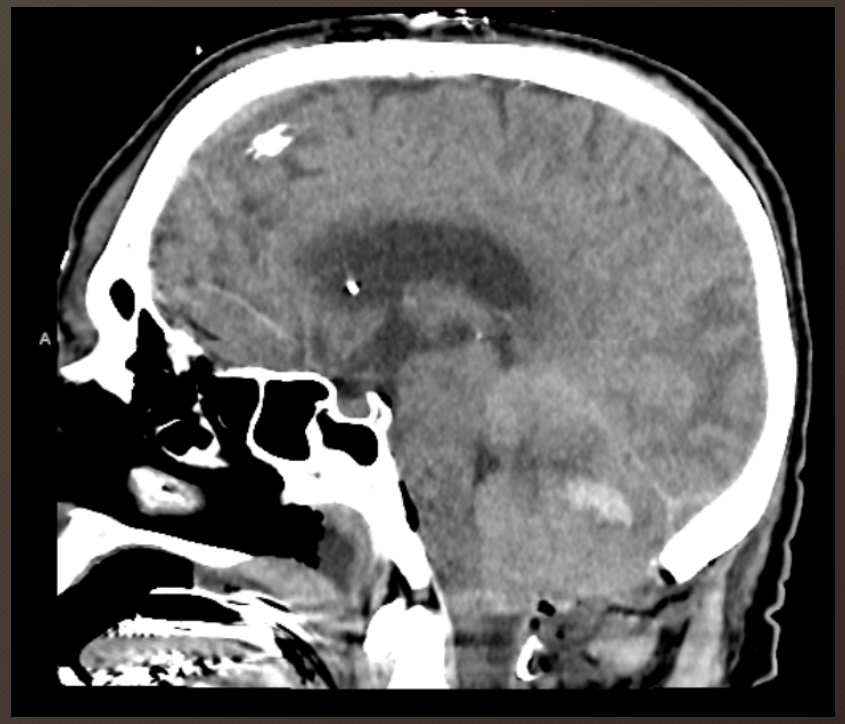
- 45 yo male; tobacco dependence, HTN
- Several day history of progressive HA
- Morning of admission some blurred vision
- Worked all day in the sun, lawn care business
- Went home, had two beers
- Wife unable to arouse him in the morning
- No medications



28.3 mm
(3D)


A
R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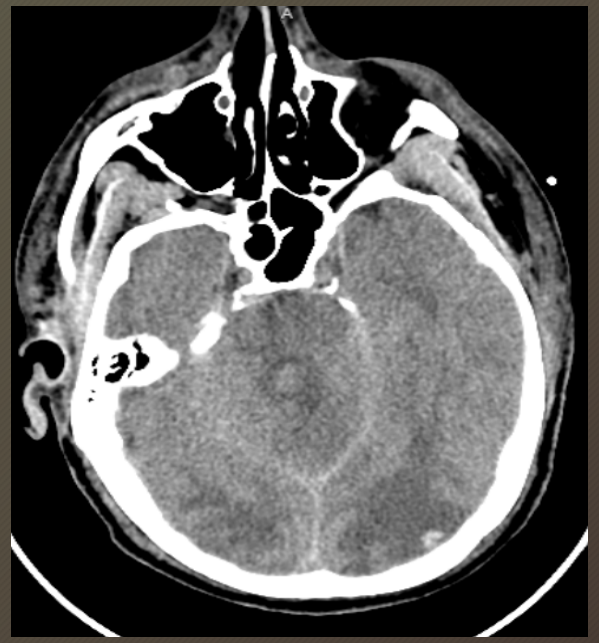
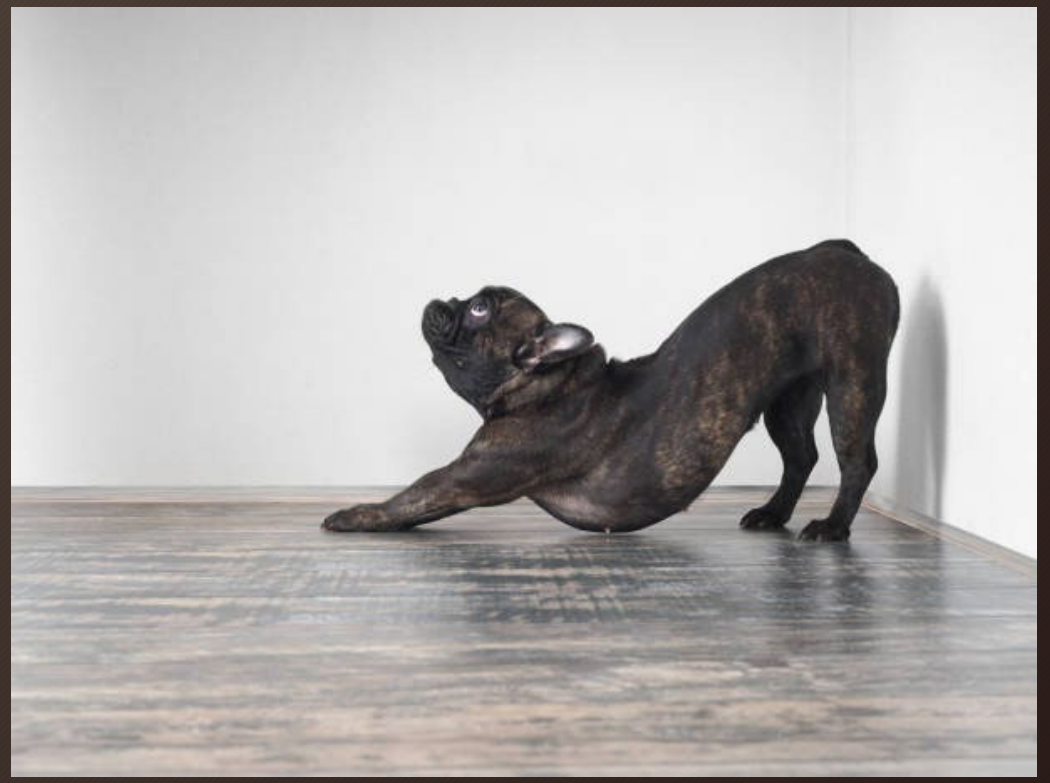


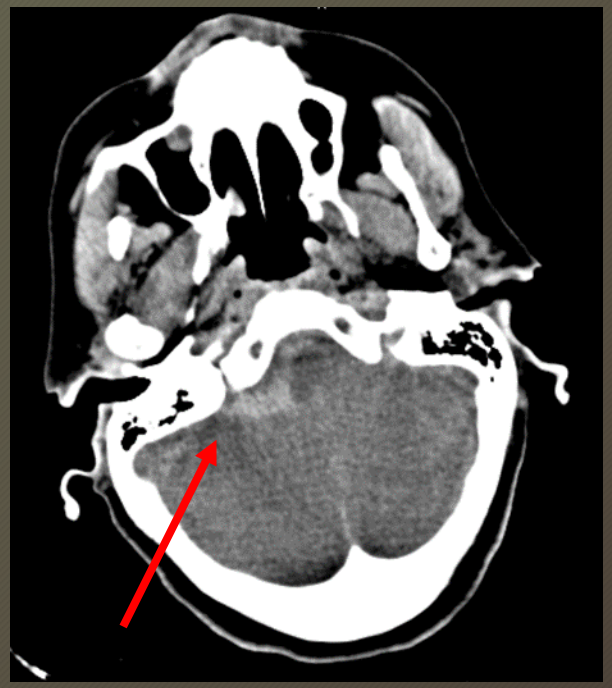
CVST Treatment Guidelines

- Anticoagulation
  - dose-adjusted IV unfractionated heparin
  - body weight-adjusted LMWH
- Local thrombolysis may be option for patients at high risk of poor outcome despite heparin therapy
- Consider antiepileptic therapy
  - focal neuro deficits and supratentorial lesions on admission, duration unclear
- Intracranial hypertension
  - Patients most frequently die d/t transtentorial brain herniation
- No evidence that clinical outcome is better with thrombolysis than with heparin alone

Harmful: avoid steroids

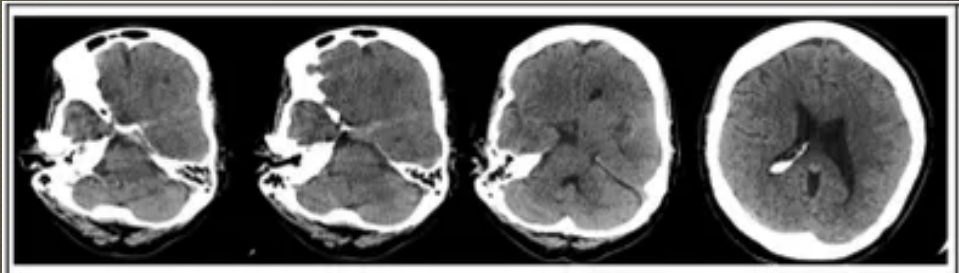
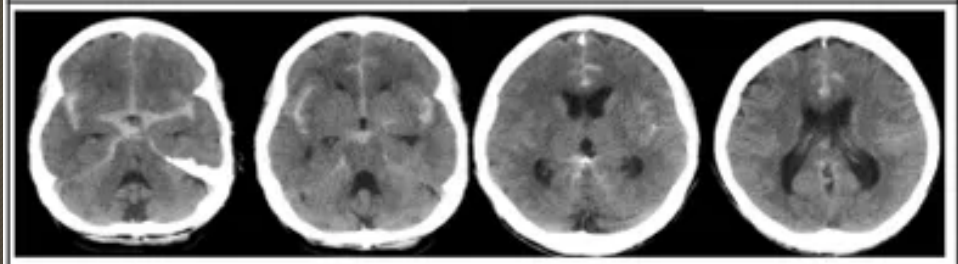
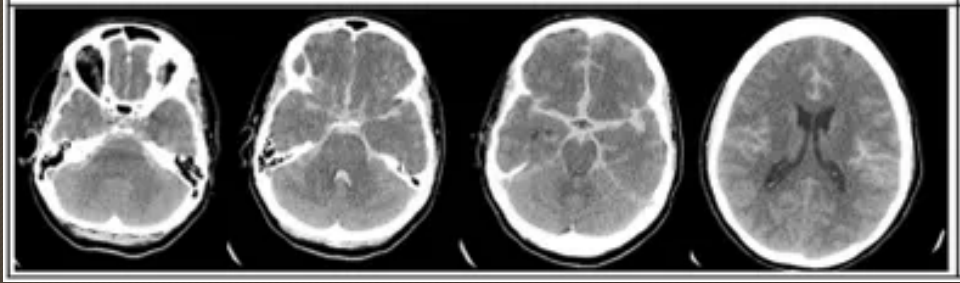


- 66 yo female
- PMH
  - Hypertension, rheumatoid arthritis, CKD 3 (membranous nephritis), renal cell carcinoma s/p left radical nephrectomy
- 12/2019 Mid Coast ED: severe HA for 5 days prior to presenting to the ED
  - Husband found her unresponsive with seizure-like activity
  - Intubated in ED
  - Hypertensive with SBP 190s



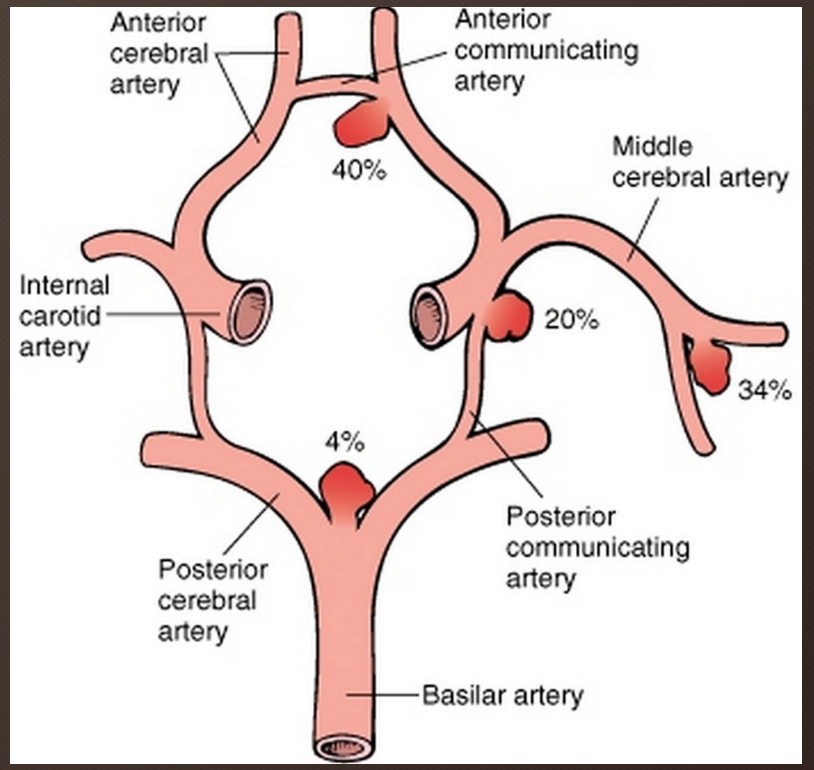

Grading SAH

Hunt and Hess Classification of SAH	
Grade	**Description**
1	Asymptomatic or mild H/A and slight nuchal rigidity
2	CN palsy (III, VI), moderate to severe H/A, nuchal rigidity
3	Mild focal deficit, lethargy, confusion
4	Stupor, moderate to severe hemiparesis, early decerebrate rigidity
5	Deep coma, decerebrate rigidity, moribund appearance
Add one grade for serious systemic disease (HPN, DM, severe atherosclerosis, COPD), or severe vasospasm on arteriography.	

	modified Fisher Grade 1: thin SAH, no IVH Complete scan can be seen here: https://youtu.be/yp6_0P5IfXo
	modified Fisher Grade 2: thin SAH, with IVH Complete scan can be seen here: https://youtu.be/ITZdUCBOcaM
	modified Fisher Grade 3: thick SAH, no IVH Complete scan can be seen here: https://youtu.be/DjDfF192dno
	modified Fisher Grade 4: thick SAH, with IVH Complete scan can be seen here: https://youtu.be/lmodUyZdIPM

Subarachnoid Hemorrhage

- 2-7% of all strokes
- Younger, higher mortality
- Aneurysms typically form at branch points along the intracranial arteries



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SAH immediate treatment

- BP (at least <160)
- Hydrocephalus
- Anticoagulation reversal
- Definitive aneurysm treatment
- With f/u vascular imaging
- nimodipine

- Euvolemia/normal circulating volume to prevent DCI
- Hypertension for symptomatic DCI unless not tolerated
- TXA or aminocaproic acid for those with unavoidable delay to reduce the risk of rebleeding

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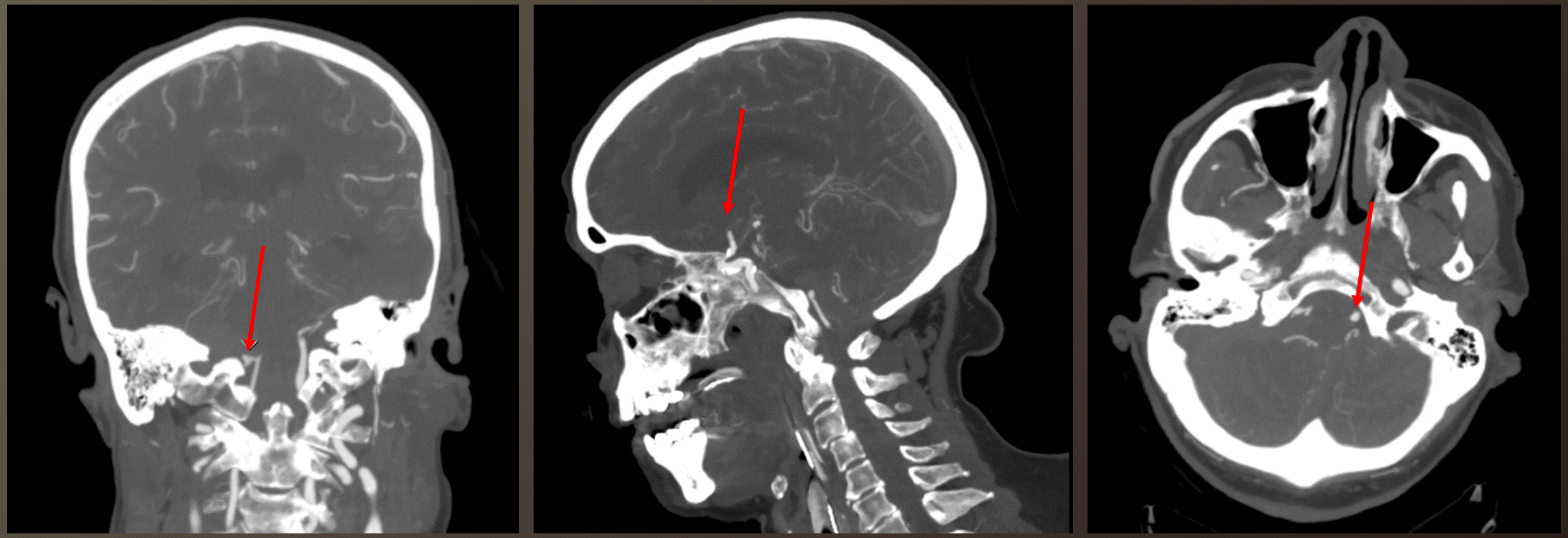
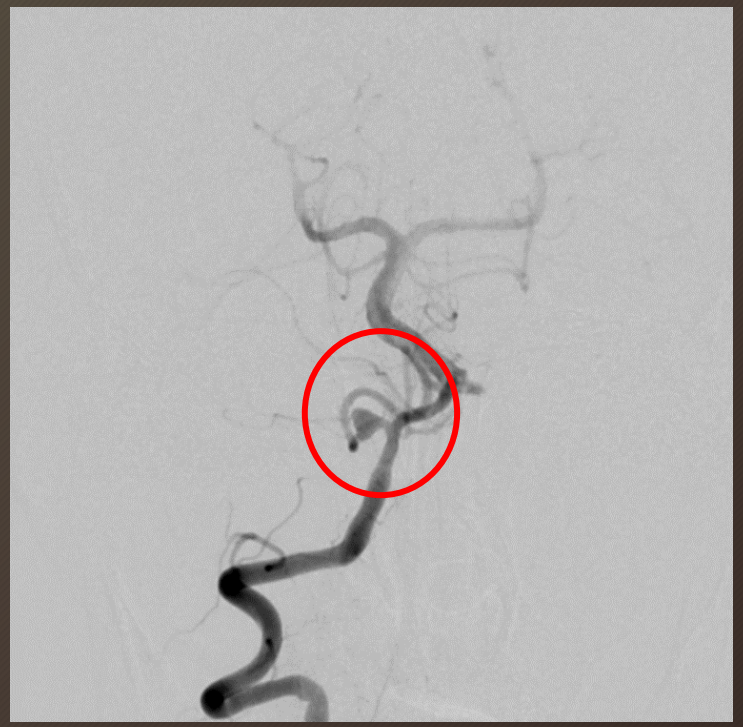


Cerebral angiogram



Take home points

- ABCs
- Treat BP early
- Treat intracranial hypertension and hydrocephalus immediately
- Consider need for neuromonitoring and transfer
- Consult
- Anticoagulation reversal
- Be aggressive in the first 48 hours
- *Early and aggressive treatment may improve functional outcome!!

THANK YOU