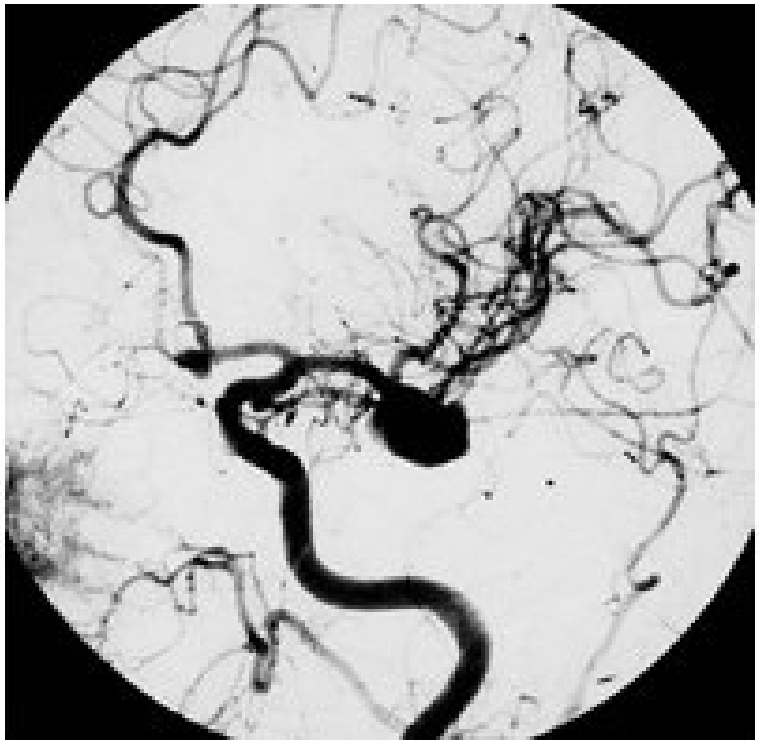
Vascular Neurosurgery
Cerebral Aneurysms

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Cerebral Aneurysms

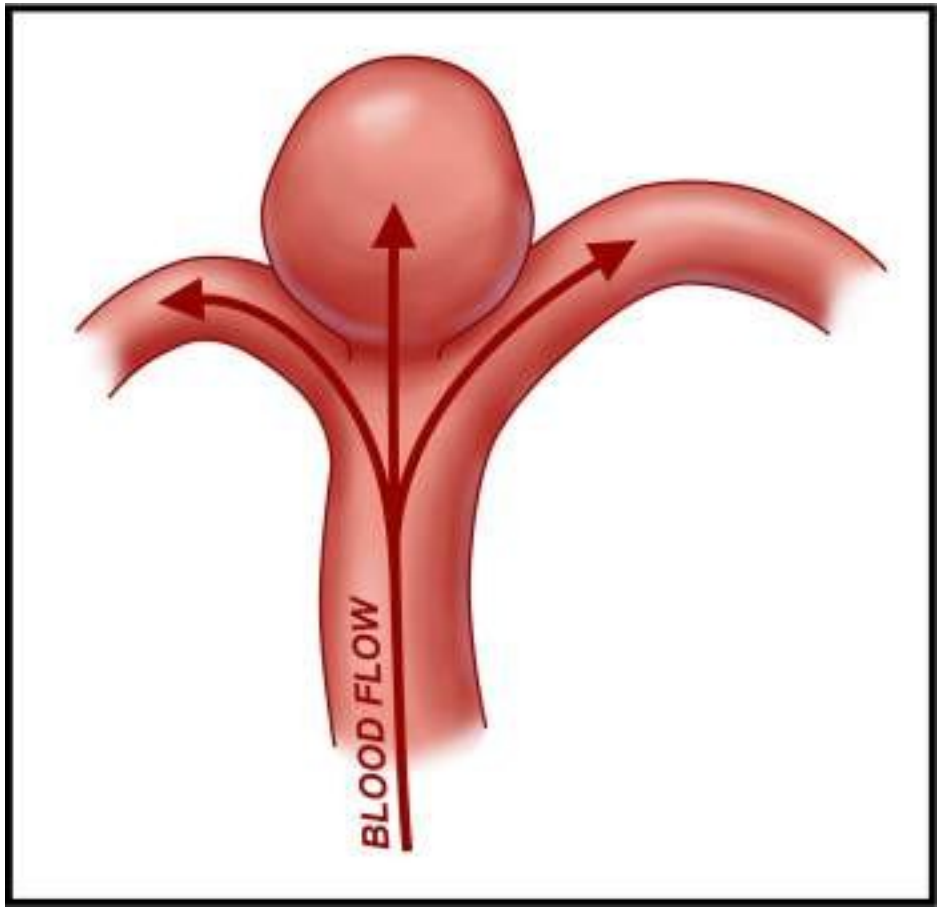


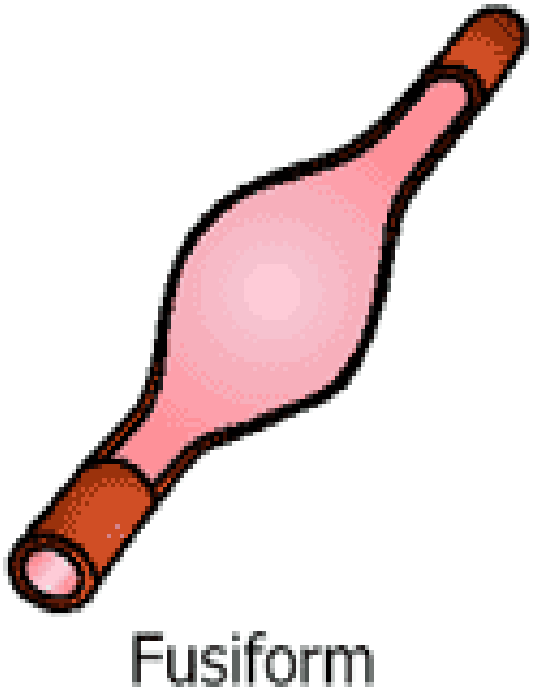


Cerebral Aneurysms

- Prevalence ≈ 5%
- Ruptured : Unruptured ratio is 1:1
- Etiology:
  - Congenital predisposition (medial gap, HTN)
  - Infection (Mycotic aneurysms)
  - Trauma (Traumatic aneurysms)
- Shape:
  - Saccular / berry
  - Fusiform

Saccular vs. Fusiform





Cerebral Aneurysms

- Location:
  - Saccular: Proximally on the major cerebral arteries at the branch points or curves (sites of maximum hemodynamic stress)
  - Mycotic or traumatic: more peripherally
  - Fusiform: more in the vertebrobasilar system

Cerebral Aneurysms

- Location of saccular aneurysms:
  - 85% Anterior circulation (carotid system)
    - ACoA 30%
    - Pcom 25%
    - MCA 20%
  - 15% Posterior circulation (vertebrobasilar system)
    - Basialr tip 10%
    - Vertebral (VA-PICA junction) 5%

Cerebral Aneurysms
Presentation

- Major rupture:
  - SAH (The most common presentation. Also ruptured aneurysm is the cause in 80% of spontaneous SAH)
  - ICH in 30%
  - IVH in 20%
  - SDH in 5%
- Other than major rupture:
  - Mass effect, seizures, small infarcts or TIA, minor hemorrhage, headache, incidental

Symptoms & signs of aneurysmal SAH

- Headache (sudden, severe, worst in life)
- Meningismus
- Coma
- Ocular hemorrhage

WFNS grading of SAH

WFNS grade	GCS score	Major focal deficit
0 (unruptured incidental aneurysm)		
1	15	-
2	13-14	-
3	13-14	+
4	7-12	+ or -
5	3–6	+ or -

Outcome of aneurysmal SAH

- 15% of pts die before reaching medical care
- 10% die within the first few days
- 30-day mortality rate 46%
- 30% of survivors have moderate to severe disability
- Rebleeding rate 20% in the first 2 weeks
- Vasospasm kills 7% of pts & causes severe deficit in another 7%

Investigations for Spontaneous SAH

- Which investigations to confirm SAH?
- Which investigations to differentiate the etiology of SAH?
- Which investigations used during management of SAH?

Investigations to confirm spontaneous SAH

- CT
- LP
- MRI

CT

- Good quality, noncontrast, thin cuts
- Sensitivity > 95% if within 48 hrs
- Detect: SAH & its amount, HCP, ICH, SDH, infarction, aneurysm location
- Sensitivity decreases with increased time
- A contrast-enhanced CT scan may reveal an AVM

Fisher's CT Grades of SAH

- GRADE 1= Normal Scan. No SAH.
- GRADE 2= Less than 1mm thickness of blood (Diffuse)
- GRADE 3= More than 1mm thickness of blood
- GRADE 4= IVH or ICH with diffuse or no SAH

Modified grading system of Fisher

Modified Fisher scale group	Blood on CT	Symptomatic vasospasm
	No SAH or IVH	
1	focal or diffuse thin SAH, no IVH	24%
2	focal or diffuse thin SAH, with IVH	33%
3	focal or diffuse thick SAH, no IVH	33%
4	focal or diffuse thick SAH, with IVH	40%

Grade 1 SAH

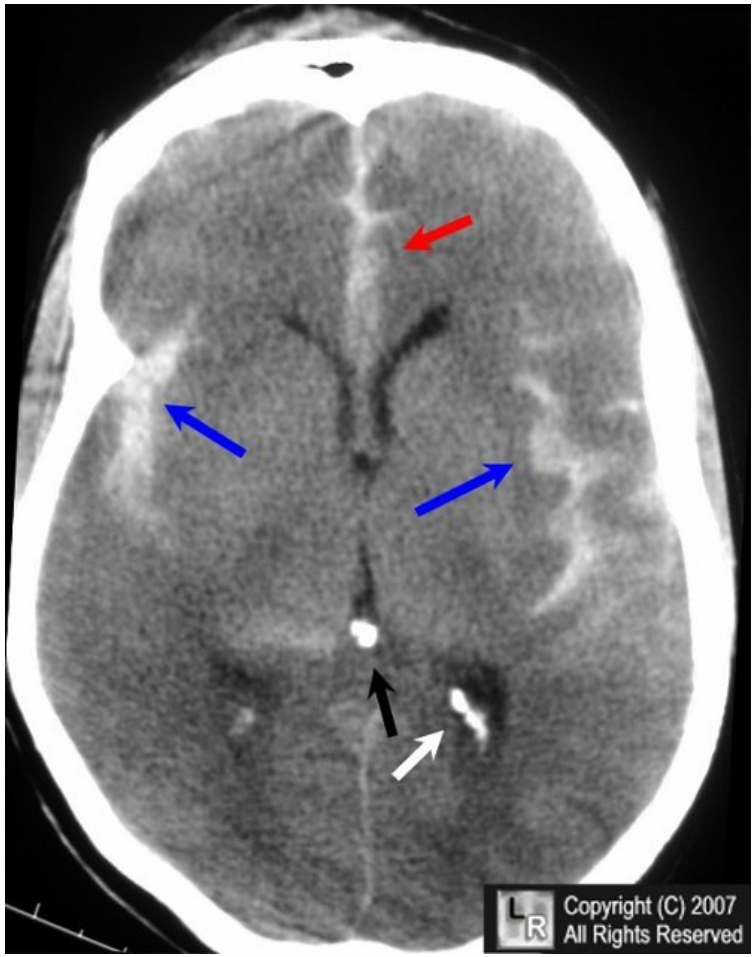




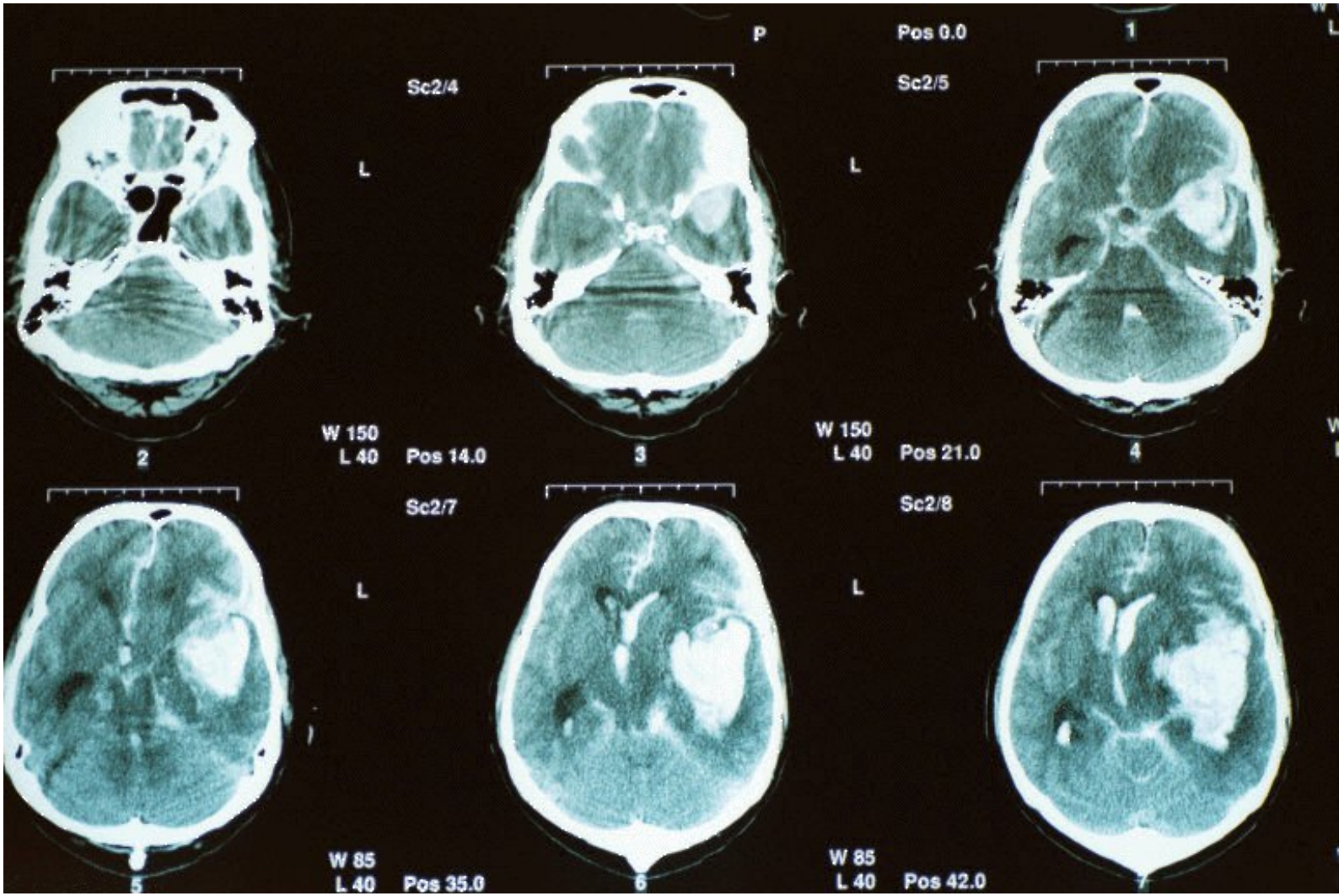
Grade 2 SAH


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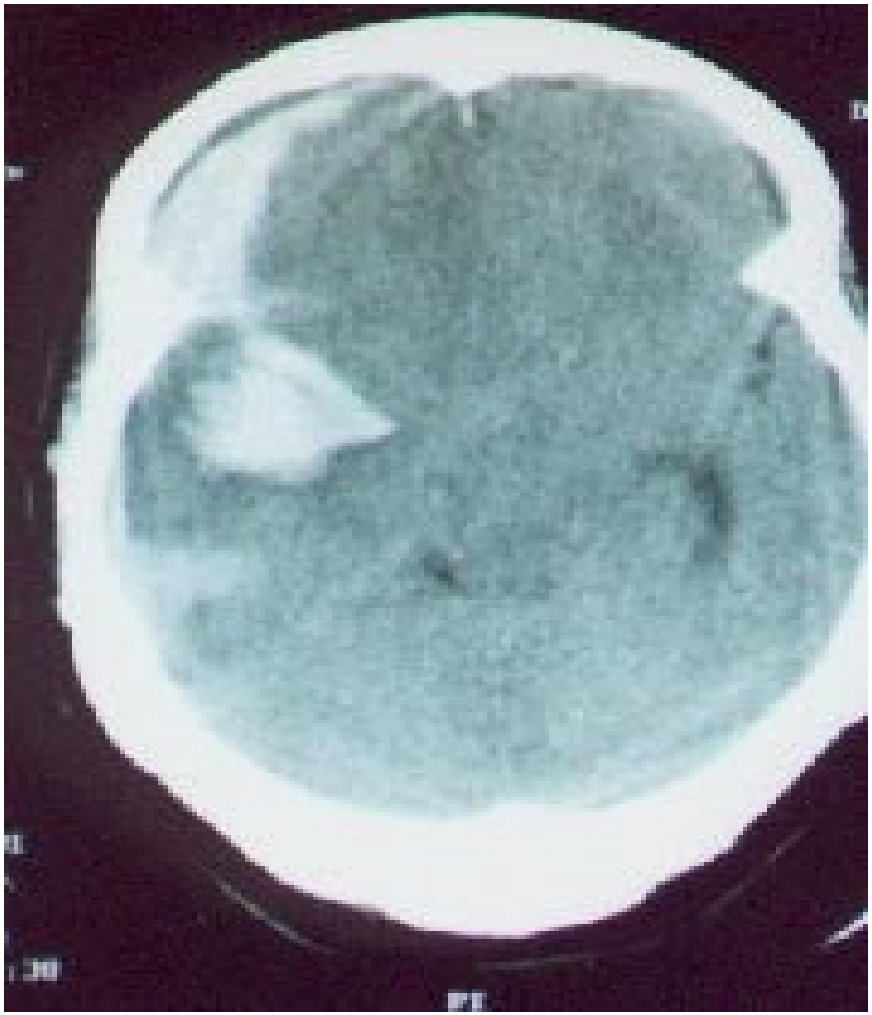
Grade 3 SAH



Grade 4 SAH


P
Pos 0.0
Sc2/4
Sc2/5
L
L
W 150
L 40
Pos 14.0
W 150
L 40
Pos 21.0
2
3
4
Sc2/7
Sc2/8
L
L
W 85
L 40
Pos 35.0
W 85
L 40
Pos 42.0
5
6

Acute aneurysmal SDH



Unruptured Aneurysm on CT



Spont. Vs. Traumatic SAH





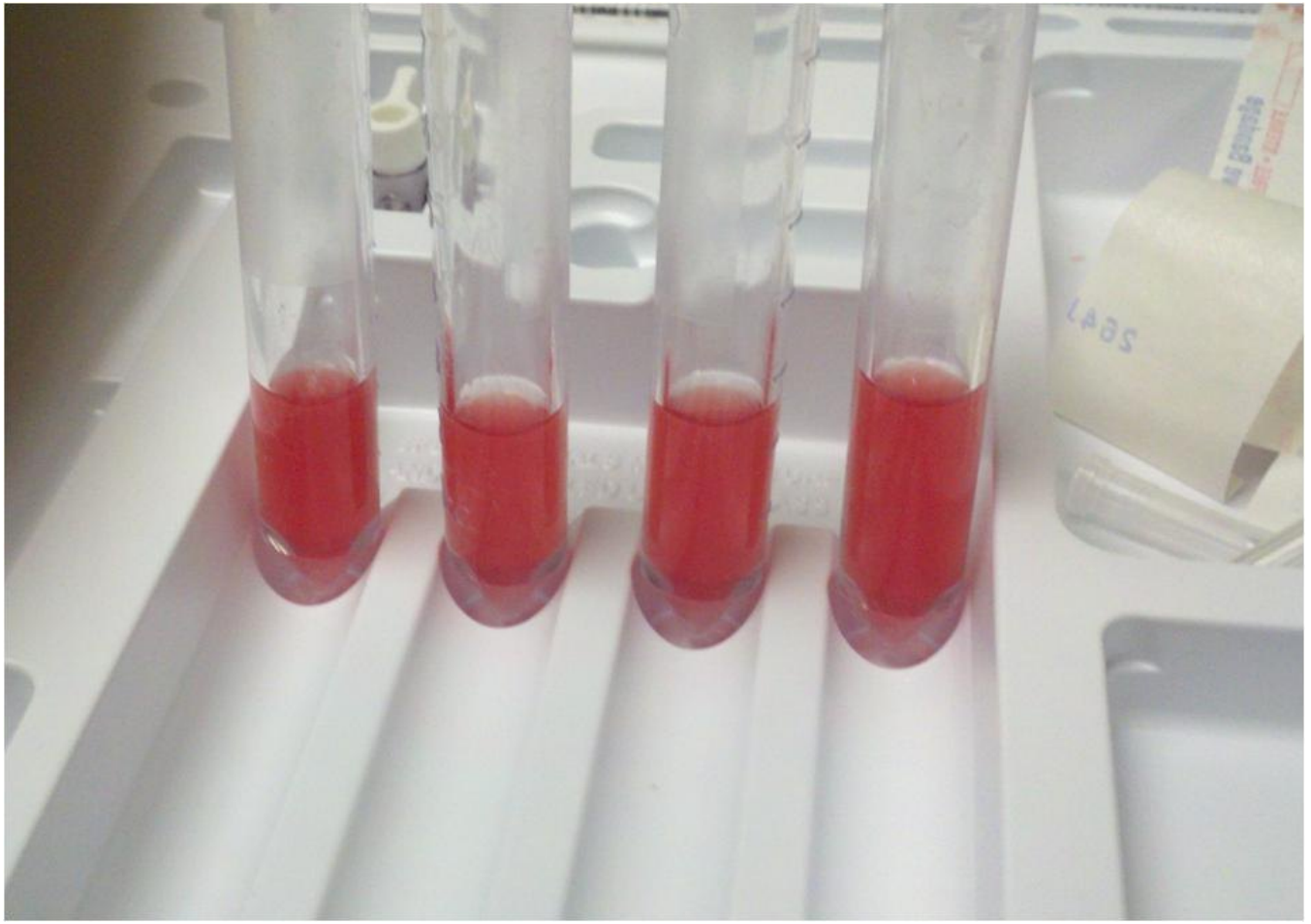
LP

- Performed if (-) CT
- Negative within 2 hours of the ictus, and LP is most sensitive 12 hours after the bleed.
- The most sensitive test
- Invasive & false (+) results may occur
- Lowering CSF pressure may cause rebleed!, so (small amount, small needle <20 Ga)

LP (Findings)

- High opening pressure
- Appearance:
  - Nonclotting, not clearing bloody fluid
  - Xanthochromia (> 6 hrs-2/52)
  - Spectrophotometry
- RBC > 100,000/mm3
- Protin high, Glucose normal or low

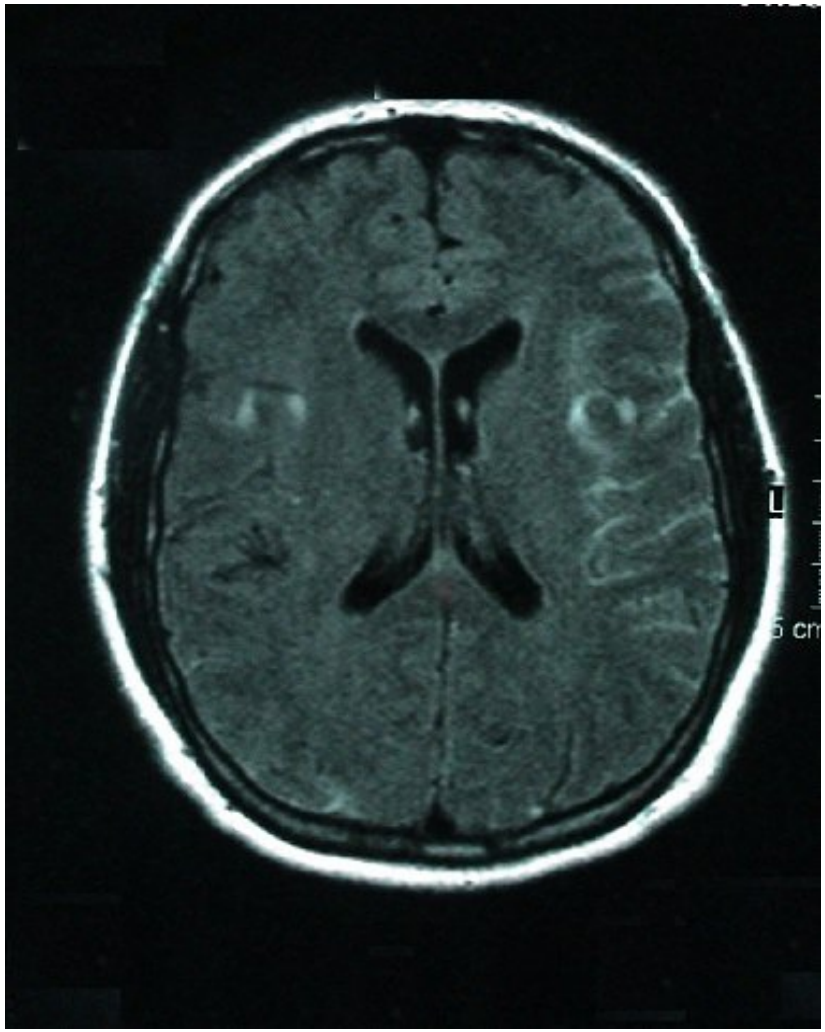
Nonclotting not clearing bloody fluid

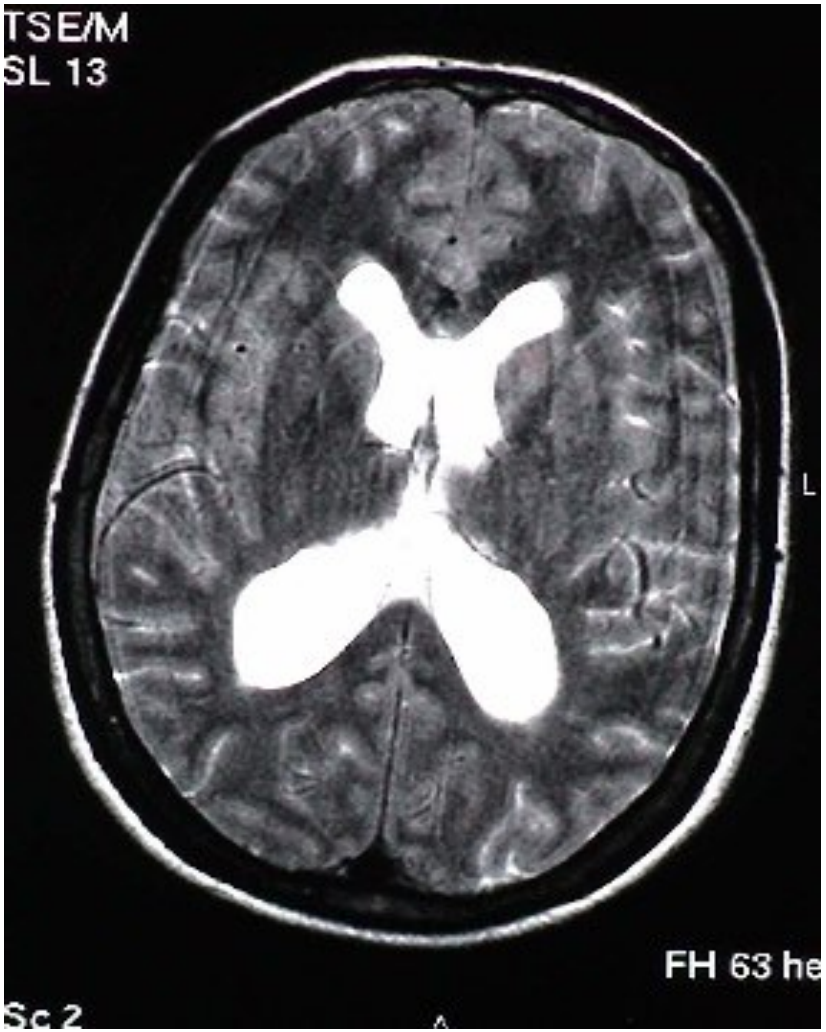


MRI

Stage	Time	Hb	T1WI	T2WI
Hyperacute	0-2 hrs	Intracell. Oxy-Hb	Low	High
Acute	2 hrs – 5 days	Intracell. Deoxy-Hb	Low	Low
Early subacute	5-10 days	Intracell. Met-Hb	High	Low
Late subacute	10-20 days	Free Met-Hb	High	High
Chronic	months	Haemosiderin, Ferritin	low	Low

SAH on MRI





Investigations to differentiate the etiology of SAH

Search for aneurysm!

- Cerebral angiogram (DSA)
- MRA
- CTA
- MRI (for AVM)

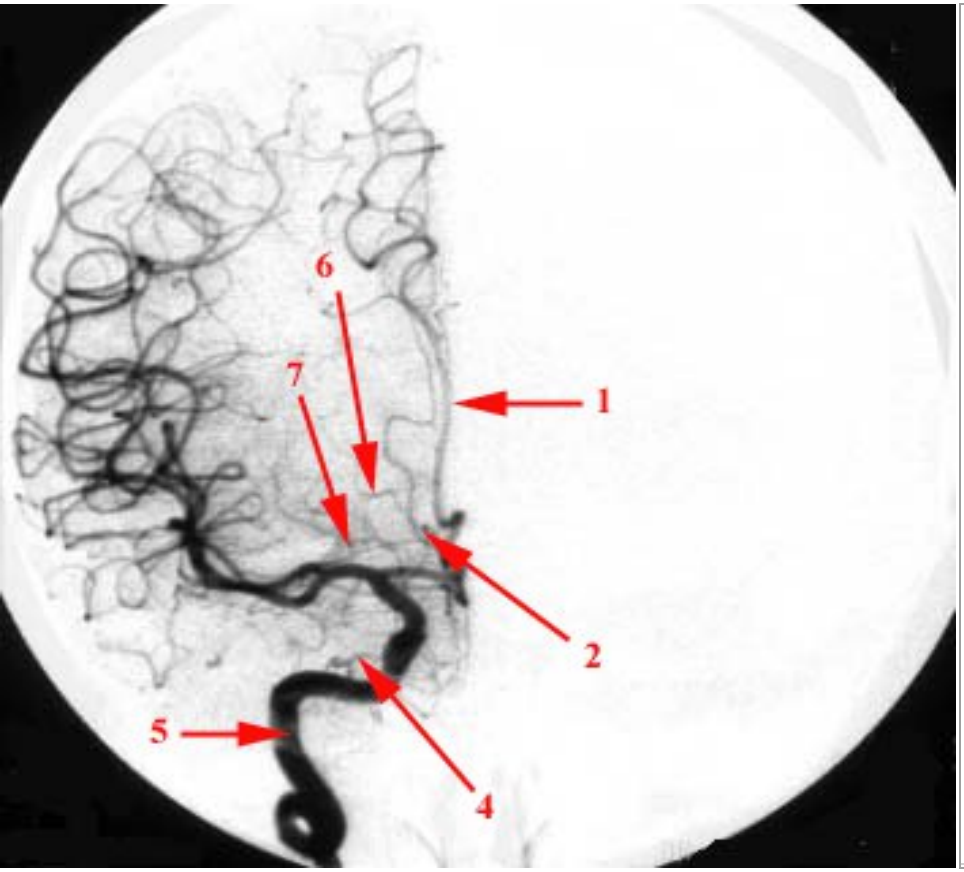
DSA

- The gold standard
- Sensitivity 85%
- Detect radiographic vasospasm
- Study the vessel with highest suspicion 1st
- Complete 4 vessel angiography
- Must see: Both PICA, Flow through AcoA

Cerebral Angio provides

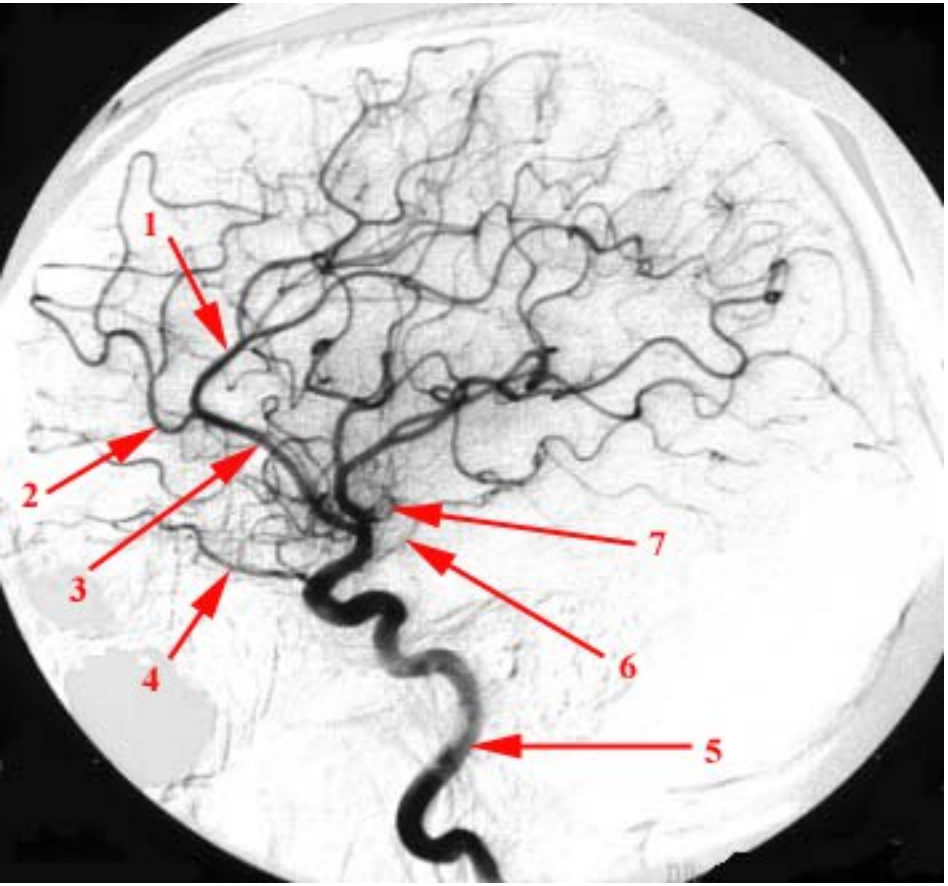
- Cerebrovascular anatomy
- Aneurysm location and source of bleeding
- Aneurysm size and shape, as well as orientation of the aneurysm dome and neck
- Relation of the aneurysm to the parent artery and perforating arteries
- Presence of multiple or mirror aneurysms

Carotid angiogram
A-P view



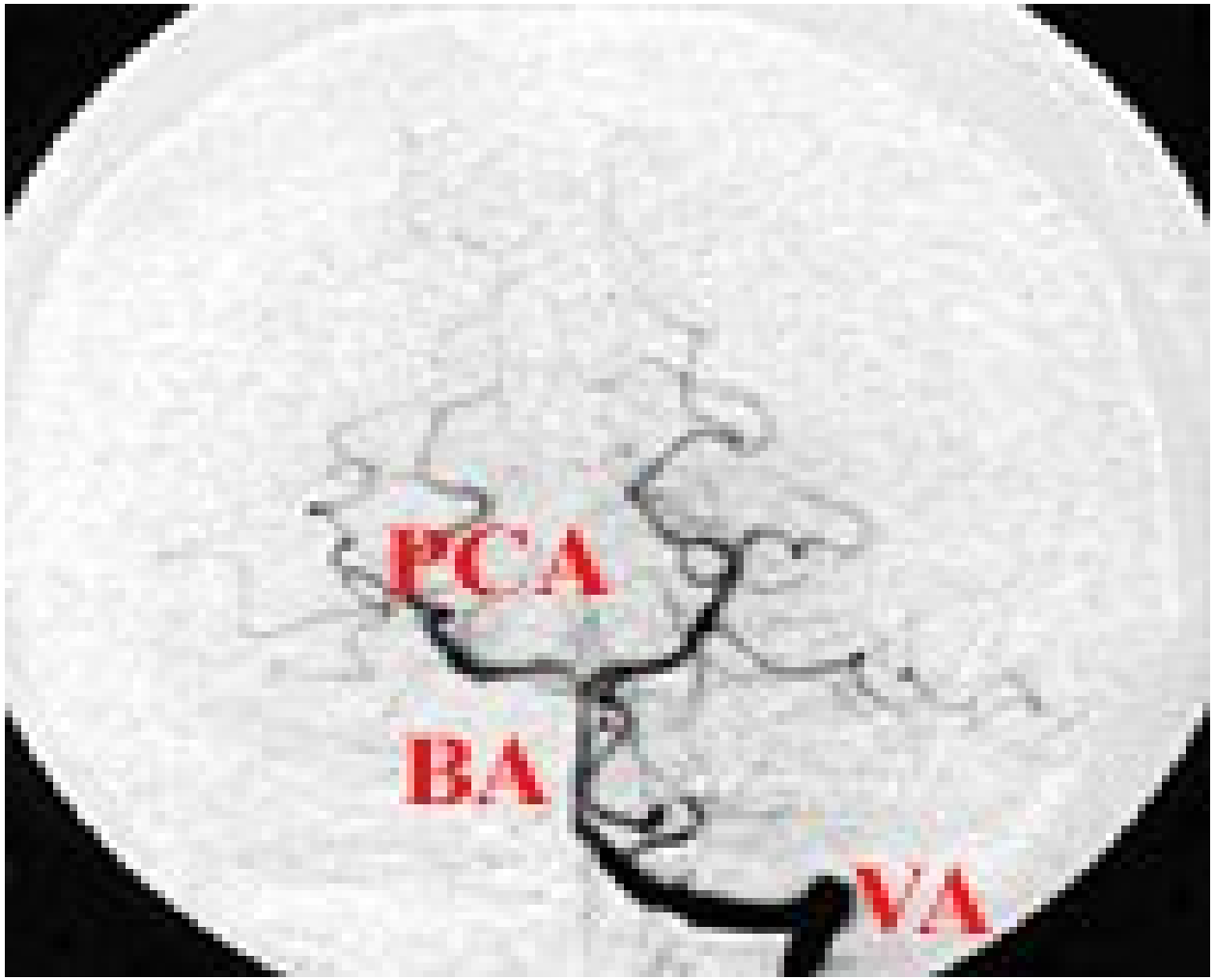
- 1. Pericallosal artery
- 2. Callosomarginal artery
- 3. Anterior cerebral artery
- 4. Ophthalmic artery
- 5. Internal carotid artery
- 6. Anterior choroidal artery
- 7. Lenticulostrate arteries

Carotid angiogram
Lateral View

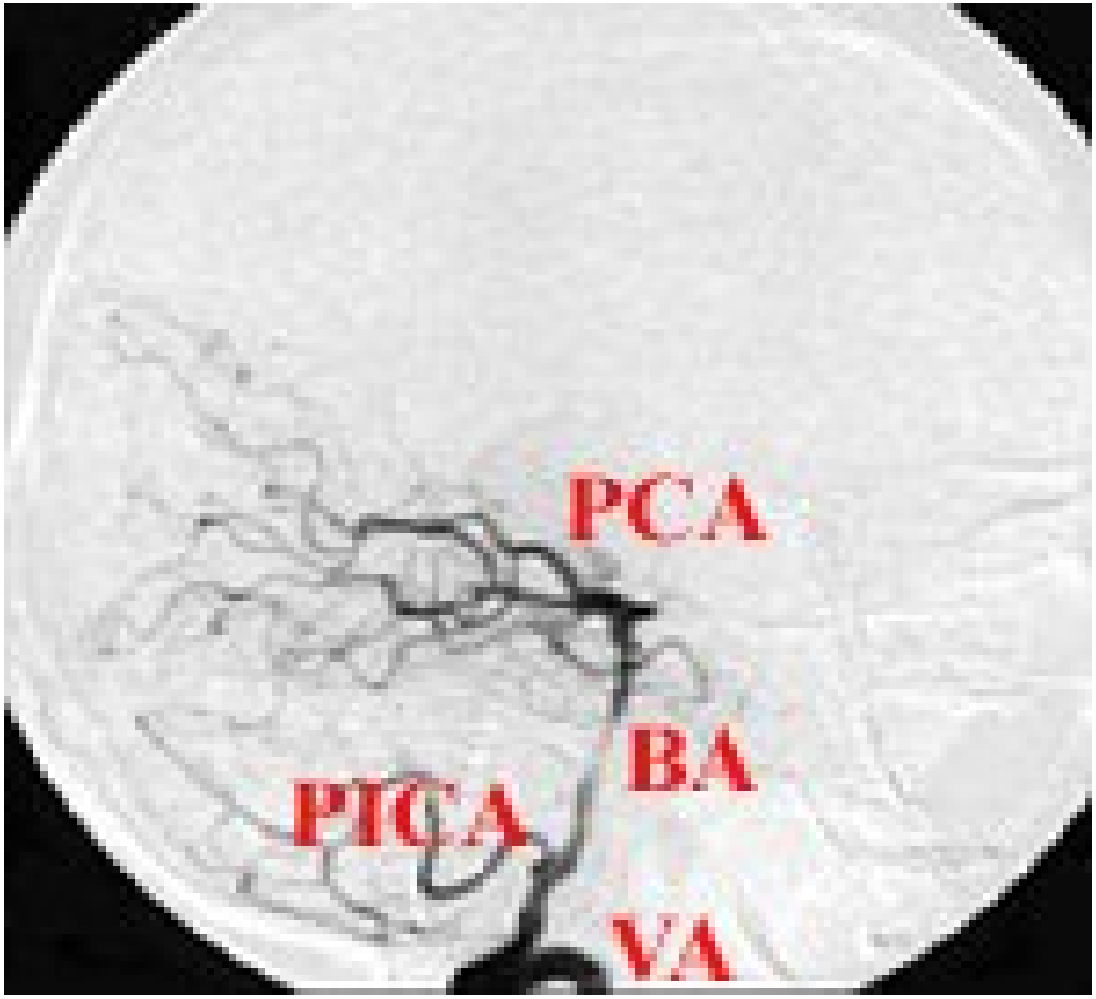


- 1. Pericallosal artery
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- 5. Internal carotid artery
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- 7. Lenticulostrate arteries

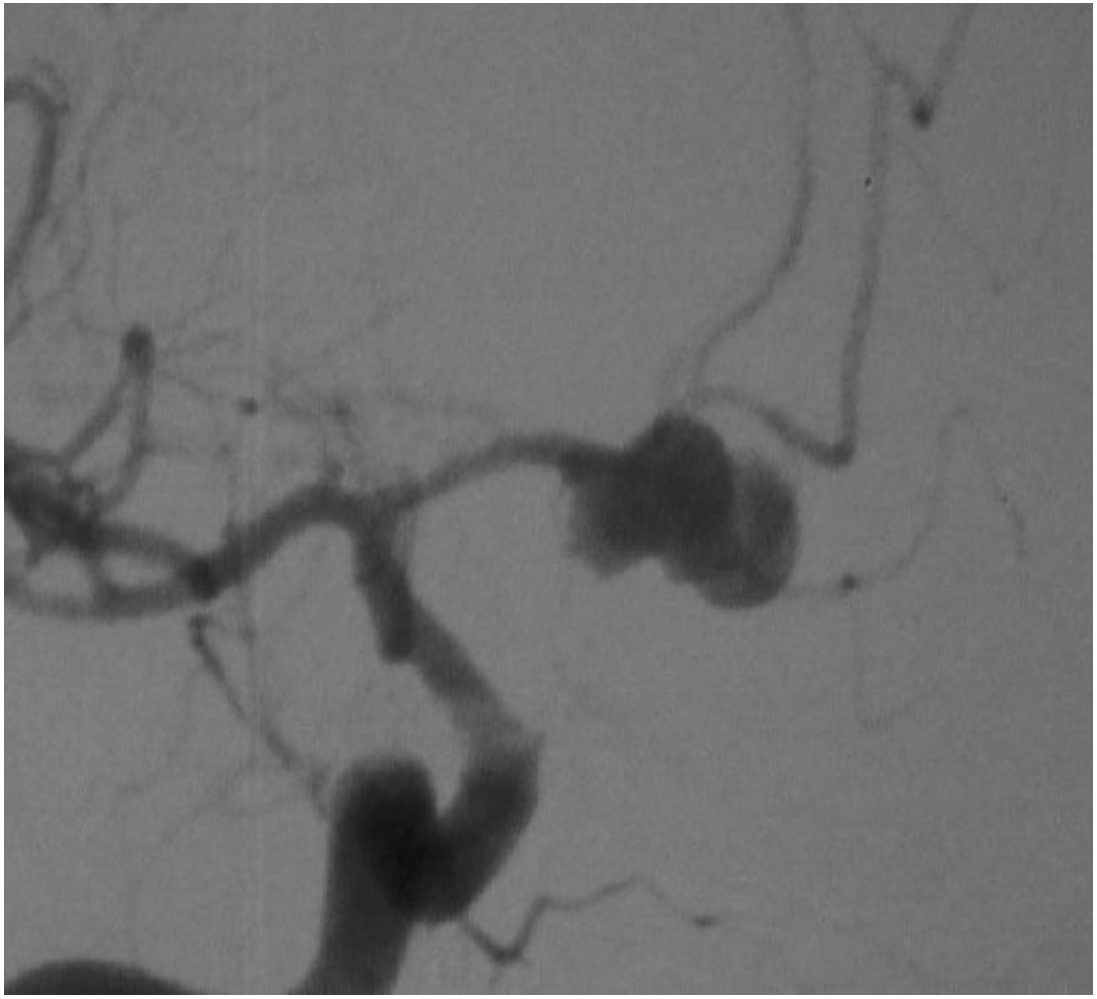
Vertebral angiogram
A-P view



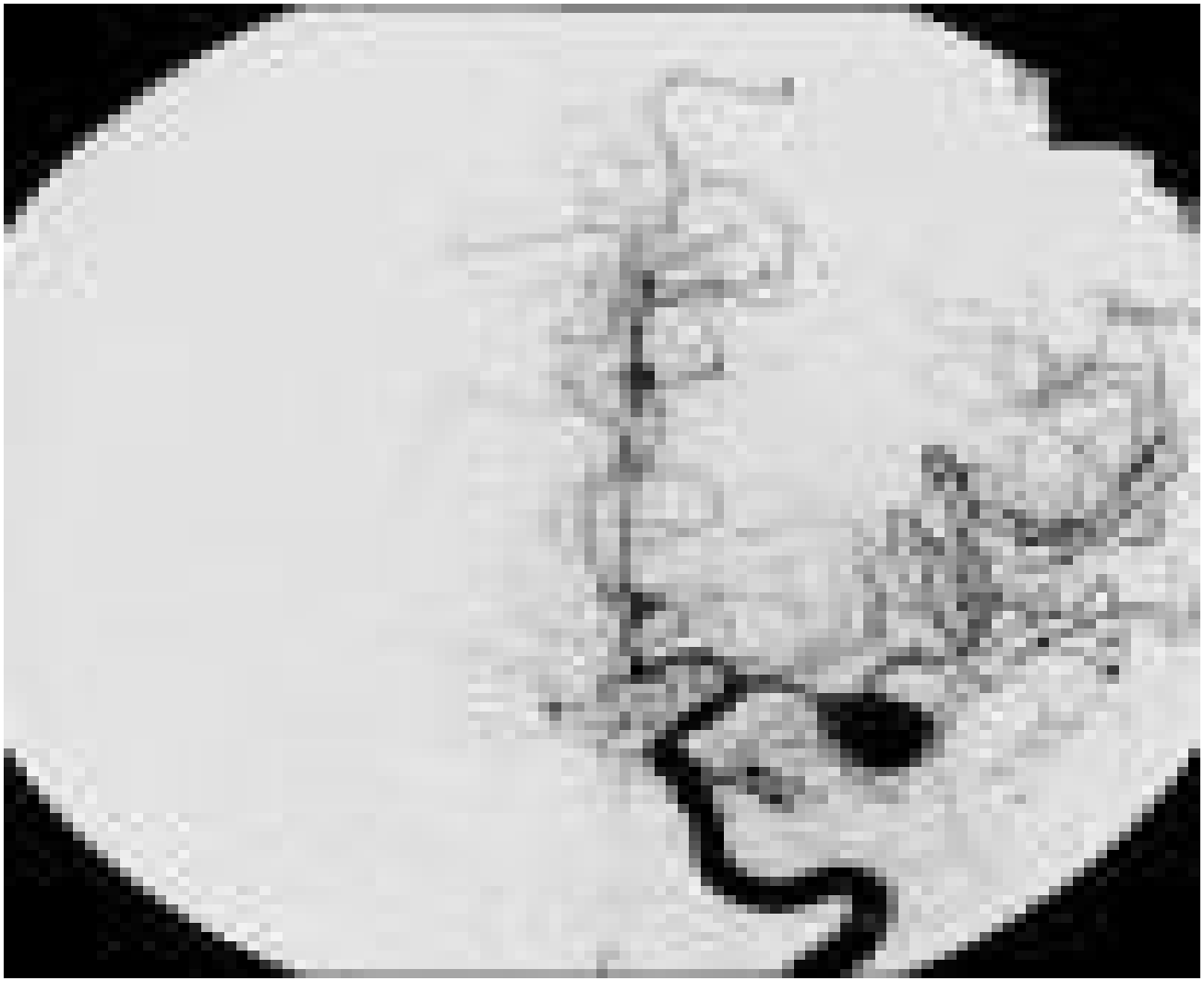
Vertebral angiogram
Lateral View



A-comm Aneurysm



MCA Aneurysm



P-comm Aneurysm



DACA aneurysms(2) + AVM



Basilar tip aneurysm

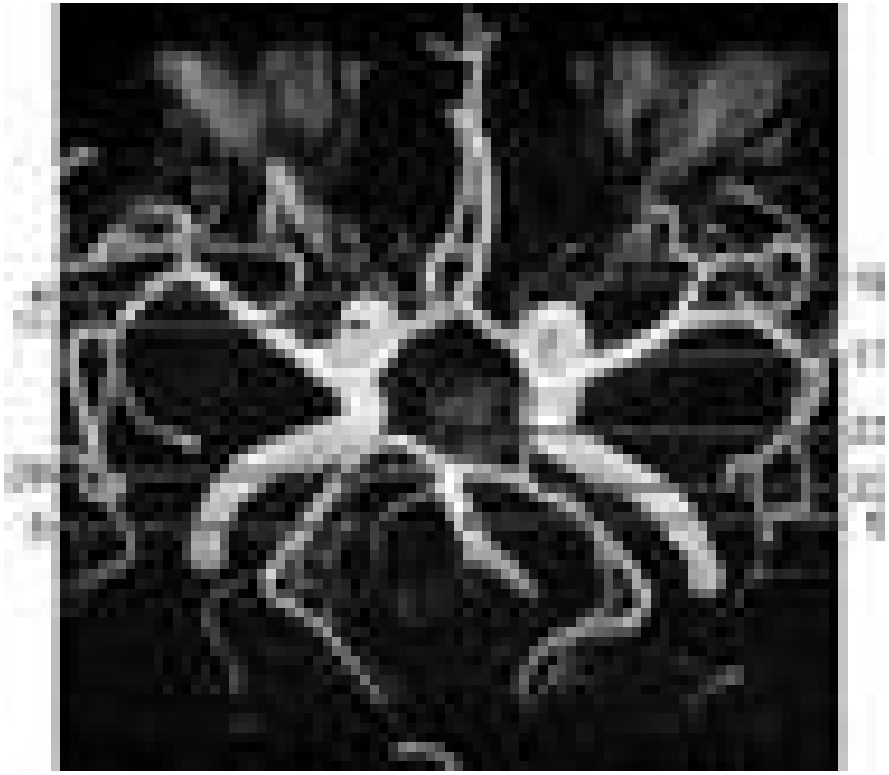


MRA

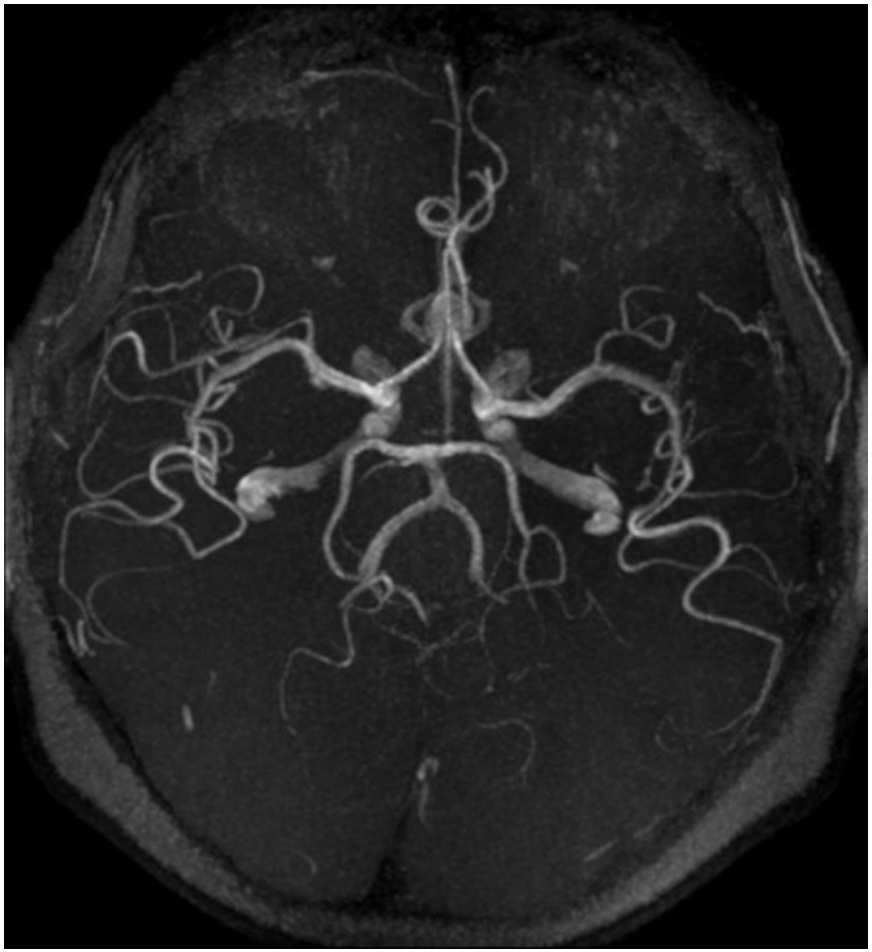
- Experience is evolving
- Sensitivity 86% - 95% (> 3mm diameter)
- False (+) 16%
- Useful as a screening test
- Provide more information than DSA about aneurysm shape & size of the neck.
- Limitation: Failure to detect PICA

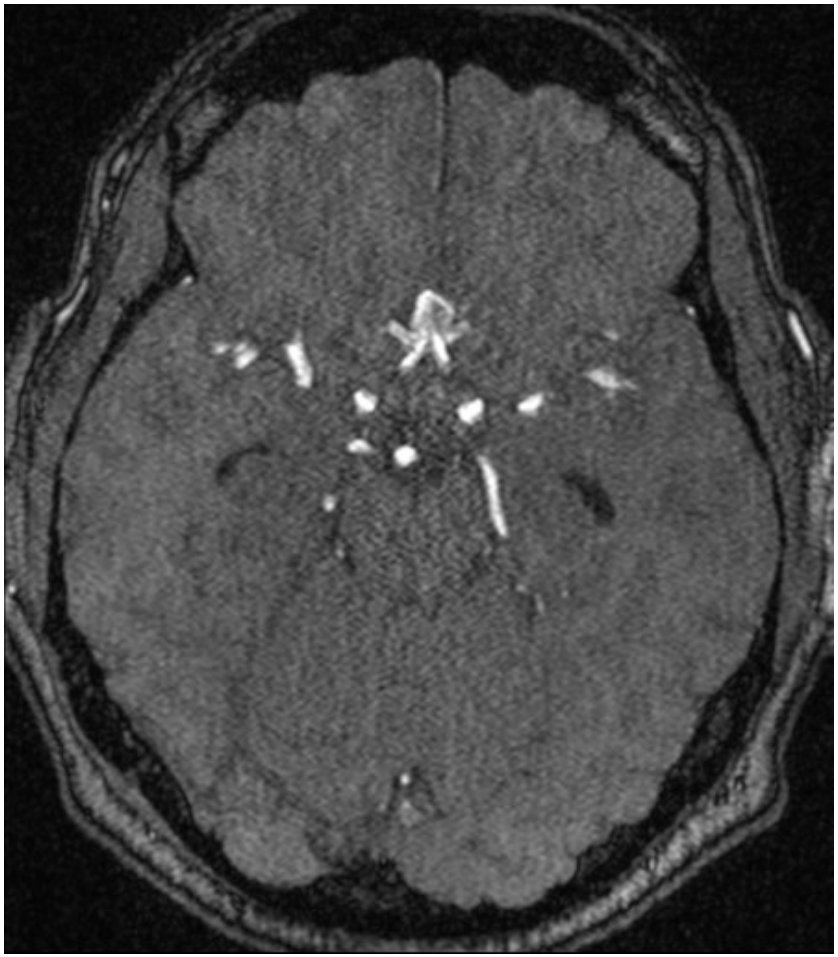
MRA





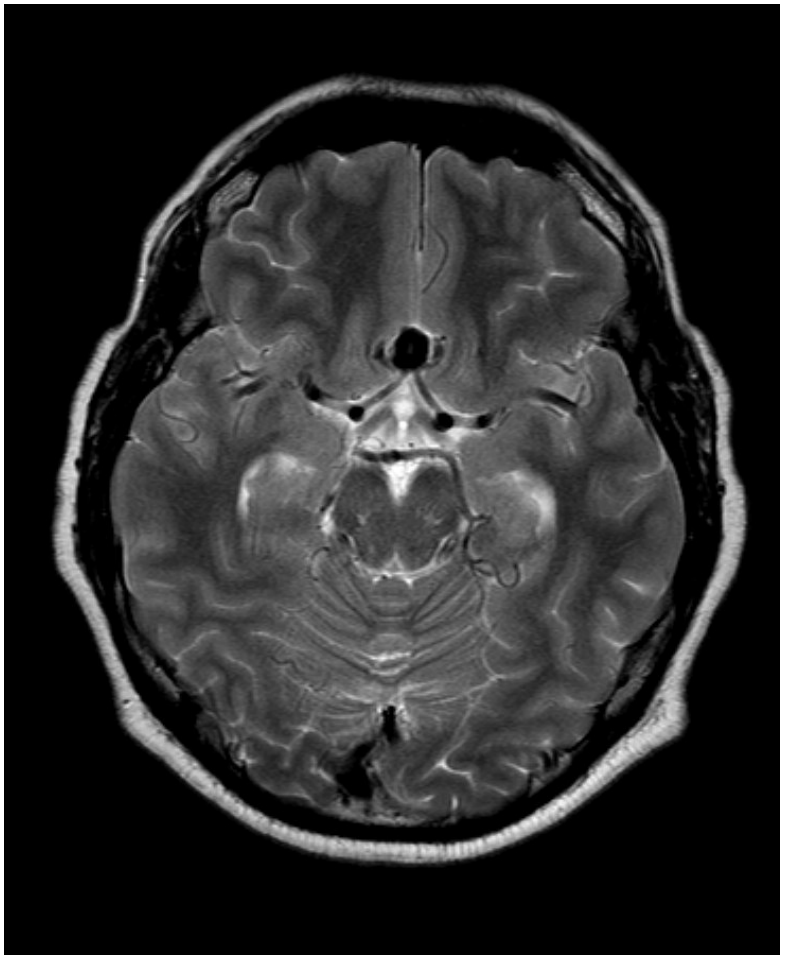
MRA





MRI



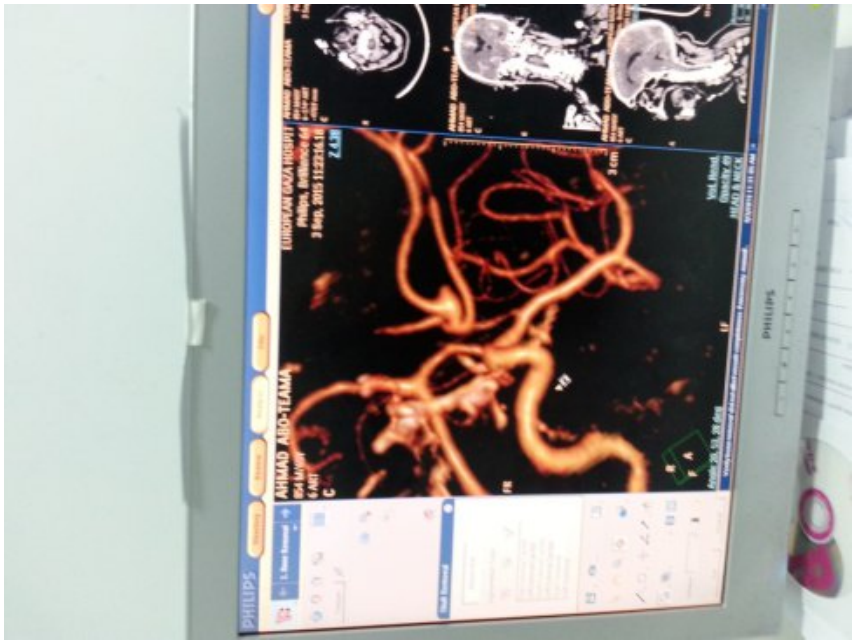


CTA

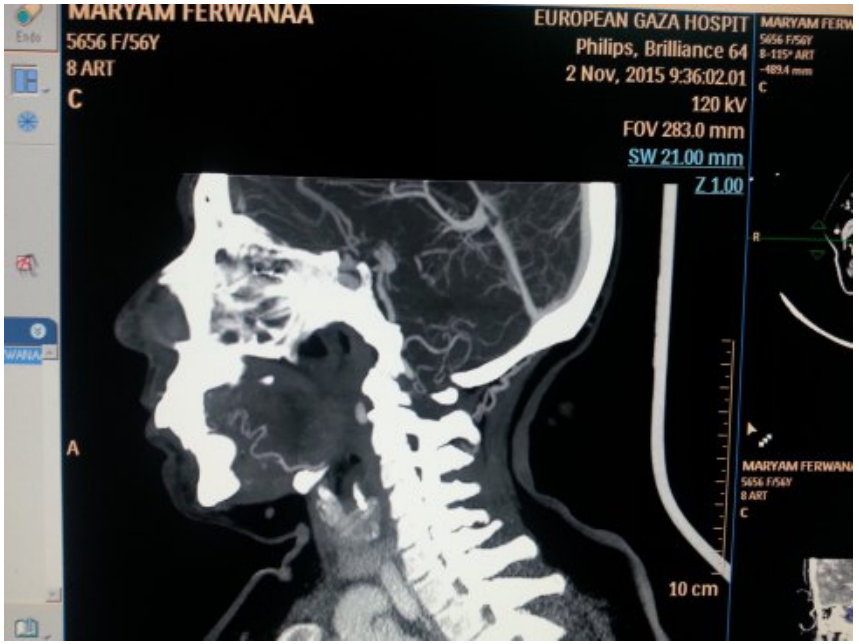
- Sensitivity 95%, specificity 83%
- Detect aneurysm small as 2.2 mm
- Advantages: (3-D, 4-D); relation to bony structures
- Provide more information than DSA about aneurysm shape & size of the neck.
- The best for screening!

CTA

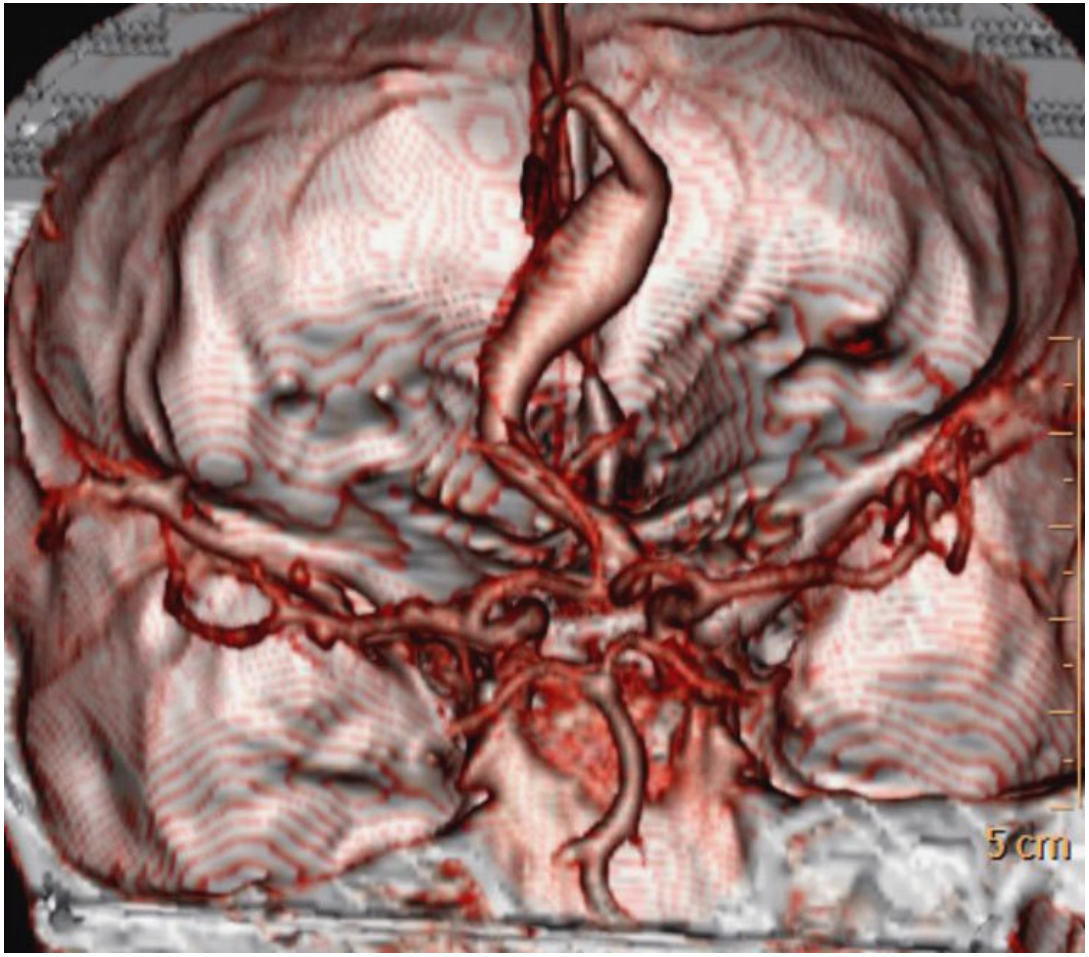
Acom aneurysm



Basilar tip aneurysm

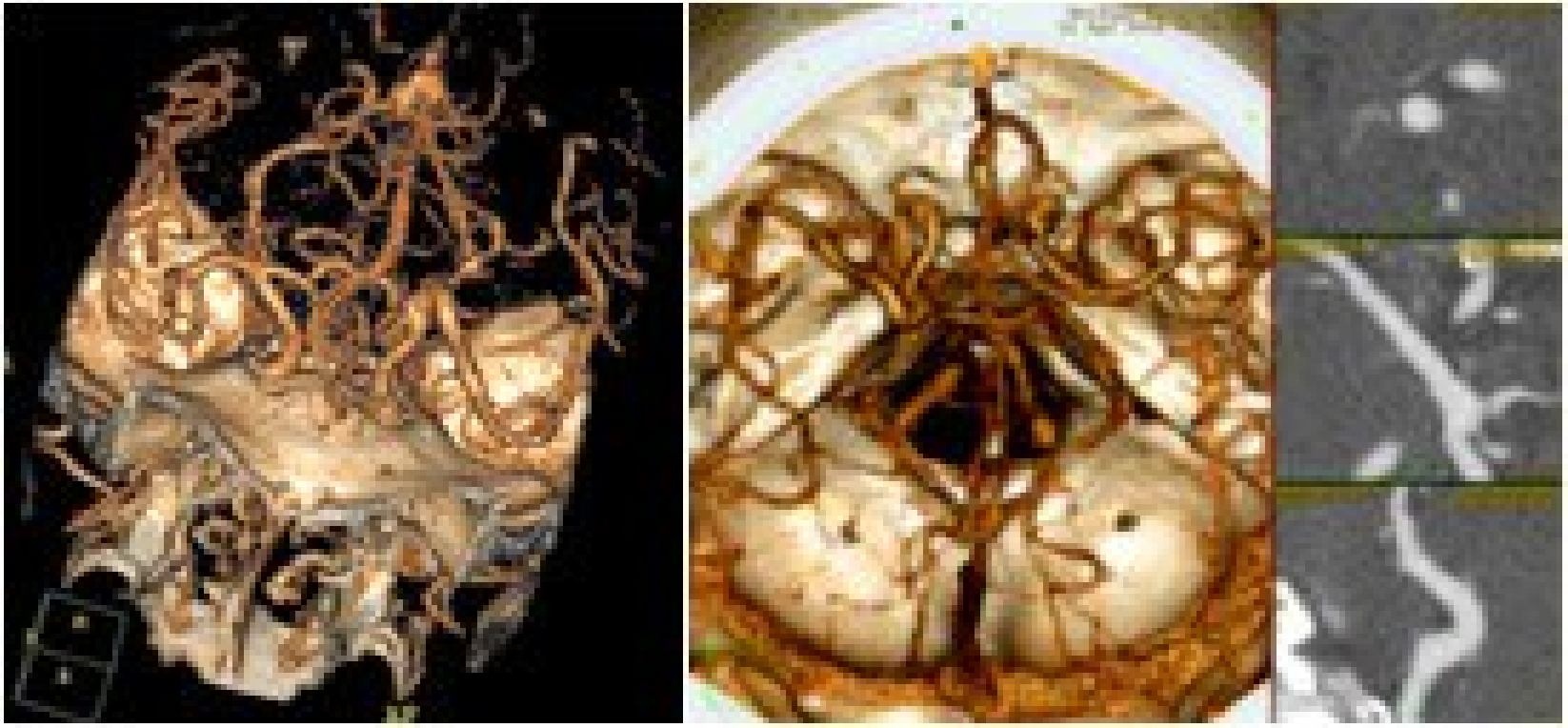


CTA
Fusiform aneurysm of ACA



4D Cerebral CT angiography

(assess cerebral aneurysm hemodynamics)



SAH of Unknown Etiology or Angiogram-negative SAH

Causes of missed aneurysms:

- Inadequate angiography
- Obliterated aneurysm
- Thrombosed aneurysm
- Small aneurysm
- Vasospasm

SAH of Unknown Etiology or Angiogram-negative SAH

What to do?

- Repeat angio after 2/52
- CT is helpful in decision to repeat
- Don’t repeat for classical pretruncal SAH or if no blood on CT
- MRI, MRA, CTA
- Rule out spinal AVM!

SAH of Unknown Etiology or Angiogram-negative SAH

Investigations for other causes!

- PT, PTT
- Sickle-cell screen
- Toxicology screen (cocaine)
- Tissue plasminogen activator
- Check for vasculitis

Investigations during the management of SAH

Laboratory:

- CBC
- Serum electrolytes (Na+!!)
- PT, APTT
- Blood type and screen
- Cardiac enzymes
- ABG

SIADH & CSW

Parameter	SIADH	CSW
Bp	Norm	Low, norm
HR	Slow, norm	Tachy, norm
Ht	Norm, low	Elevated
GFR	Increased	Decreased
Urea & Cr	Norm, low	Norm, high
Urine Na excr.	Norm	High

SIADH & CSW

Parameter	SIADH	CSW
Urine vol.	Norm, low	Norm, high
Urine Na conc.	High	High
Blood vol.	Increased, norm	Decreased
Hydration	Well hydrated	Decreased
Body wt.	Norm, increased	Decreased
Day of app-ce	8^{th} day	$4\text{-}5^{th}$ day

Investigations during the management of SAH

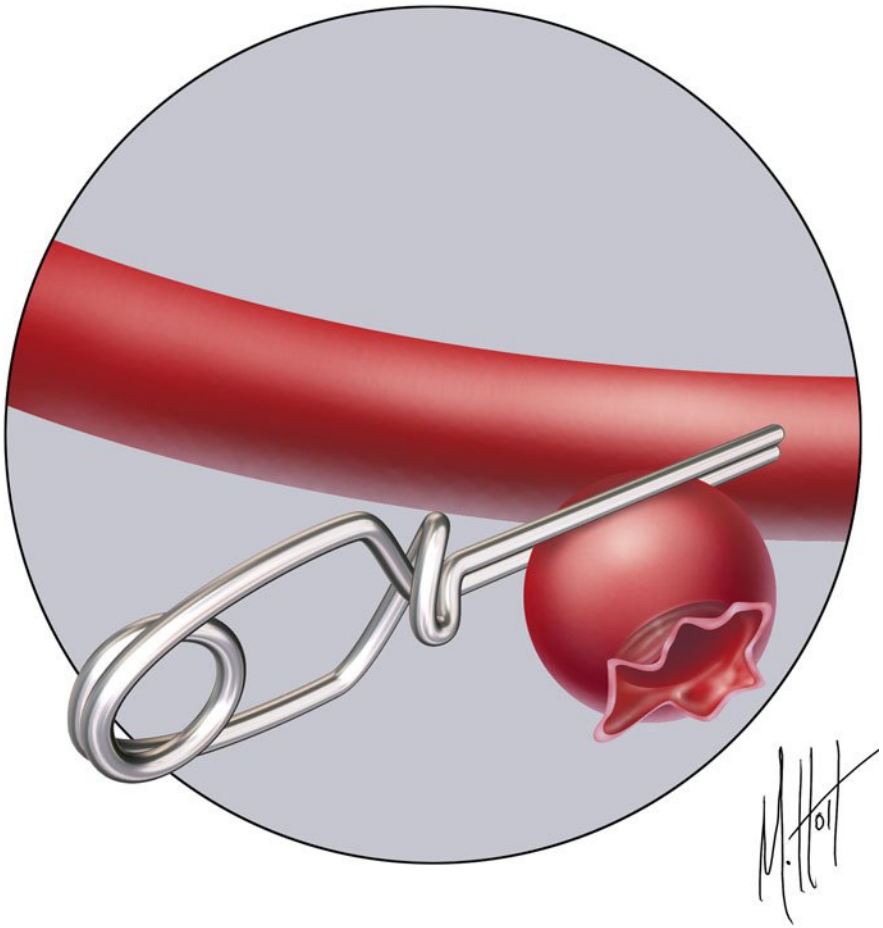
Radiological:

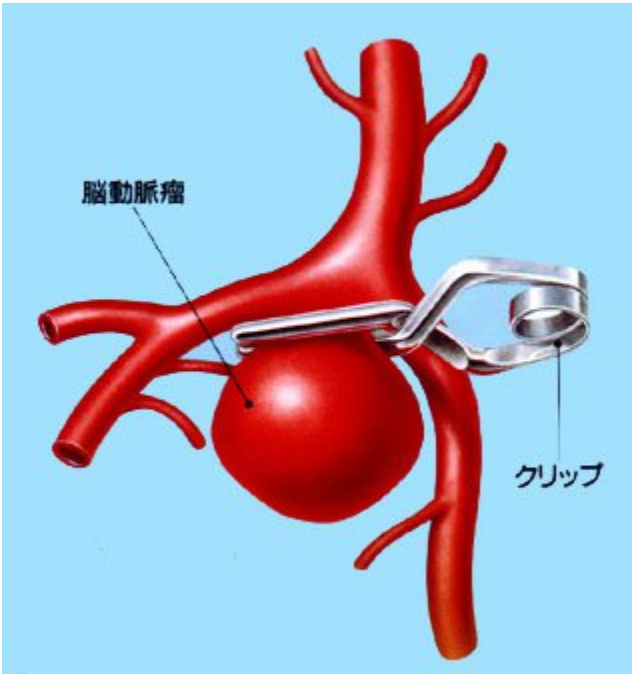
- CT follow up (HCP, Rebleeding)
- Transcranial Doppler studies – vasospasm!
- Chest radiograph: as a baseline!
- Echocardiogram: myocardial ischemia!

Treatment options for aneurysms

- Surgical clipping: the gold standard
- Endovascular coiling

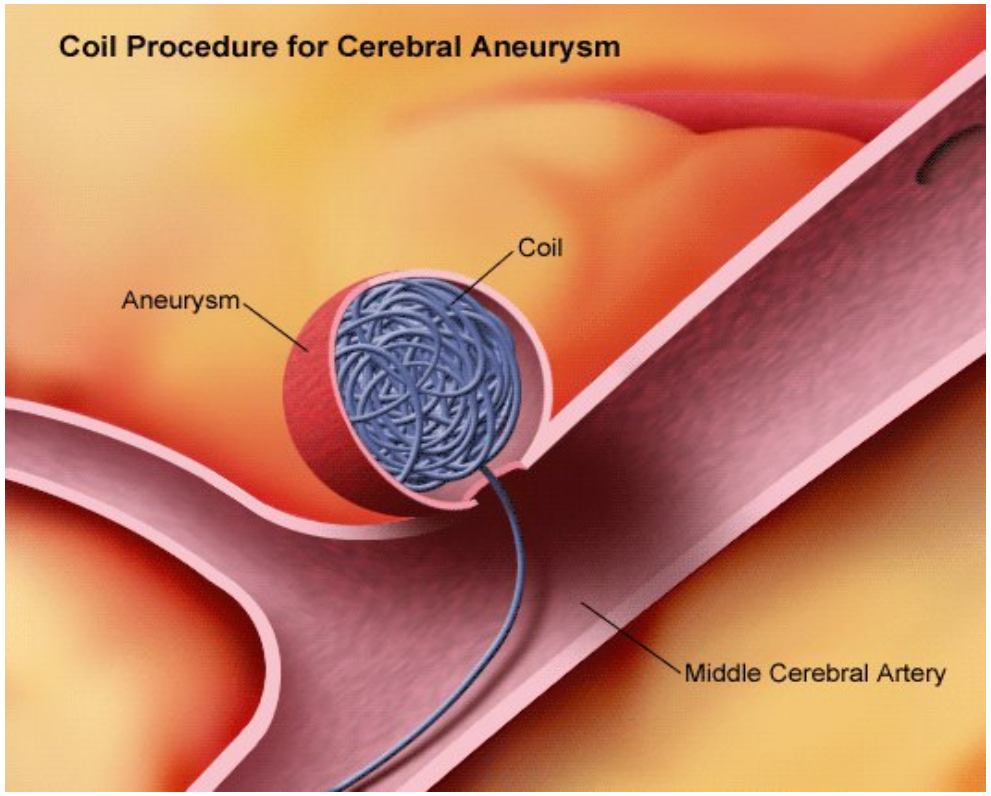
Clipping





Coiling




Coil Procedure for Cerebral Aneurysm
Coil
Aneurysm
Middle Cerebral Artery

Thanks



Any Questions?