CURRENT TREATMENT FOR CEREBRAL ANEURYSMS
TCD AND VASOSPASM SAH

Michigan Sonographers Society
2Nd Annual Fall Vascular Conference

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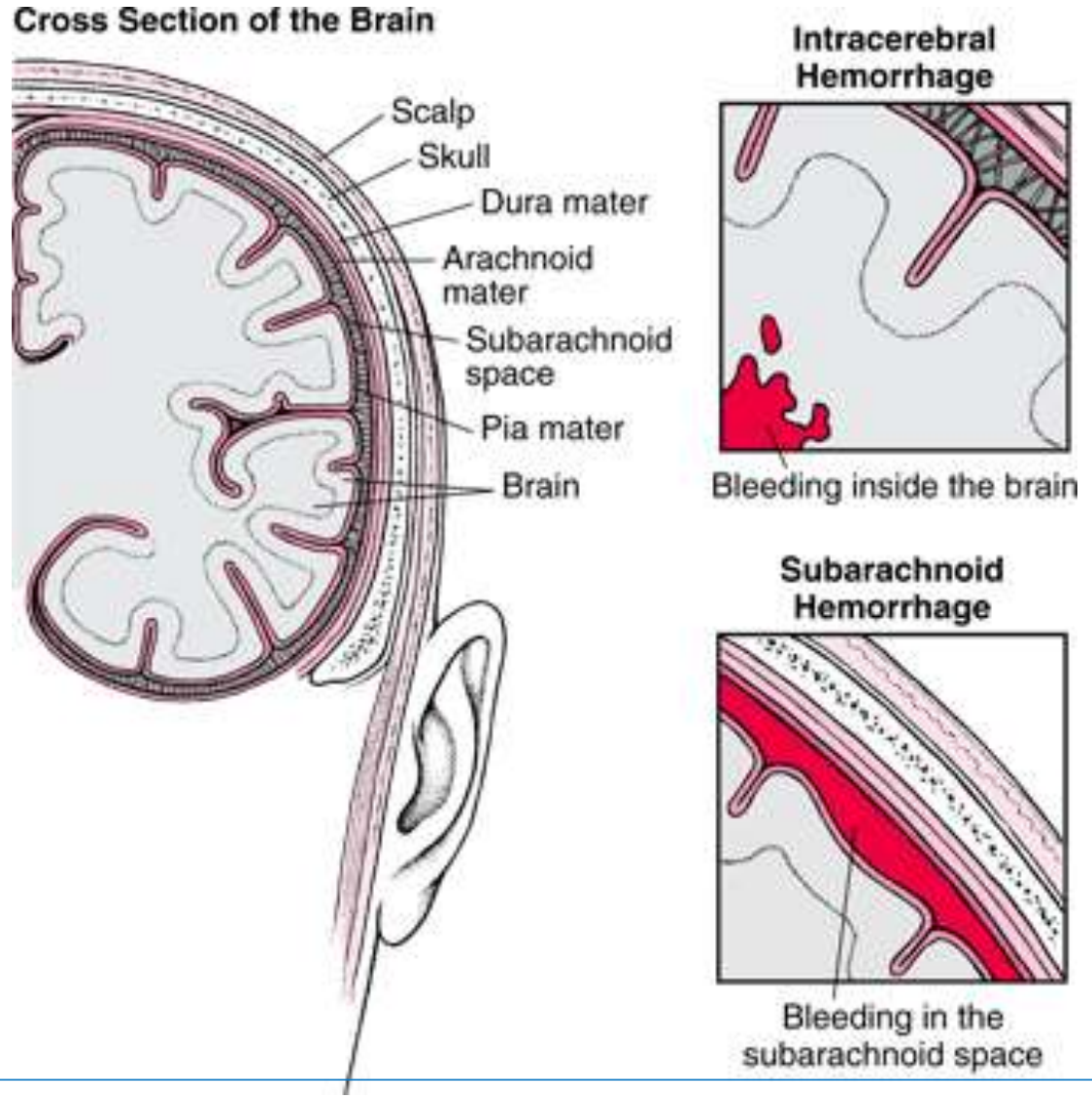
SUBARACHNOID HEMORRHAGE

Subarachnoid Hemorrhage

- Ruptured aneurysm – 77%
- AVM's that bleed
- Vascular tumors
- Head trauma (Skull fractures, gunshots)
- Unknown etiology

Anatomy

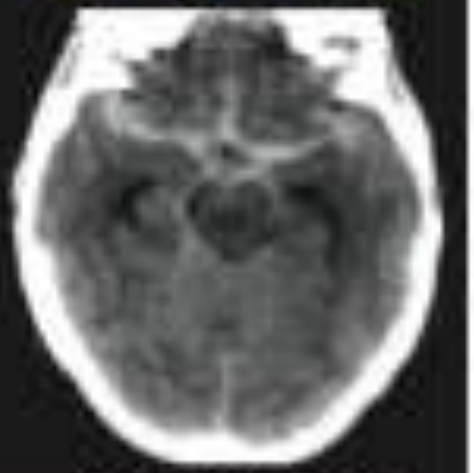
What is SAH?



Stroke CT Evaluation

- Infarction (88%)
- Hemorrhage (12%)

Parenchymal



Subarachnoid

Thrombo-embolic

Hypertensive

Aneurysmal

SAH Symptoms

- Sudden onset of severe headache
- Popping or snapping sensation in the head
- Nausea and vomiting
- Stiff neck
- Loss of vision
- Seizures

Imaging

- CTA
- MRI
- ANGIO

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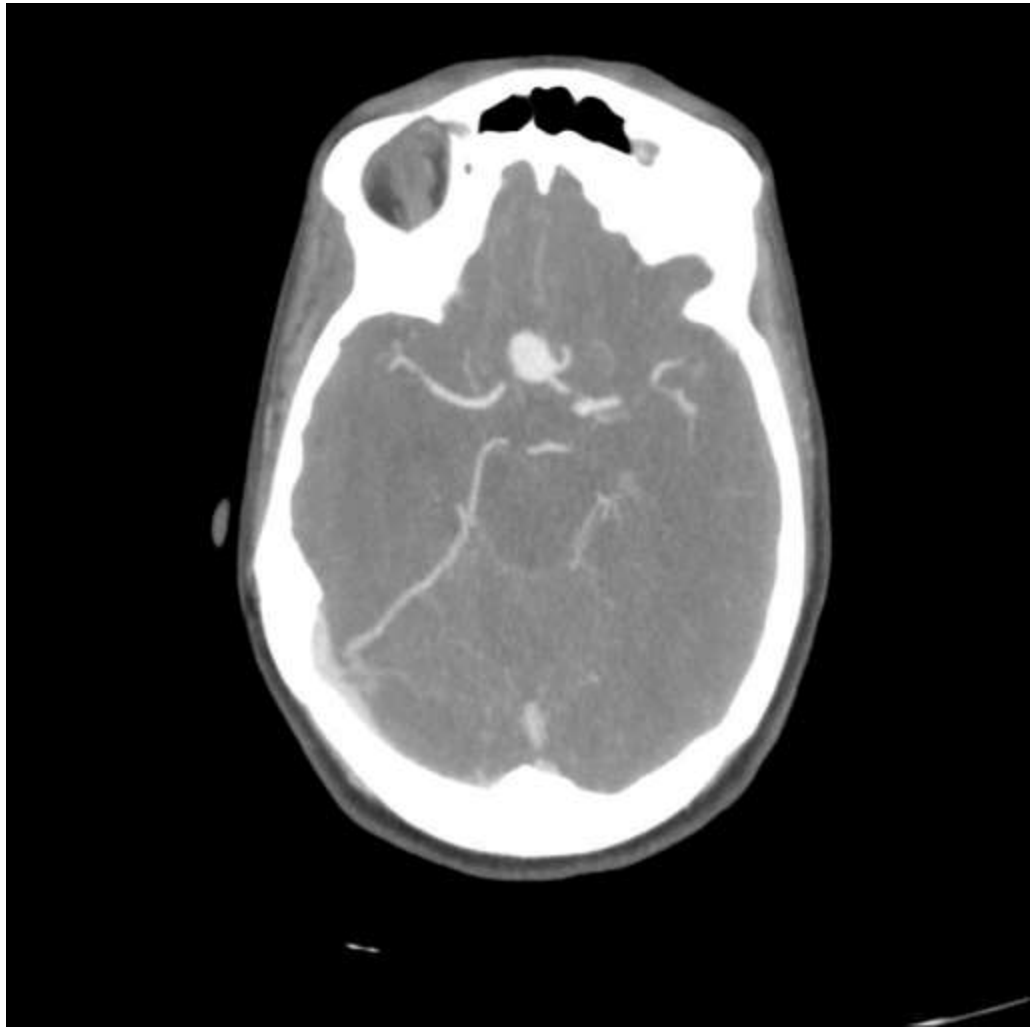
Imaging

- Angiogram CTA
-

CT Angiogram



Rotational Angiogram

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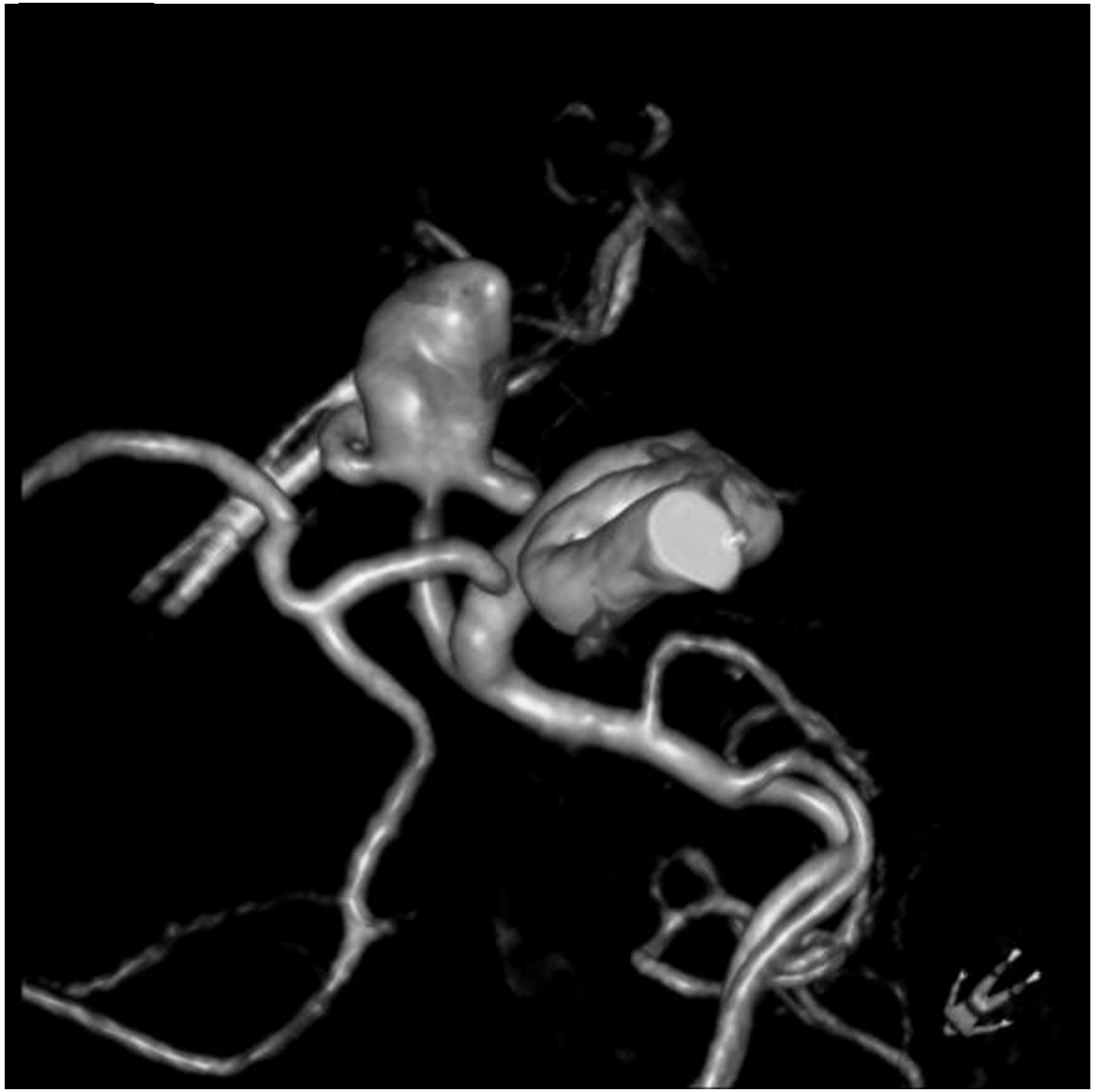
Rotational Angiogram



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Rotational Angiogram

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Subarachnoid Hemorrhage
Hunt-Hess Grading Scale

- Grade 1 - Alert, mild headache, stiff neck
- Grade 2 – Alert, vision problems, moderate to severe headache, stiff neck
- Grade 3 – Confusion, weakness or partial paralysis on one side of the body
- Grade 4 – Stupor, moderate to severe paralysis on one side of the body
- Grade 5 - Comatose

Subarachnoid Hemorrhage Survival Rates

- **Grade 1** - 75%
- **Grade 2** - 60%
- **Grade 3** - 50%
- **Grade 4** - 30%
- **Grade 5** - 10%

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Aneurysmal SAH

- ½ SAH from aneurysm rupture die before reaching hospital care
- Half of the survivors are left with persistent neurological deficit
- Average age of onset is 50 years
- More common in adults than in children

Natural History of Outcomes of SAH

- Median mortality rate of SAH in the US is 32% (does not usually account for the pre-hospital death)

Risk Factors

- Presence of unruptured cerebral aneurysm
  - -Symptomatic, larger size
- Hypertension
- Smoking
- ETOH abuse

Risk Factors

- Drug use (cocaine)
- Increase risk females
- Personal history of SAH
- Family history
    - at least 1 first degree family member, especially 2 or more

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Risk Factors

- With a history of HTN and smoking aneurysms will rupture when smaller
- Significant life event in the past month may increase the chance of SAH
- Size matters! Aneurysm >7mm is an independent risk factor for aneurysm rupture and SAH

Risk Factors

- Aneurysm growth is a risk factor of SAH
  - Aneurysms >8mm have been shown to grow frequently when followed by MRI.
- Aneurysm morphology
- Ratio of the size of the aneurysm to the parent vessel

Treatment of Cerebral Aneurysms

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Treatment

- Depends on many factors
  - Size
  - Location
  - Anatomy
  - Age
  - Medical co-morbidities

Treatment

- 3 Main Options
- Conservative management (unruptured aneurysms)
- Surgery – Clipping
- Endovascular
    - -Coil
    - -Stent
    - -Flow diverter

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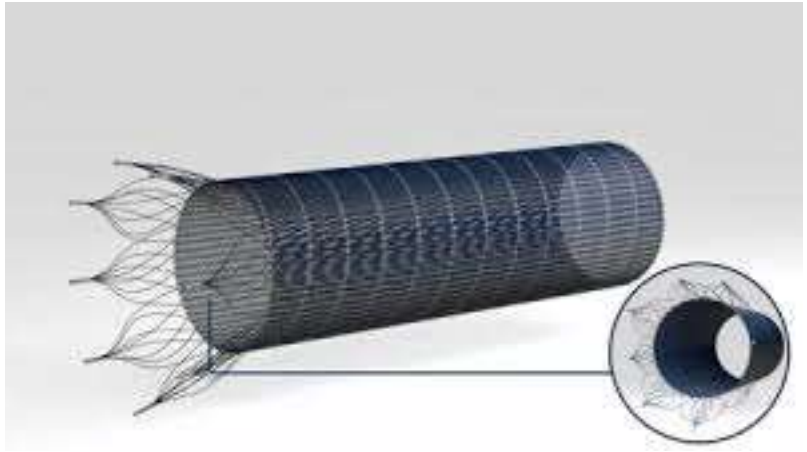
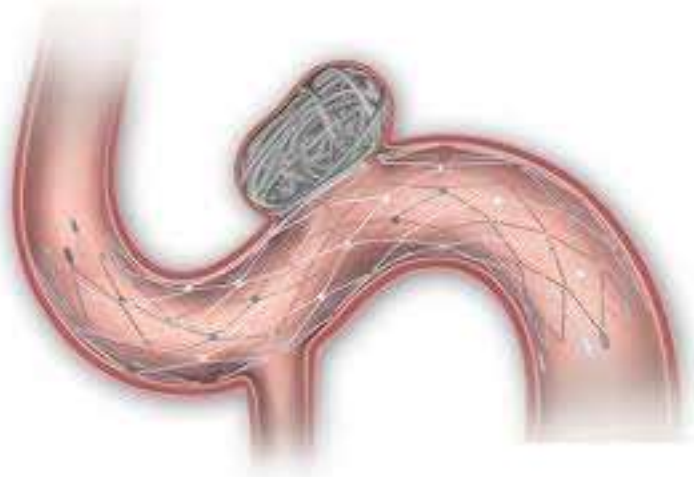
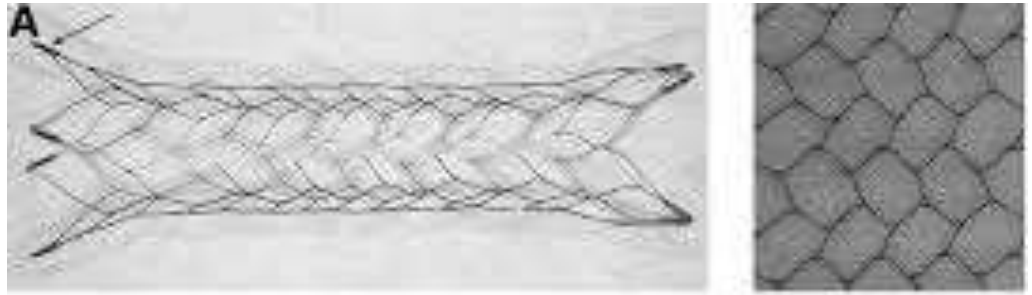
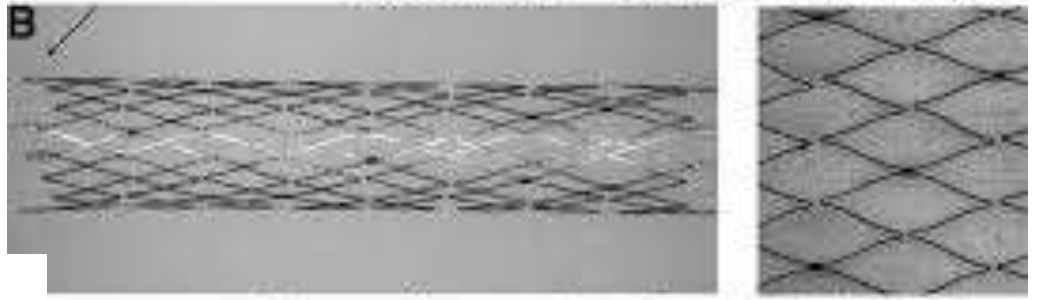
Flow Diverters



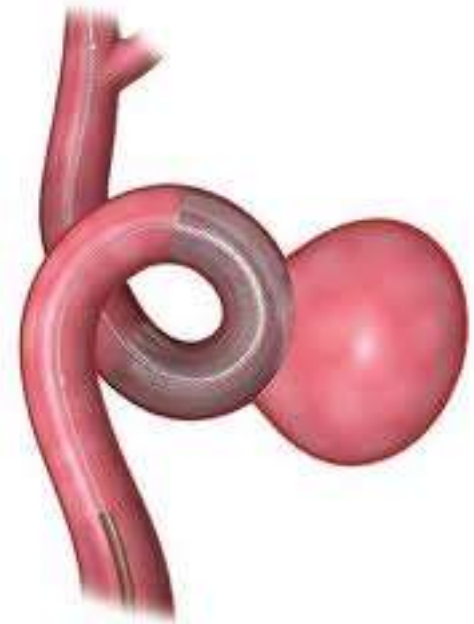


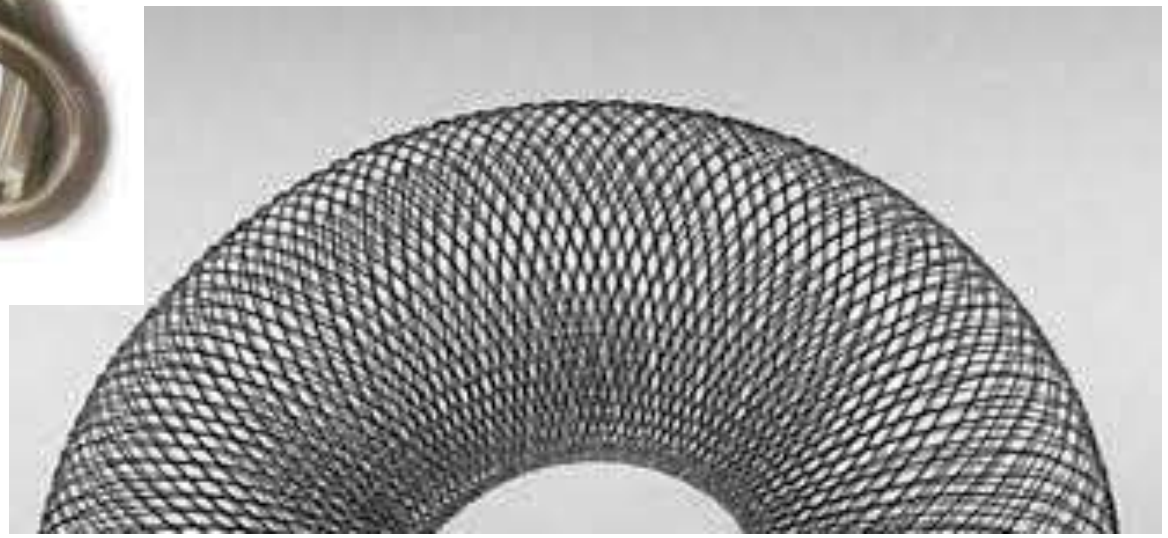


Enterprise - Closed Cell Design



Neuroform - Semi-open Cell Design





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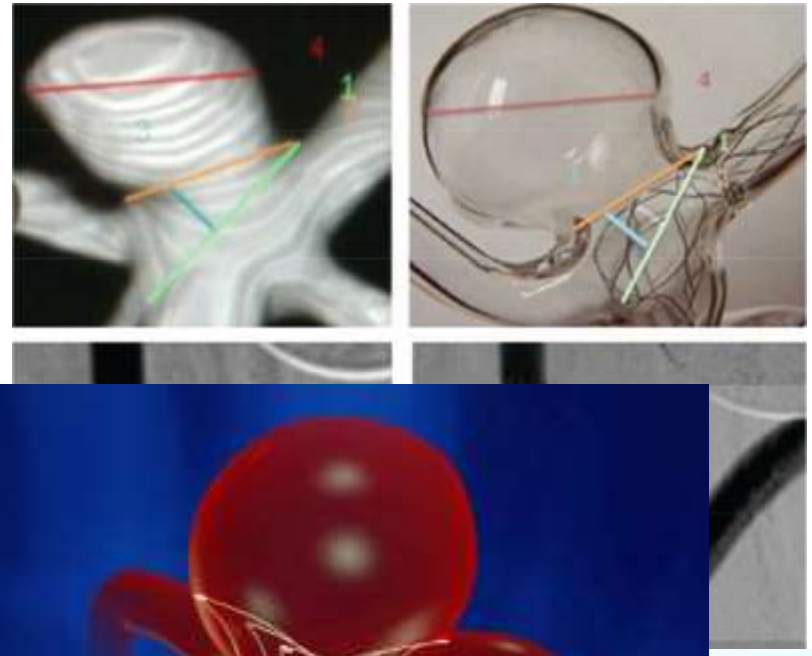
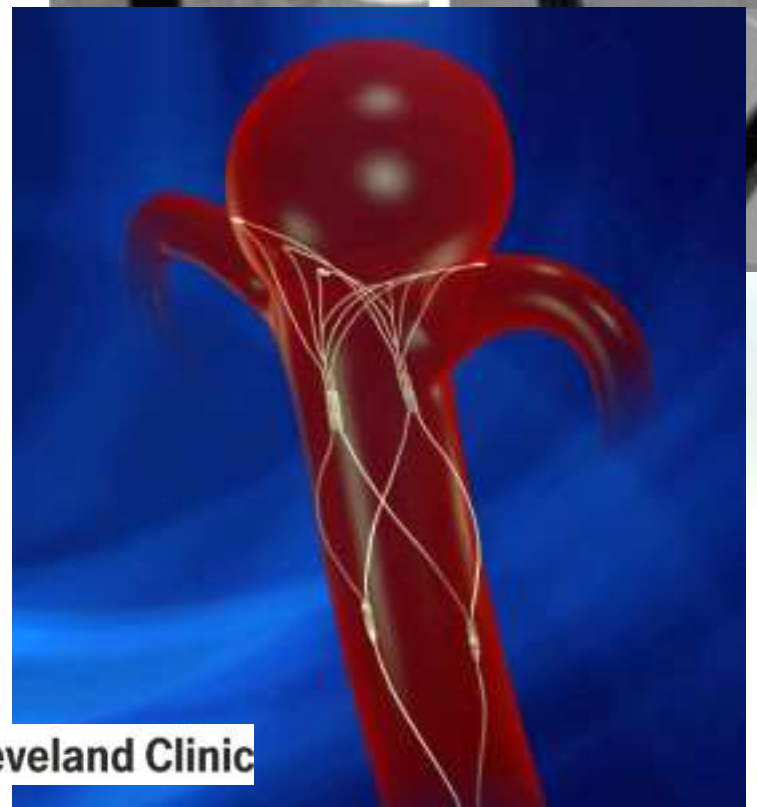
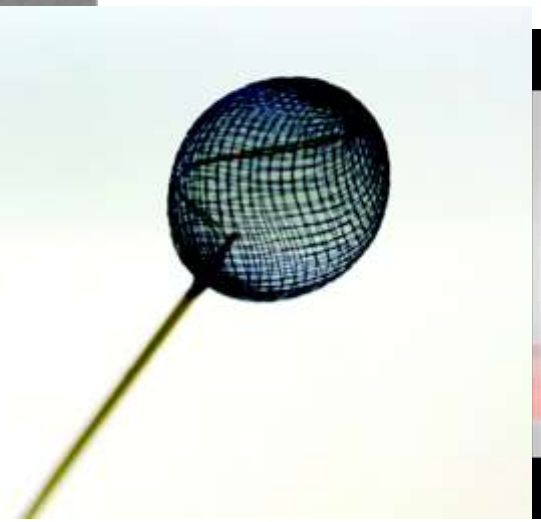
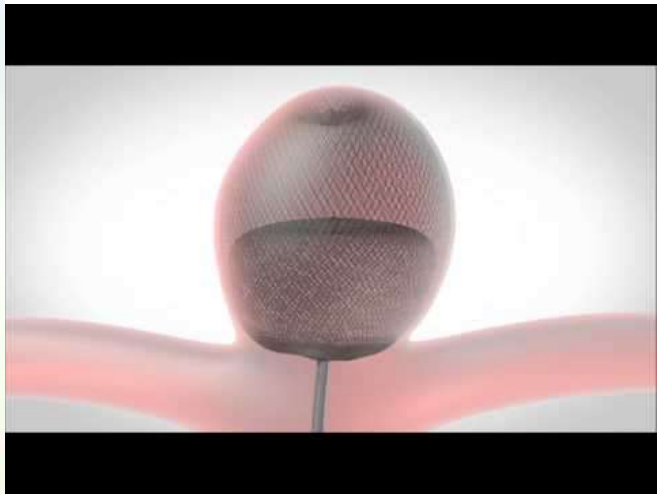
New Devices



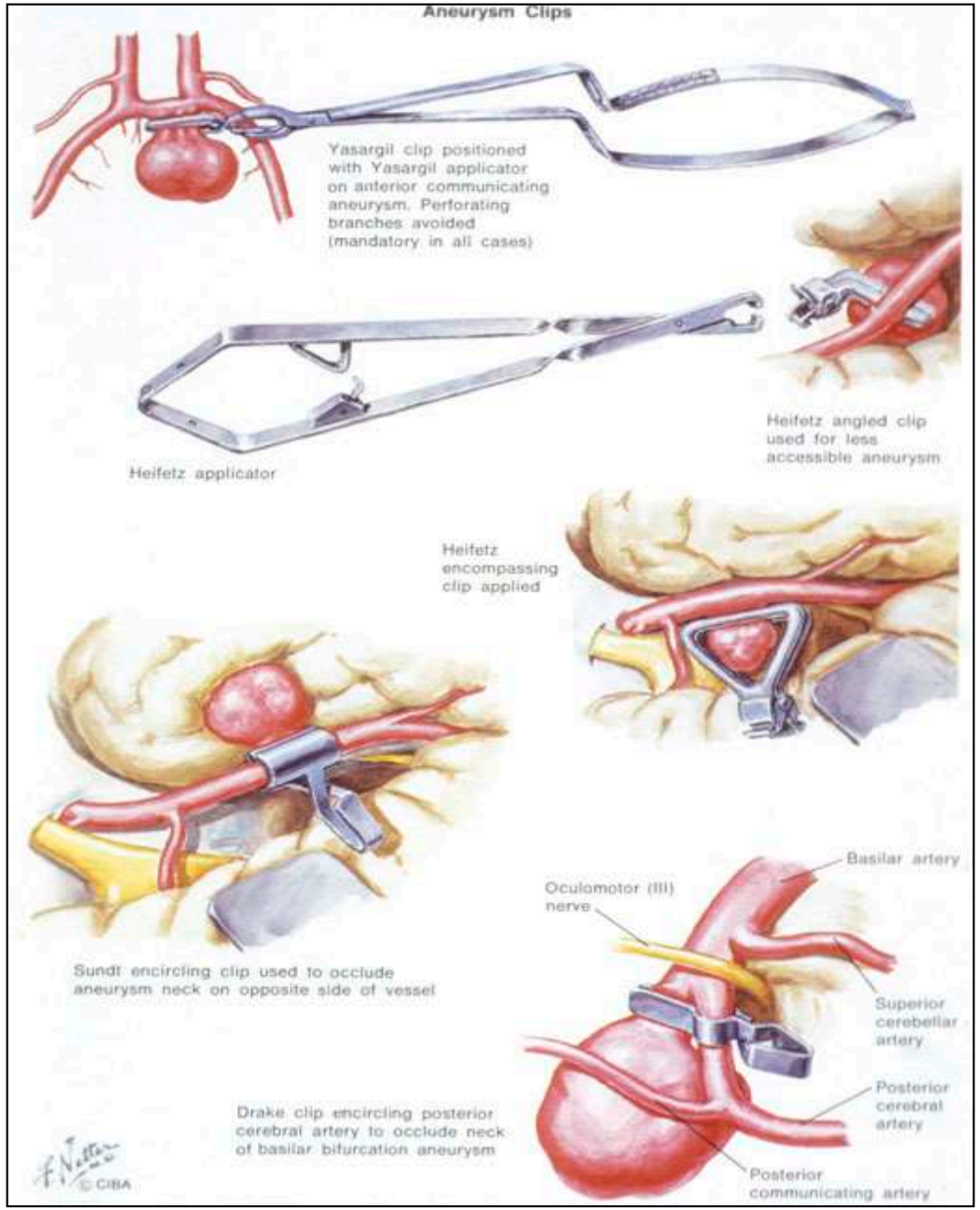






Surgery / Clipping

- Requires a hemicraniectomy
- Aneurysm is located and a clip is put on the neck of the aneurysm to cut off blood supply to the aneurysm
- Patient is treated for major surgery of having a hemicraniectomy and SAH.



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Coiling

- Soft metal wires
- Tightly packed in the aneurysm

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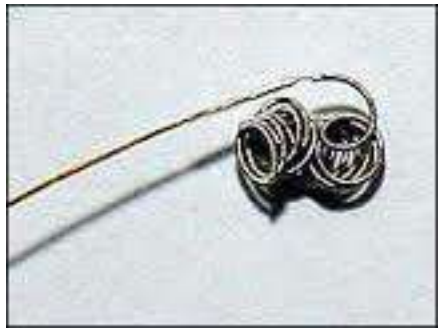
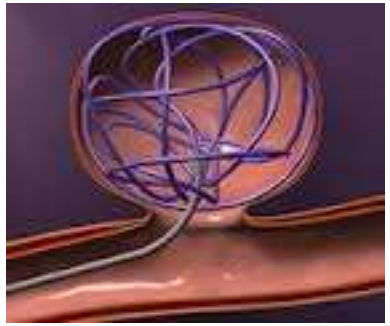
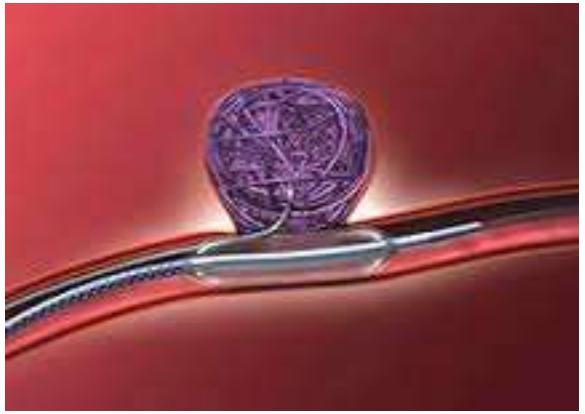
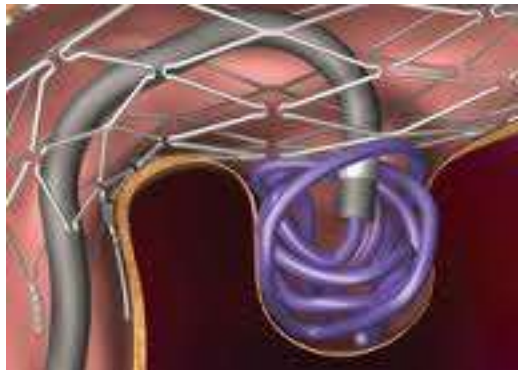
Coiling









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INDICATIONS FOR TCD

VASOSPASM

Abnormal narrowing or
constriction of arteries
due to irritation by blood
in the subarachnoid space

VASOSPASM

- FOLLOWING SAH
- PEAKS 7-10 DAYS
- MAXIMAL SEVERITY DAYS 7 TO 12
- MAY LAST 3-4 WEEKS

VASOSPASM

- DEGREE DEPENDS ON ***AMOUNT*** OF BLOOD

- VESSELS AFFECTED DEPENDS ***LOCATION*** OF BLOOD

HEMODYNAMIC EFFECTS OF VASOSPASM

- INCREASED MFV
- LOSS OF PRESSURE THROUGH NARROW SEGMENT
- CBF REDUCED WHEN AUTOREGULATION EXHAUSTED
- ISCHEMIA AND INFARCTION

VALUES MADE SIMPLE

- MCA 60 CM/SEC
- ACA 50 CM/SEC
- PCA 40 CM/SEC
- BASILAR 30 CM/SEC
- VERTEBRAL 20 CM/SEC

TRANSTEMPORAL WINDOW

TCI

TCD

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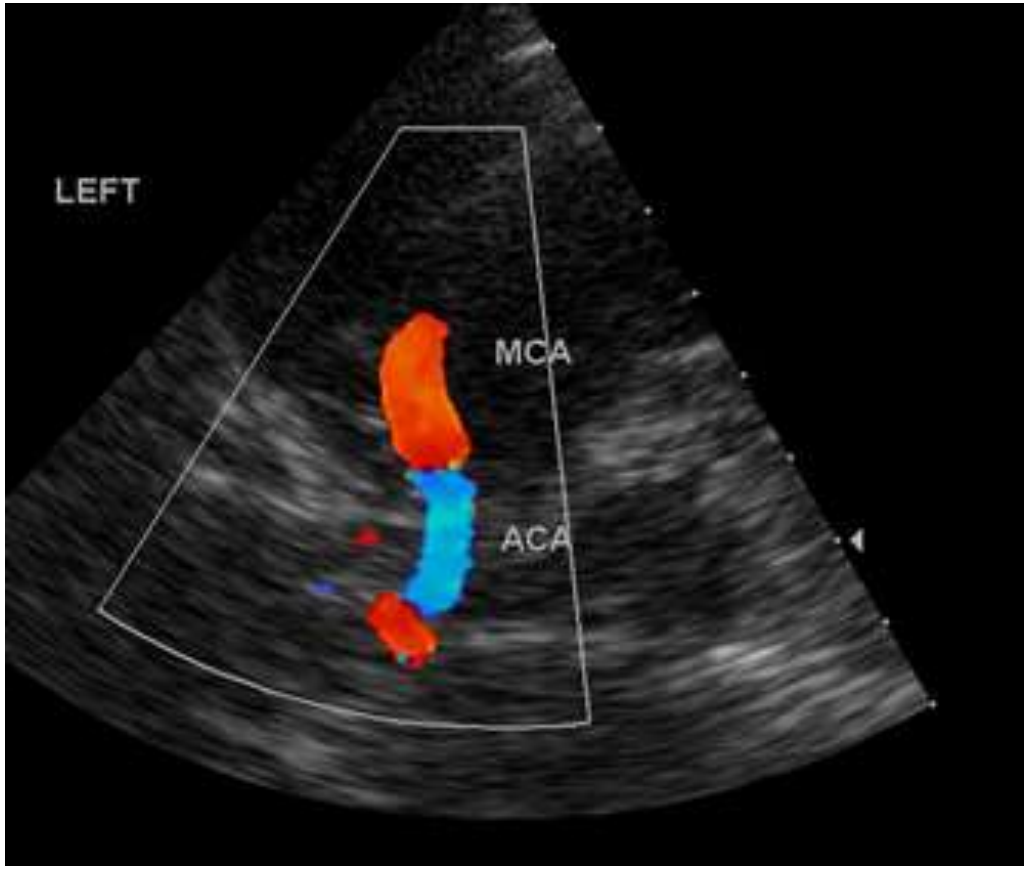
TRANSTEMPORAL WINDOW
TCI



VASOSPASM MCA

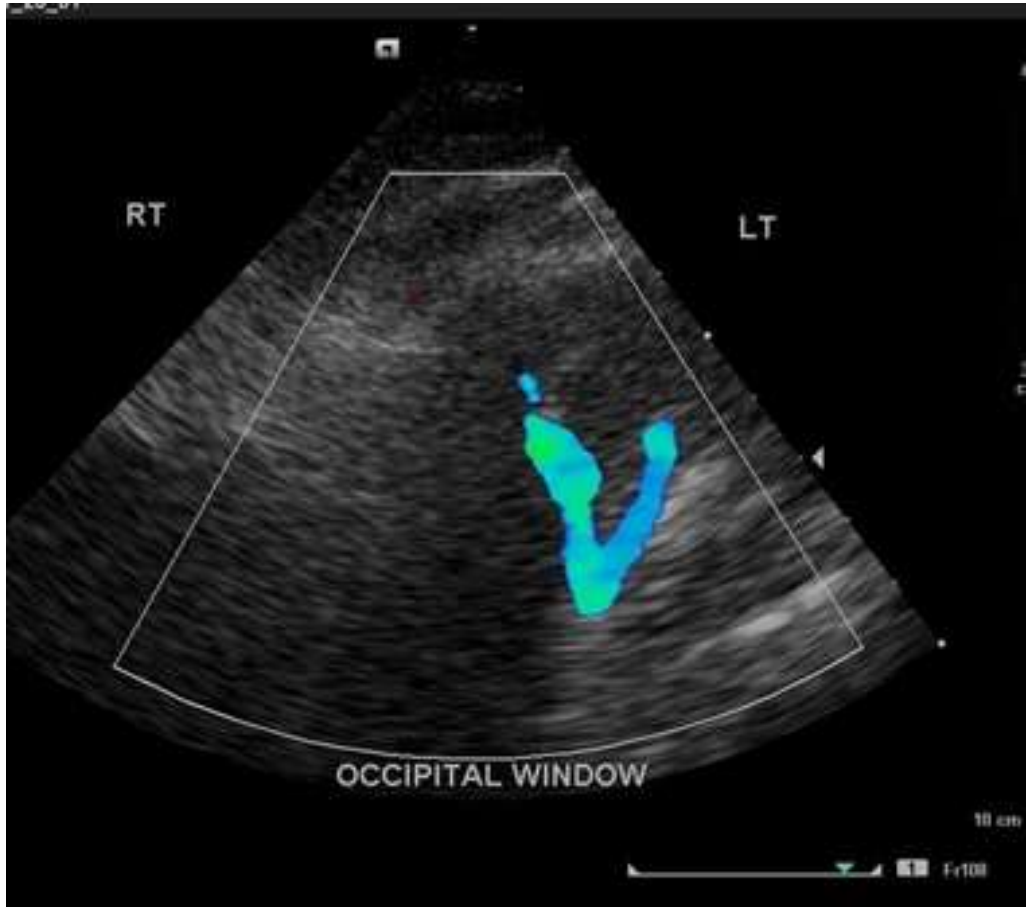
- MFV 120 -149 CM/SEC (*mild vasospasm*) ANGIO < 25%
- MFV 150-179 CM/SEC (*moderate vasospasm*) ANGIO 25-50%
- MFV 180-199 CM/SEC (severe vasospasm) ANGIO 25-50%
- MFV > 200 CM/SEC (*critical vasospasm*) ANGIO > 50%

TRANSFORAMEN / OCCIPITAL WINDOW

TCI

TCD

TRANSFORAMEN / OCCIPITAL WINDOW
TCI



BASILAR ARTERY VASOSPASM

- MFV 60-89 CM/SEC (*mild vasospasm)* — ANGIO <25%
- MFV 90-109 CM/SEC (*moderate vasospasm*) — ANGIO 25-50%
- MFV 110-119 CM/SEC *(severe vasospasm)* — ANGIO 25-50%
- MFV >120 CM/SEC (*critical vasospasm*) — ANGIO >50%

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THERAPEUTIC INTERVENTIONS

- TRIPLE H THERAPY

  1. HYPERTENSION
  2. HYPERVOLEMIA
  3. HEMODILUTION

- CALCIUM CHANNEL BLOCKERS

- TRANSLUMINAL ANGIOPLASTY

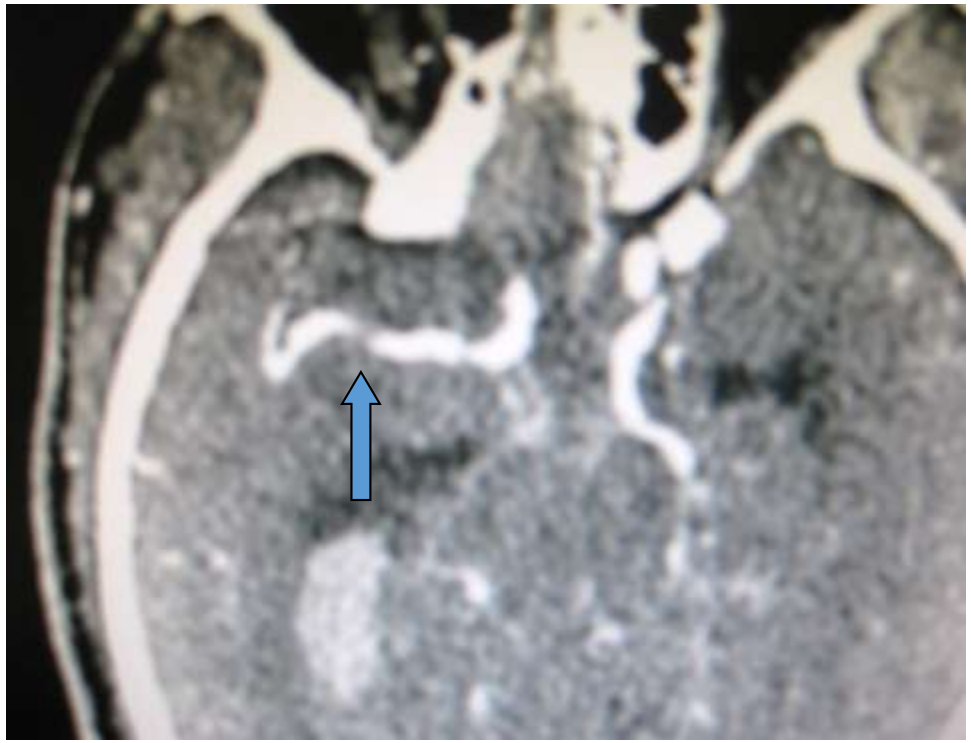
CLINICAL

- 72 YO WHITE MALE
- NAUSEA / VOMITING
- LOC AT HOME
- EMS CALLED TAKEN TO OUTSIDE HOSPITAL
- NO PRIOR MEDICAL HISTORY

CT AT OUTSIDE HOSPITAL

TCD / TCI RT MCA STENOSIS

CTA



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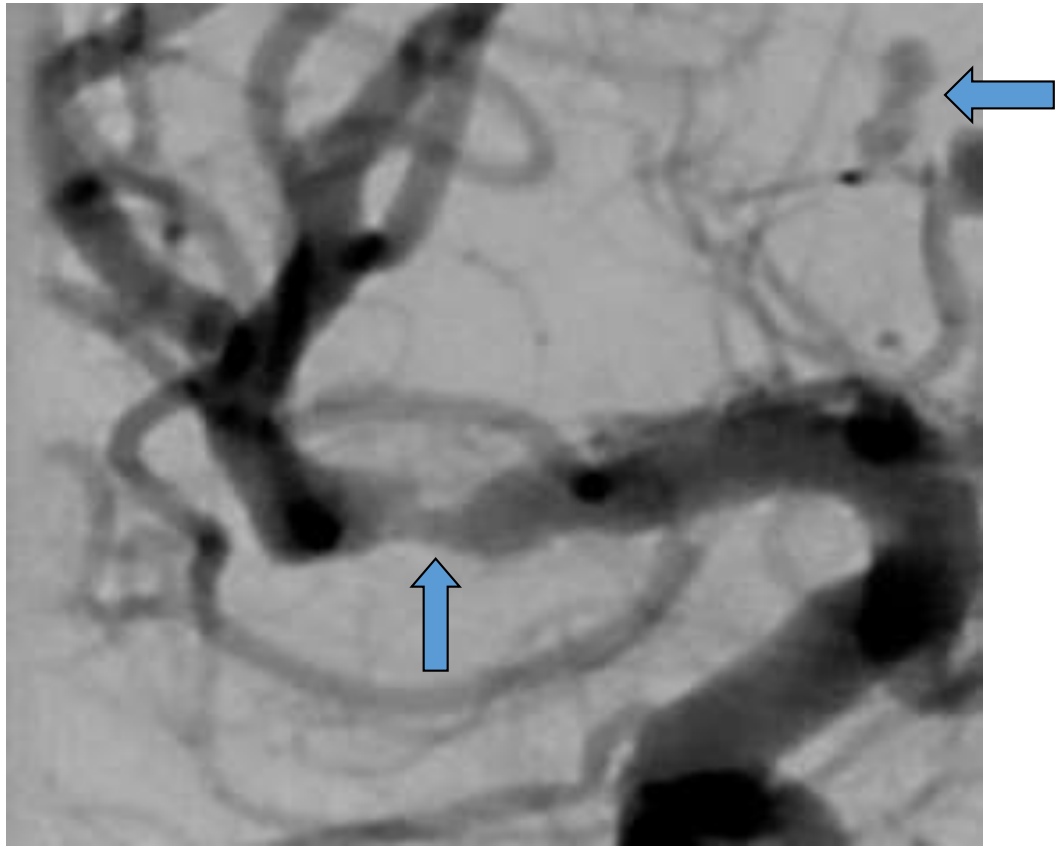
TCD / TCI RT MCA STENOSIS



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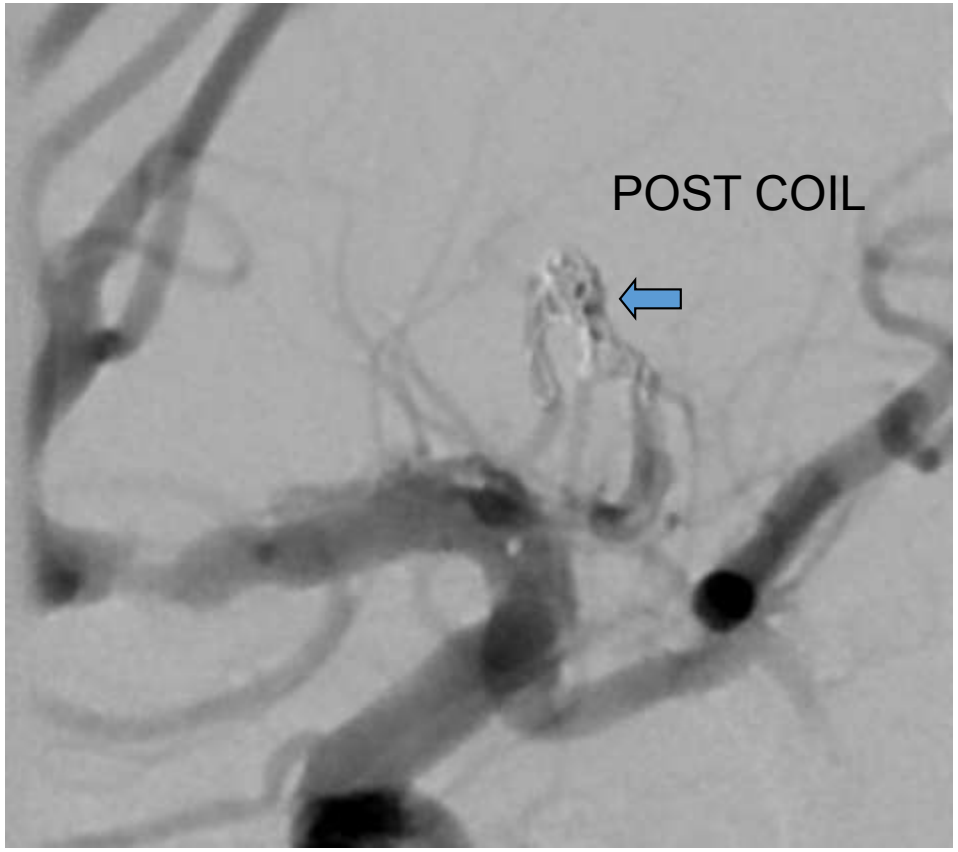
TCD / TCI RT MCA STENOSIS



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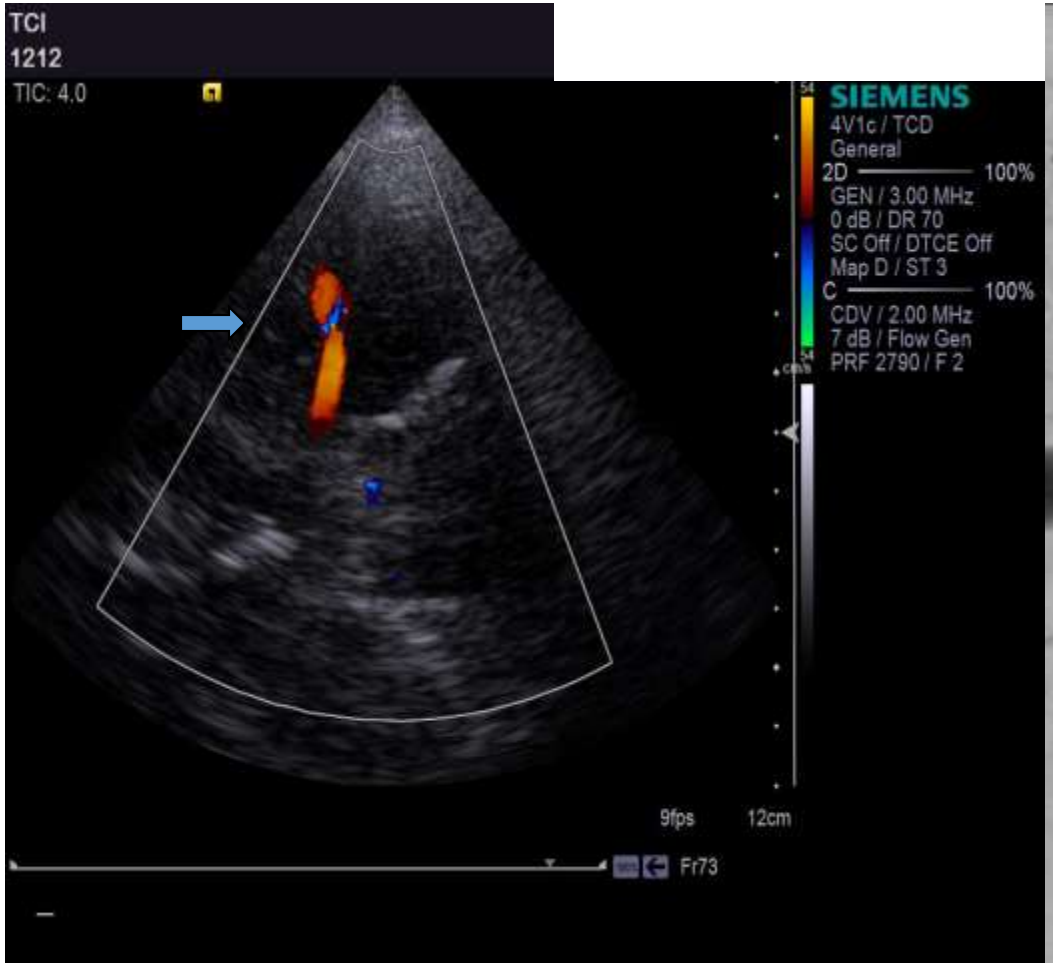
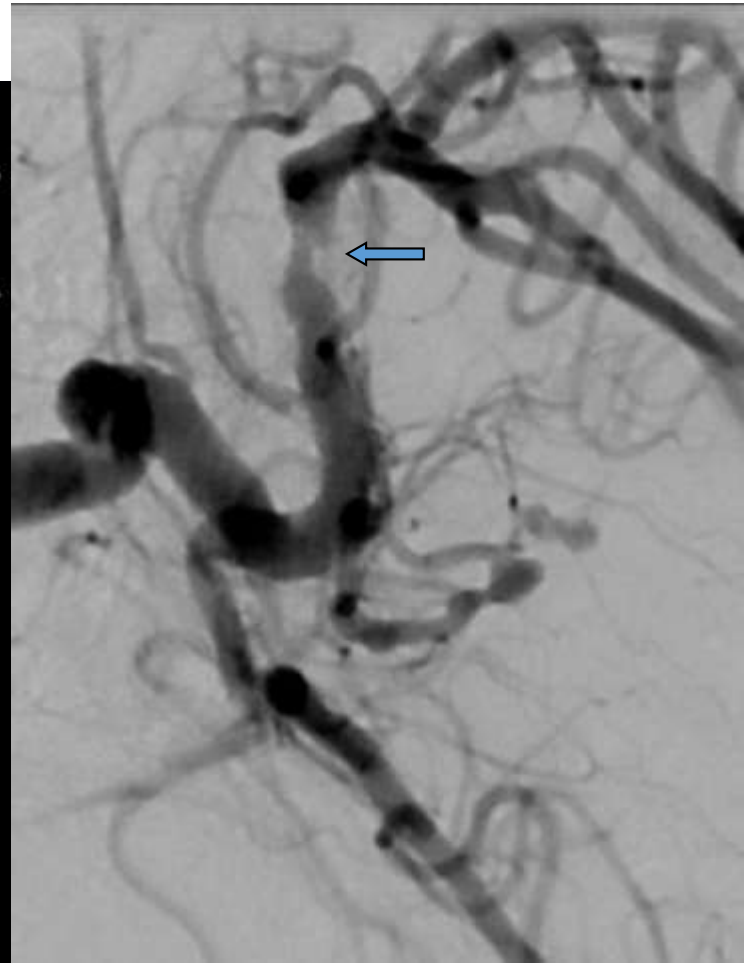
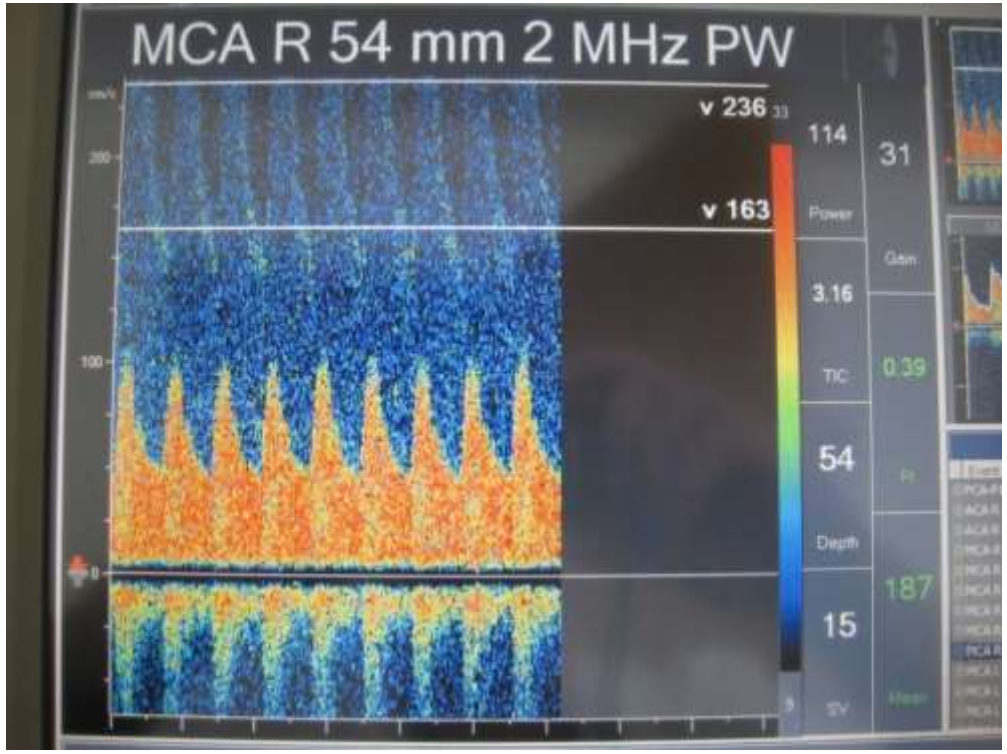
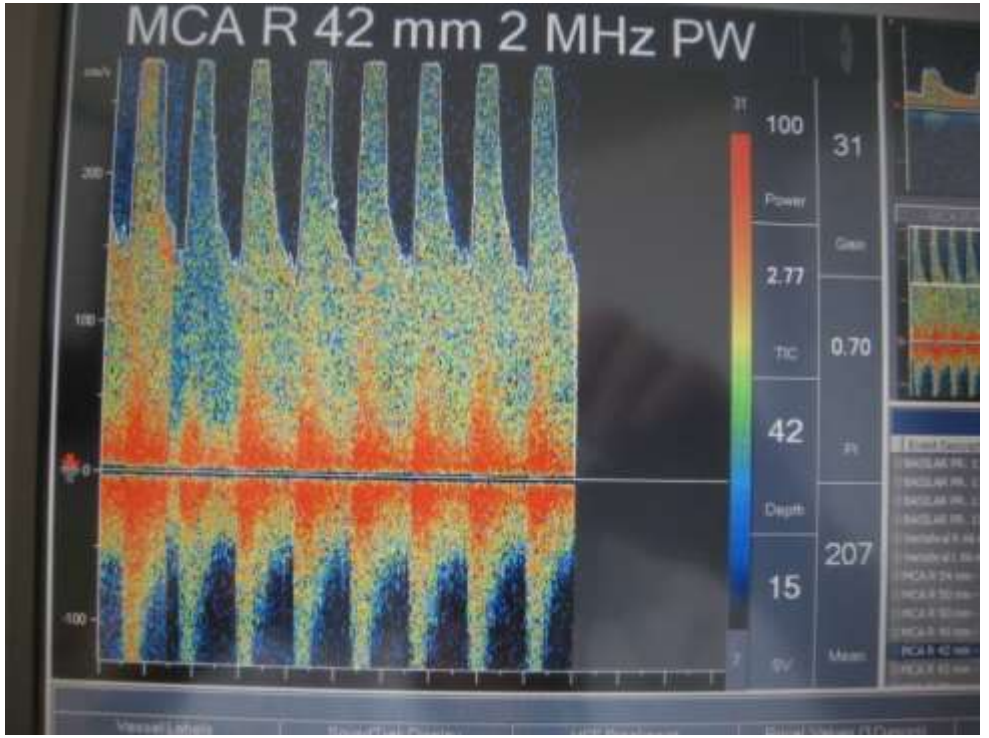
RIGHT MCA / STENOSIS / VASOSPASM





RIGHT MCA / STENOSIS / VASOSPASM
TCD





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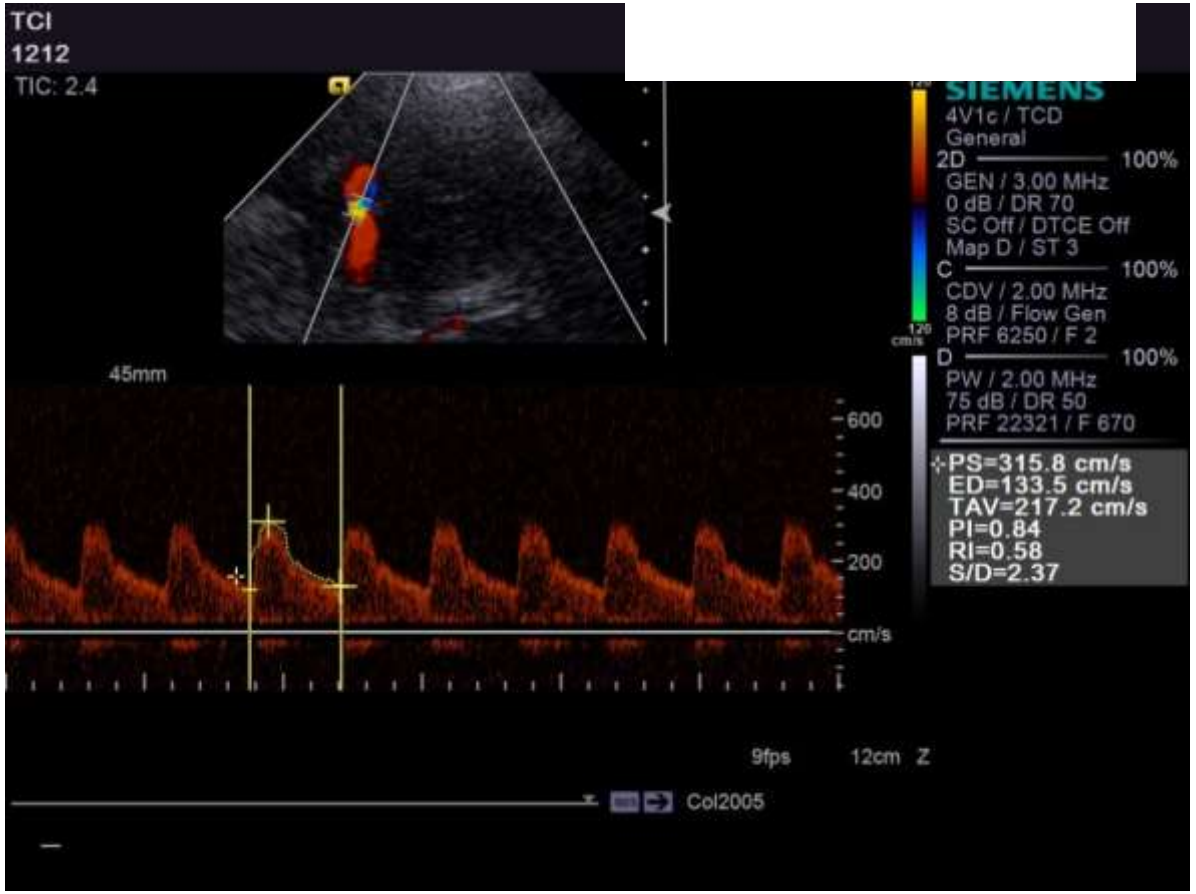
RIGHT MCA / STENOSIS / VASOSPASM
TCI



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CLINICAL

- 39YO WHITE MALE
- NAUSEA / VOMITING
- LOC AT WORK
- EMS CALLED TAKEN TO OUTSIDE HOSPITAL
- NO PRIOR MEDICAL HISTORY

SAH/CT

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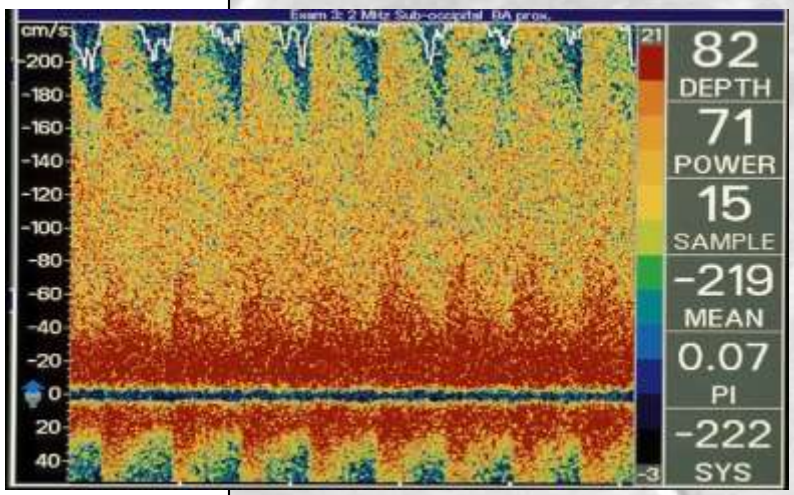
BASILAR ARTERY

SERIAL TCD'S
POST COIL DAY #4

RT. MCA / 130 CM/SEC

LT. MCA / 136 CM/SEC

BASILAR / 219 CM/SEC



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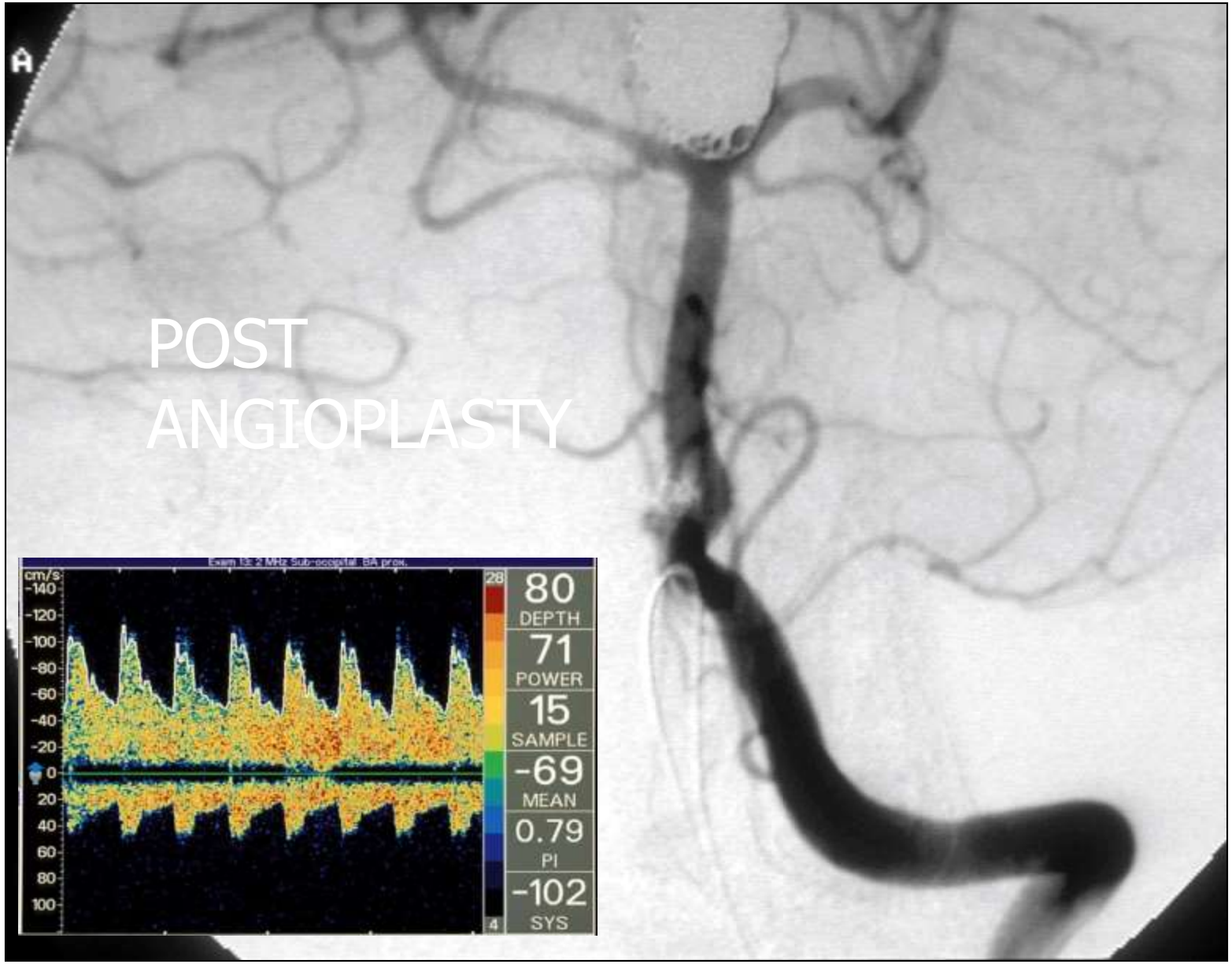

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VASOSPASM / LINDEGAARD RATIO

- RATIO BETWEEN THE EXTRACRANIAL ICA MFV AND THE HIGHEST MCA MFV.

- TO HELP DETERMINE TRUE VASOSPASM FROM HYPEREMIA

VASOSPASM / LINDEGAARD RATIO

- IF RATIO GREATER THAN 3.0 SUGGESTS VASOSPASM
- IF RATIO GREATER THAN 6.0 SUGGESTS CRITICAL VASOSPASM
- A RATIO LESS THAN 3.0 WOULD BE INDICATIVE OF HYPEREMIA RATHER THAN VASOSPASM

Conclusion

- ANGIOPLASTY WILL DILATE ARTERIES IN CRITICAL SPASM
- INCREASING BLOOD FLOW AND PREVENTING A CEREBRAL VASCULAR ATTACK (CVA)

Conclusions

- Treating the aneurysm is JUST THE BEGINNING
- Any new focal neurological deficits, including cognitive decline, could be vasospasm or hydrocephalus

Thank You !