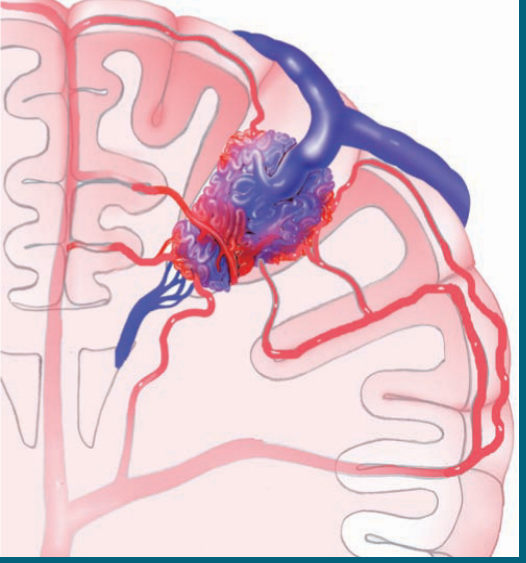
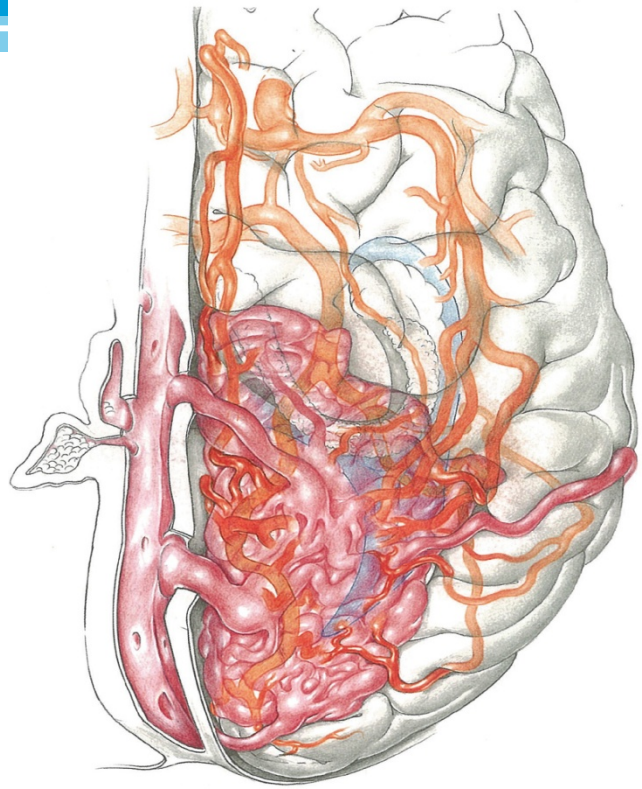


ENDOVASCULAR TREATMENT OF ARTERIOVENOUS MALFORMATIONS

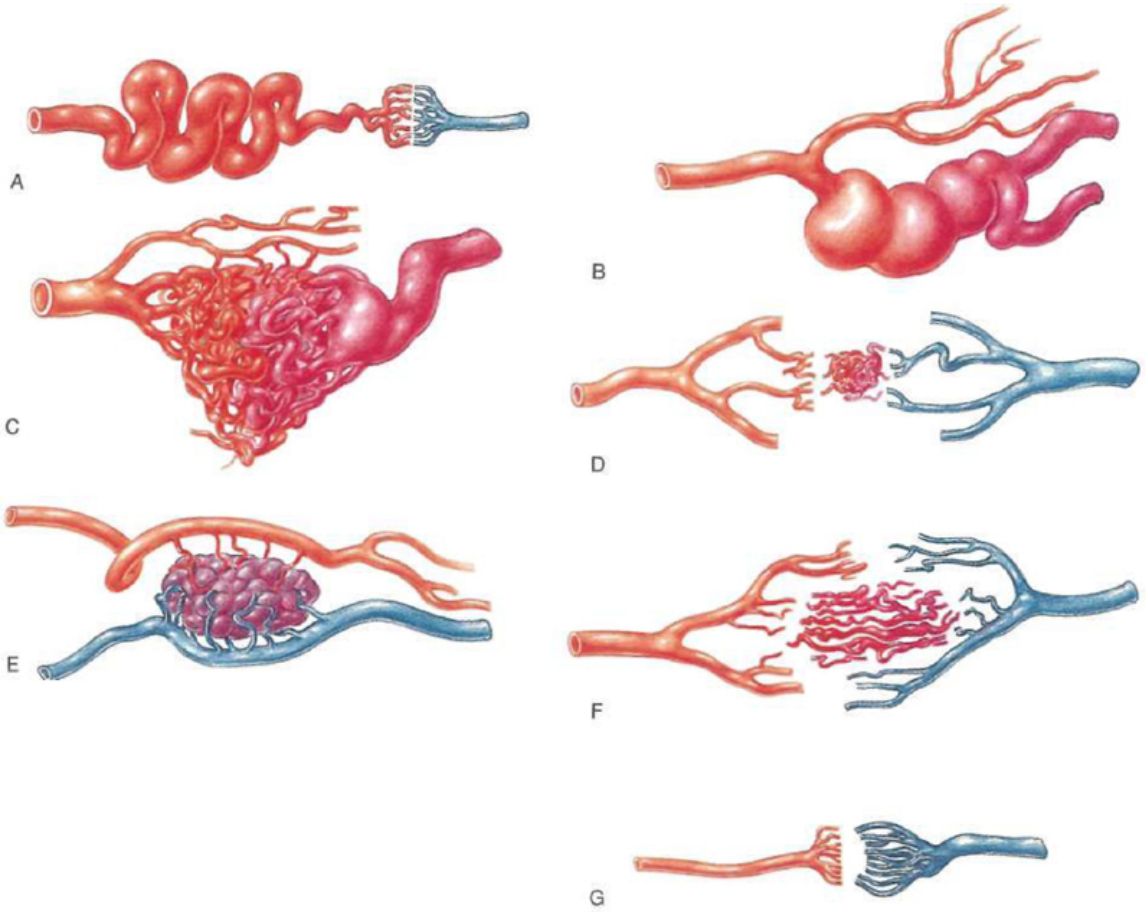
VERONICA MORENO
RN,MSN,ACNP-BC,CNRN
NEUROVASCULAR NP SANTA BARBARA COTTAGE HOSPITAL

ETIOLOGY OF AVM



- Prevalence is 15-18 per 100,000.
- Autopsy data suggests as few as 12% are symptomatic during a life time.
- Congenital vascular lesion consisting of abnormal direct connections between arterial and venous systems.

DIFFERENT TYPES OF VASCULAR MALFORMATIONS



INCIDENCE

OF DETECTION

- Data from the New York islands AVM hemorrhage study suggests that the detection rate is 1.21/100,00 person-years.

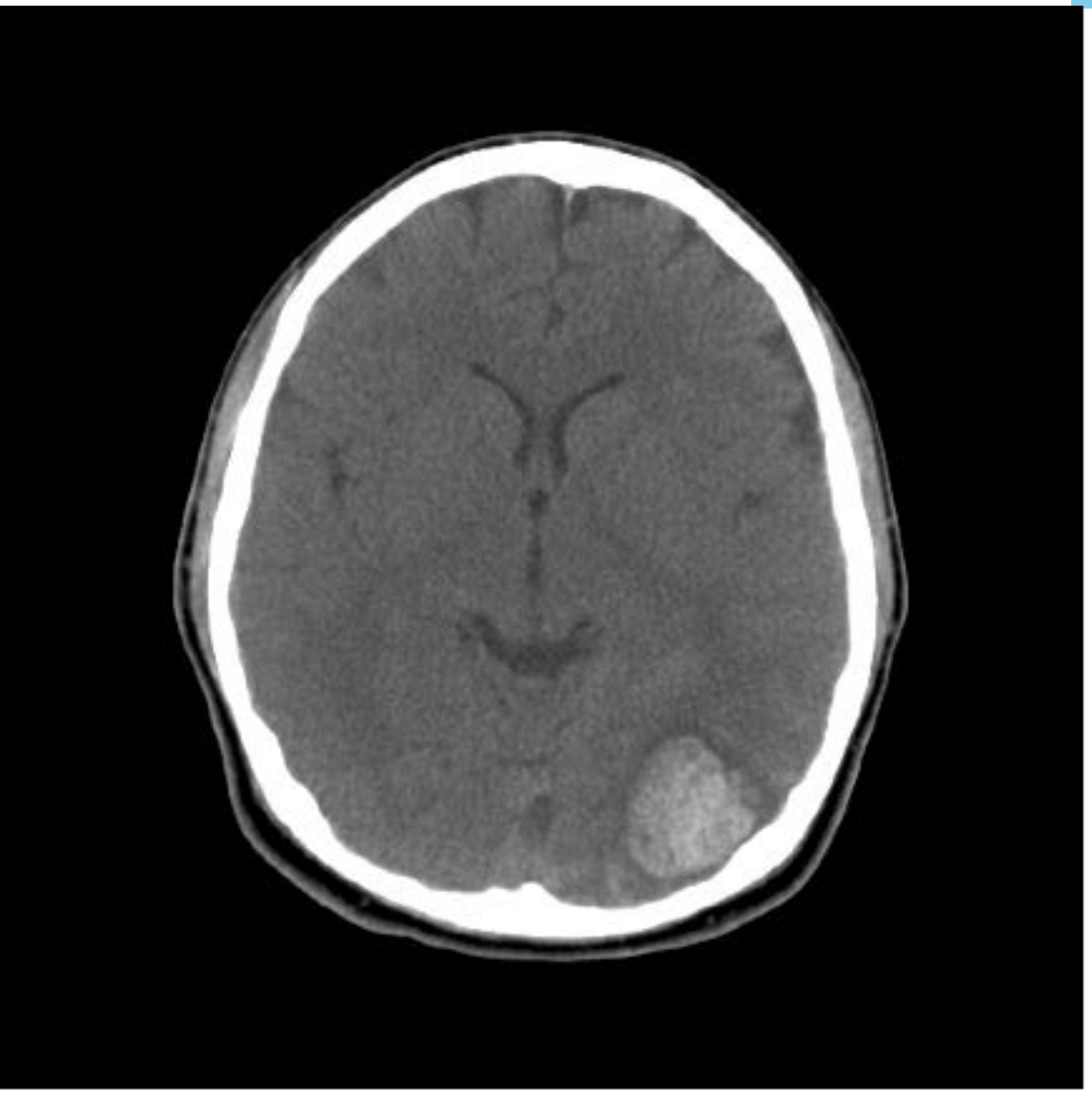
OF HEMORRHAGE

- The incidence of AVM hemorrhage is 0.42/100,000 person- years.

- Data from the Manhattan stroke study suggests the incidence for first ever hemorrhage is 0.55/100,000 person-years.

BLEEDING AND REBLEEDING

- AVM hemorrhage approximately 2%-4% per year.
- 1st episode associated with mortality rate of 10% increases to 15% with 2nd hemorrhage and 20% 3rd.
- Rate of rehemorrhage increases to 6% 1st year, returns to 2%-4% per year thereafter.
- Grade IV and V have a lower rate of hemorrhage about 1.5% per year.



PRESENTATION

Typically diagnosed before the age of 40. **Most common presentation is hemorrhage >50%.**

Second is Seizure 20-25%.

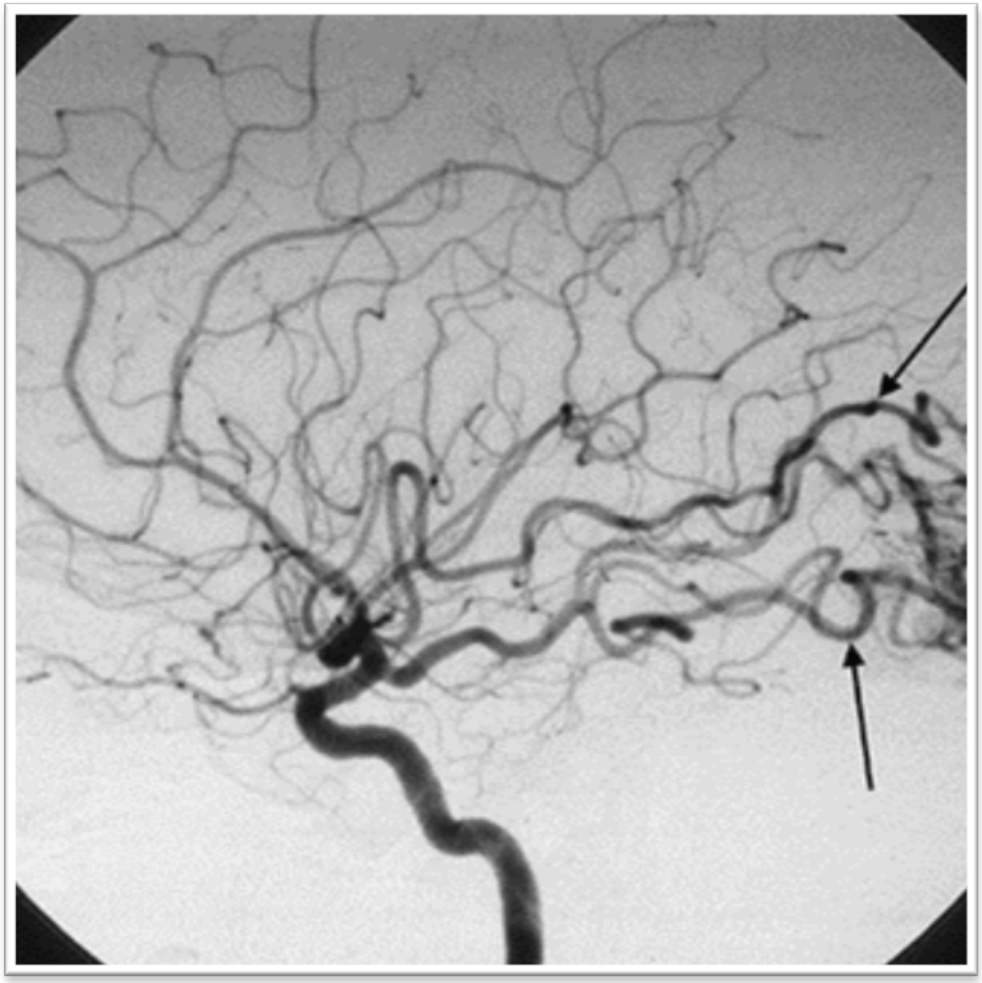
Less common is headaches 15%.

IMAGING

- Head CT, head and neck CTA, first and best studies in a hemorrhagic AVM emergent setting.

- MRI, not the first choice secondary to the time required to obtain images, however MRI will provide superior images of surrounding brain structures.

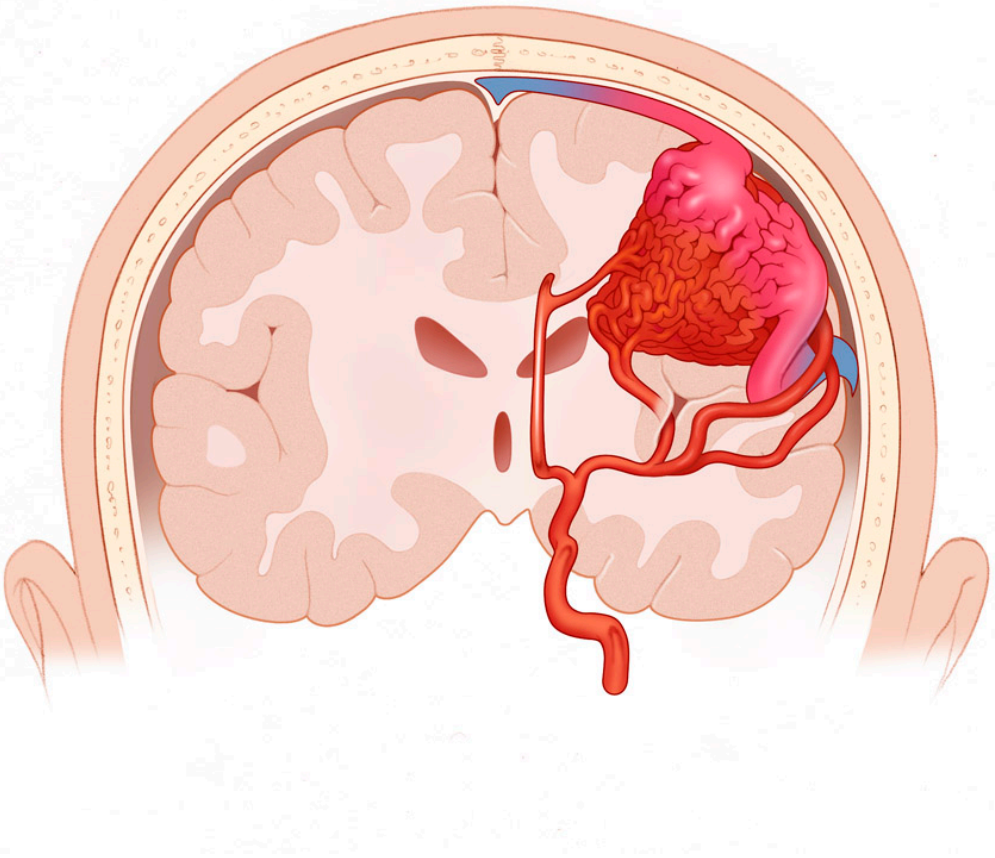
IMAGING



CEREBRAL ANGIOGRAM

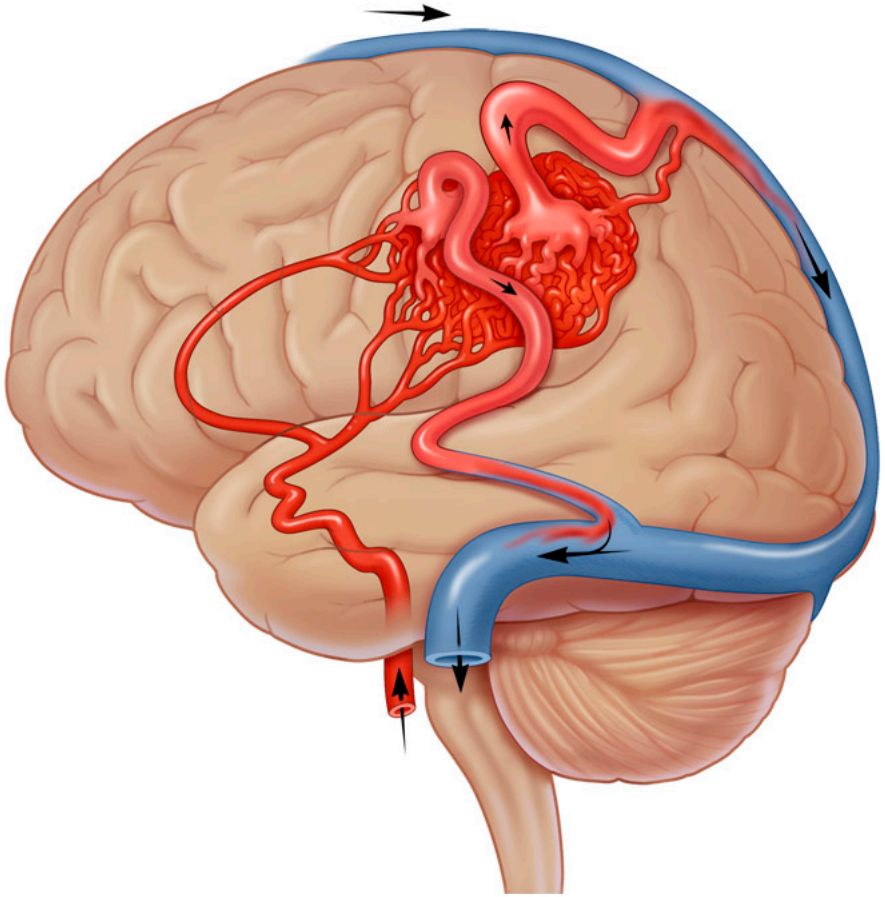
Angiography gold standard for diagnosis, treatment planning and follow up after treatment.

NIDUS



Cerebral angiography helps to evaluate nidus size and both arterial and venous flow patterns.

FEEDER ARTERIES AND VEINS



Cerebral angiography evaluates the feeder arteries and veins.

High blood flow and shunting of high pressure arterial blood causes the feeder arteries and veins to dilate.

Weakened veins are susceptible to hemorrhage; feeder arteries become susceptible to aneurysms.

SPETZLER-MARTIN GRADING SCALE

GRADED FEATURE	POINTS ASSIGINED
Size	
Small	1
Medium	2
Large	3
Eloquence of Adjacent brain	
Non-eloquent	0
Eloquent	1
Pattern of Venous Drainage	
Superficial	0
Deep	1

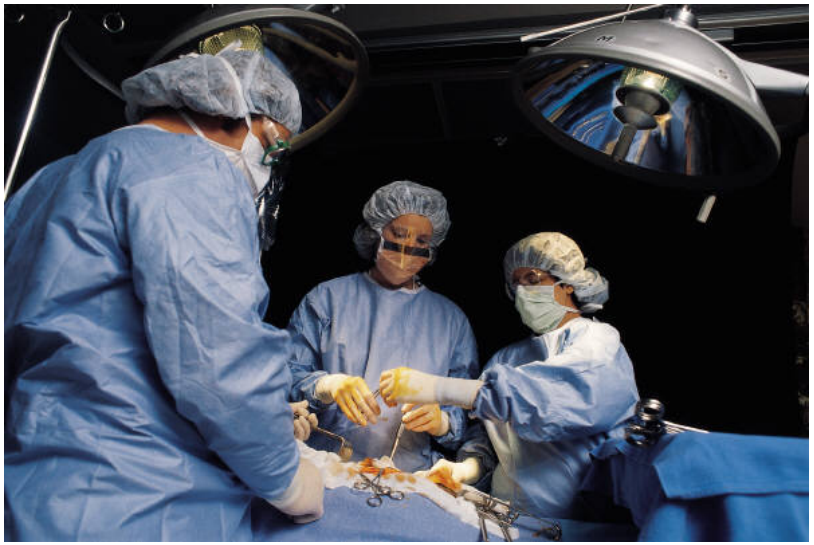
GOAL OF AVM TREATMENT

- Eliminate the risk of hemorrhage and all related symptoms. Such as seizures and neurologic deficits.

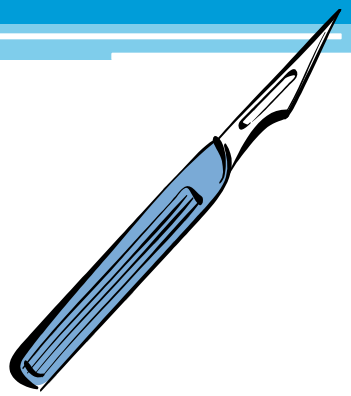
- Without any or with only minimal morbidity or mortality to the patient.

TREATMENT OF AVMS

- SURGICAL RESECTION
- EMBOLIZATION
- RADIOGURGERY
- COMBINATION THERAPY



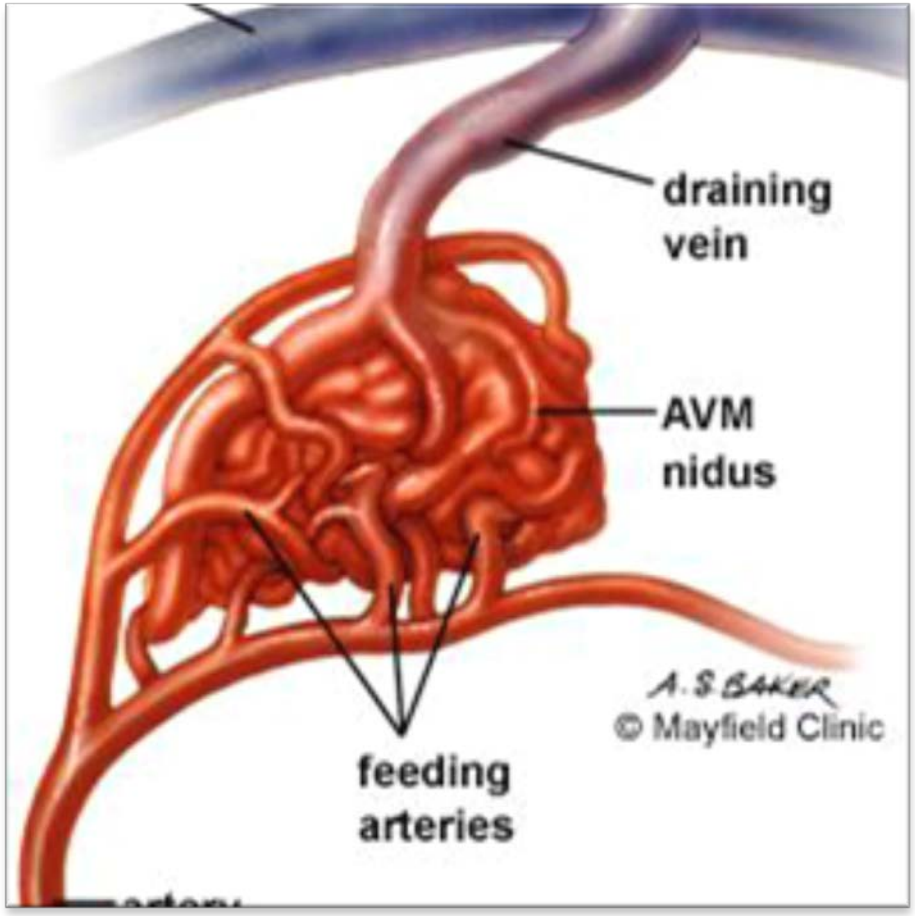
SURGICAL RESECTION



- Grade I,II,III AVMs have a low treatment-associated morbidity.
- Grade IV AVMs have a 31.2% treatment associated morbidity and the rate of permanent deficit is 29.9%.
- Grade V AVMs have a treatment –associated morbidity of 50%.

EMBOLIZATION

- **Complete obliteration** inversely proportional to AVM volume and the number of feeding arteries.
- **Achieved** by using a nonbiodegradable agent to occlude the AVM nidus.
- **Confirmed** by both immediate angiogram and follow-up angiography.



EMBOLIZATION

Complete obliteration of AVMs by using embolization as the sole method of treatment is between 5% and 40%.

These AVMs are usually smaller than 3 cm in diameter and have only one or two feeding arteries.

2 FDA APPROVED EMBOLIC MATERIALS

NBCA

N-Butyl-Cyanoacrylate

High viscosity, long term efficacy

Mixed with ethiodized oil to visualize

Rheology can be controlled

Permanent occlusion

ONYX

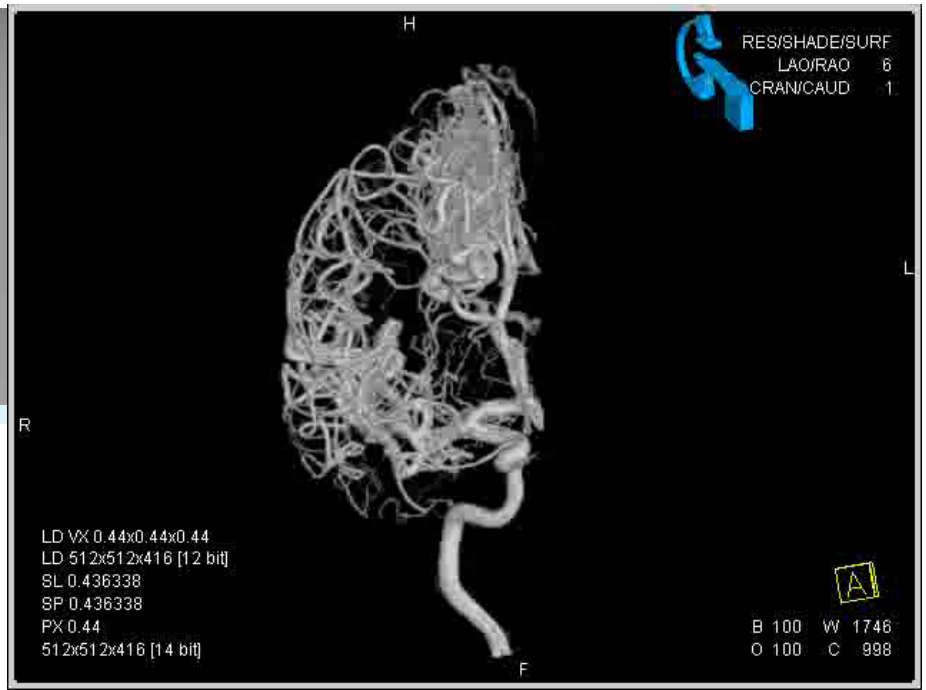
Dimethyl sulfoxide solvent

Ethylene-vinyl alcohol, tantalum

Non-adhesive but cohesive

Longer injection time

More control over polymerization



Radiosurgery

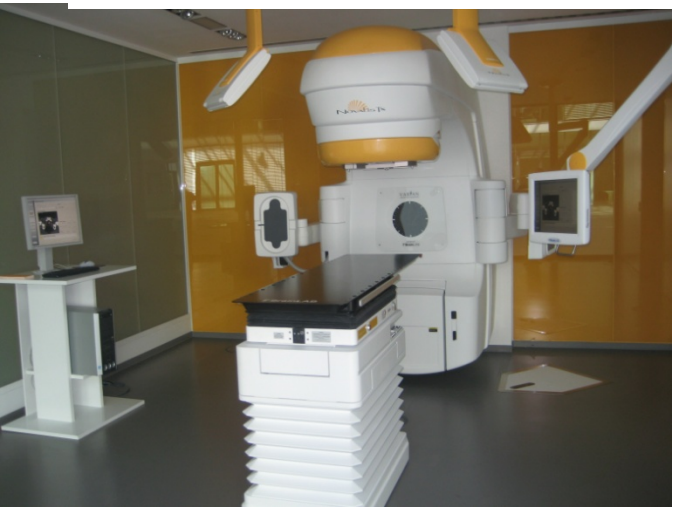
- AVMs with a nidal volumes less than 10ml are frequently curable by radiosurgery with complete obliteration at 2yrs about 80%-88%.

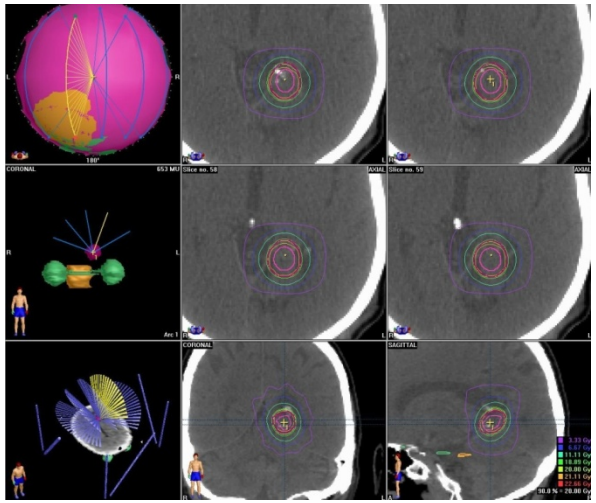
- Hemorrhage risk remains during this time or can increase up to 11-16% during the first 6 months.

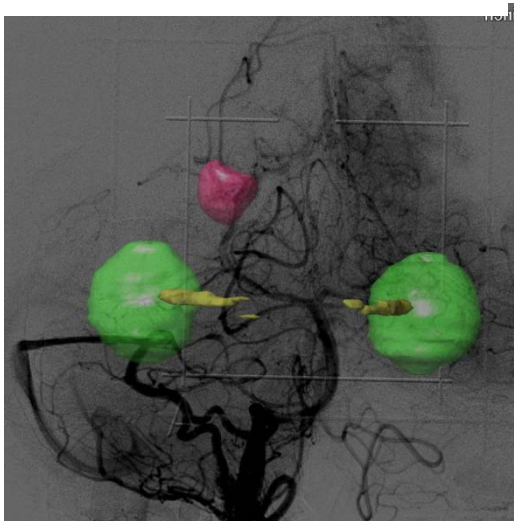
RADIOSURGERY

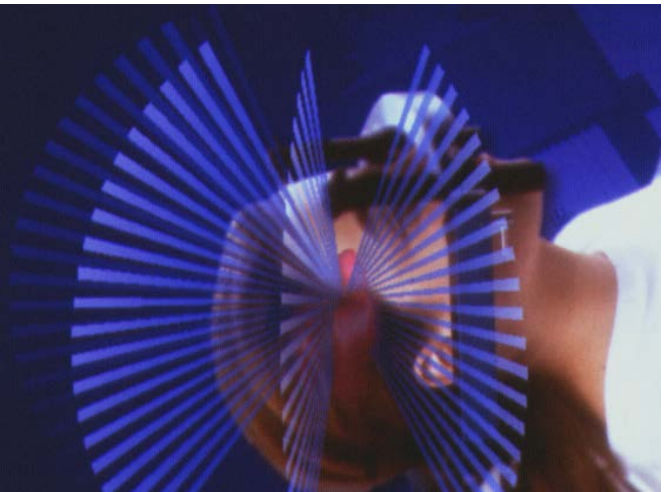
Efficacy of embolization followed by XRT not fully established

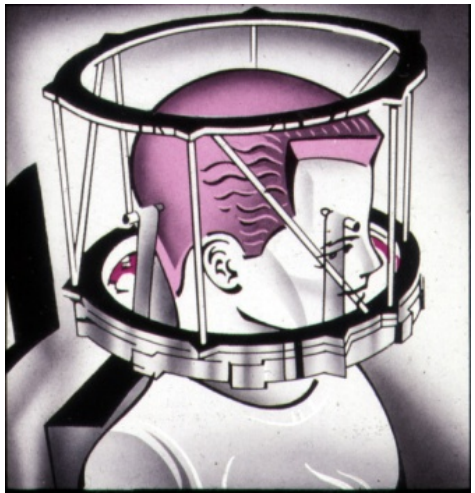
X-RT: 1 - 3 years to obliterate AVM, bleeding rate 3.7% / year

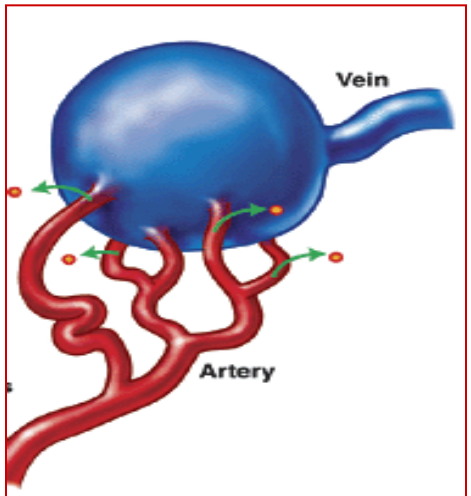




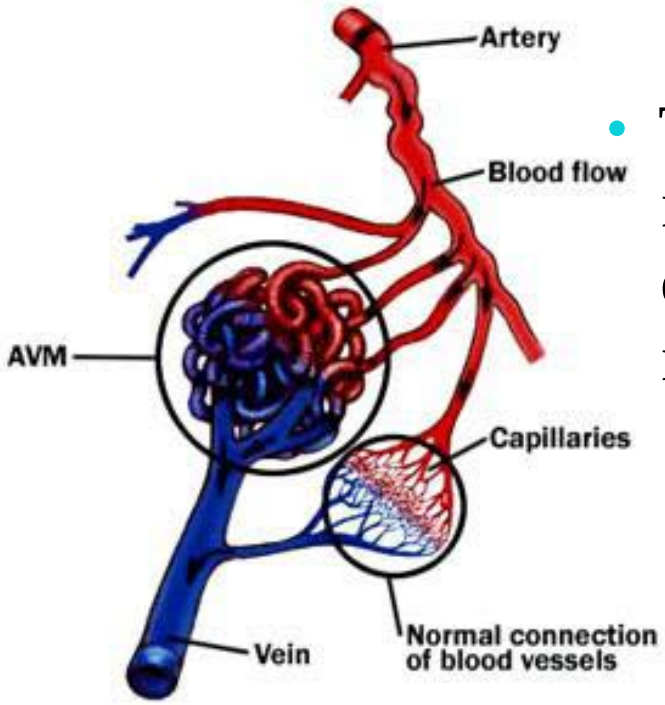








COMBINATION THERAPY



- The goal of combination therapy is to maximize the benefits of each option and decrease the overall morbidity and mortality of AVM treatment.

Neuro-Angio Suite

- Biplanar Angio: Siemens, Philips, GE
- 3D visualization technology
- Flat panel technology with Dyna CT
- Neuroanesthesiology
- Specialized technologists & nurses

BENEFITS OF EMBOLIZATION BEFORE MICROSURGERY AND RADIOSURGERY

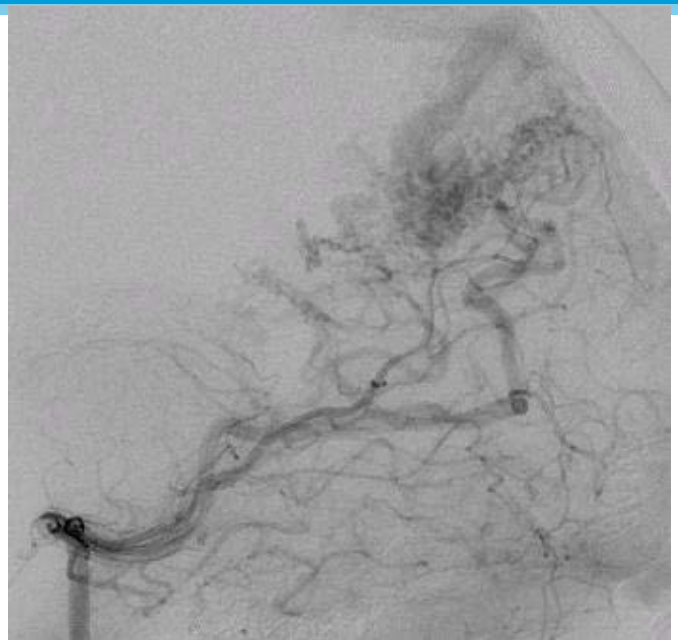
MICROSURGERY

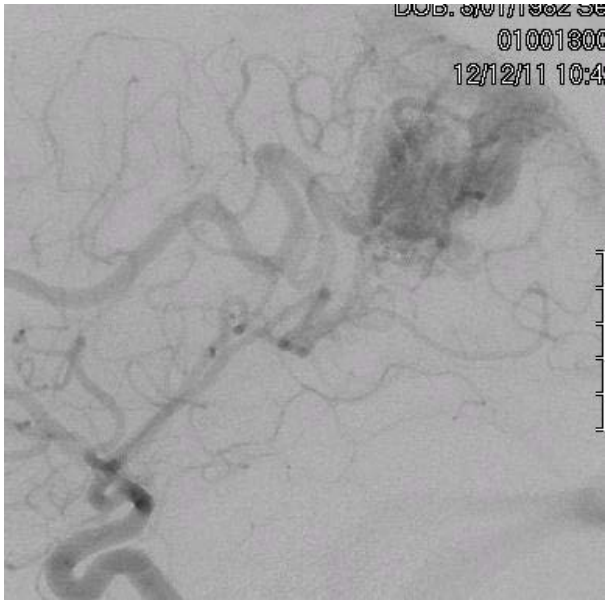
- Occludes the deep and surgically inaccessible feeding arteries.
- Decreases blood flow and nidal size, less blood loss during surgery.
- Onyx or n-BCA in arteries provides a good road map.
- AVM associated aneurysms treated prior to surgical resection.

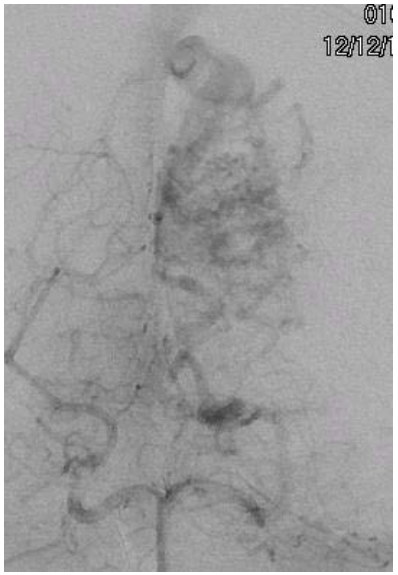
RADIOSURGERY

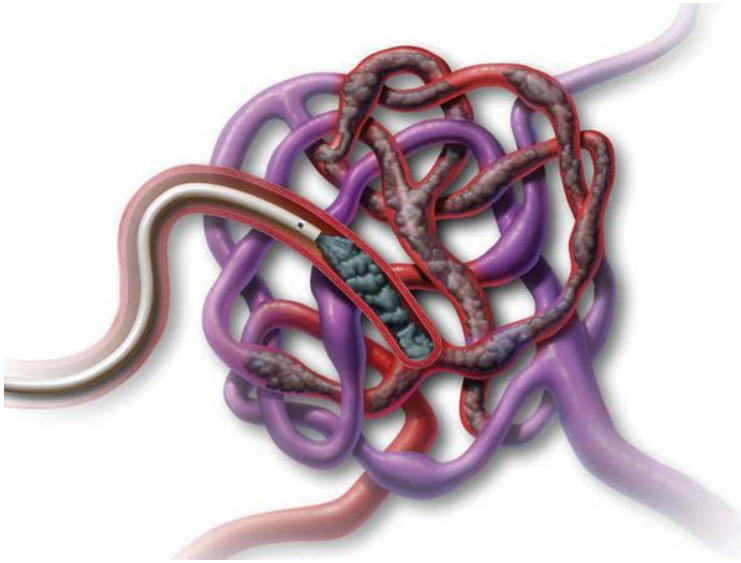
- Decreases the size so radiosurgery can be performed.
- Treat AVM-associated aneurysms prior to radiosurgery which may not be effective for the aneuyrsms.
- Smaller residual AVMs have a higher radiosurgical cure rate.

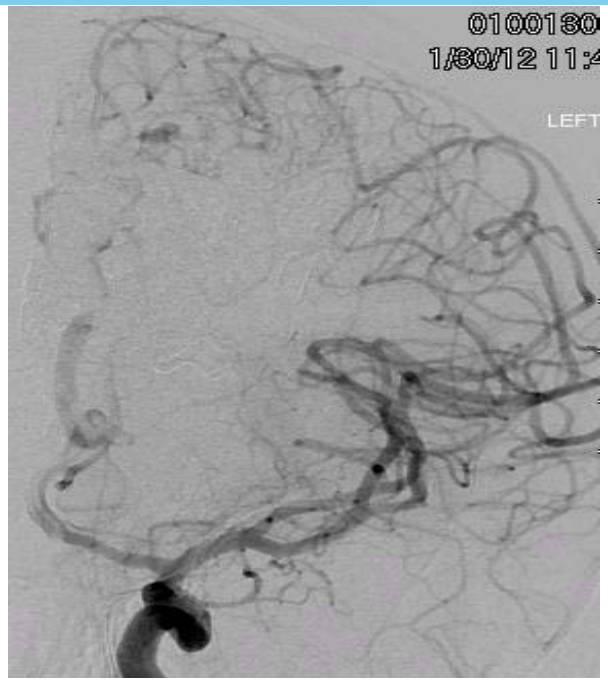
AVM PRE EMBO

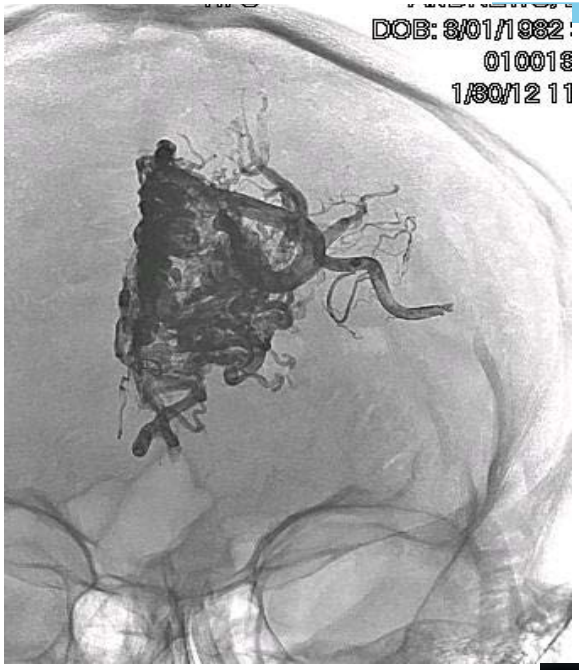






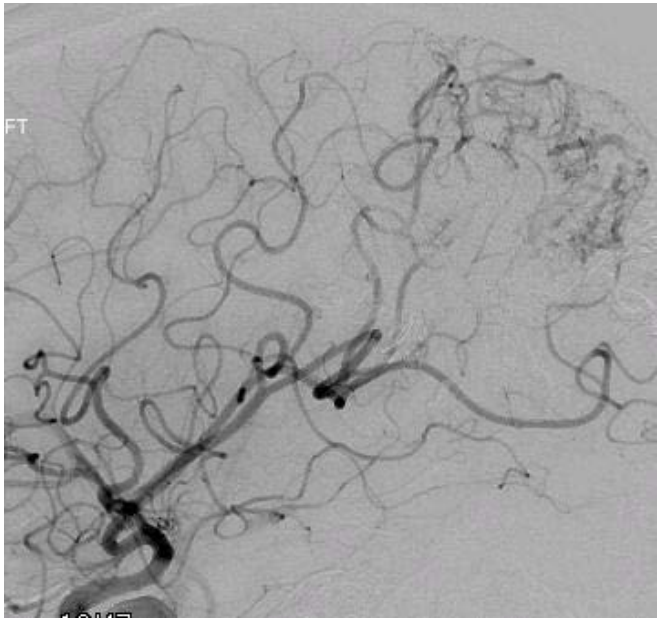


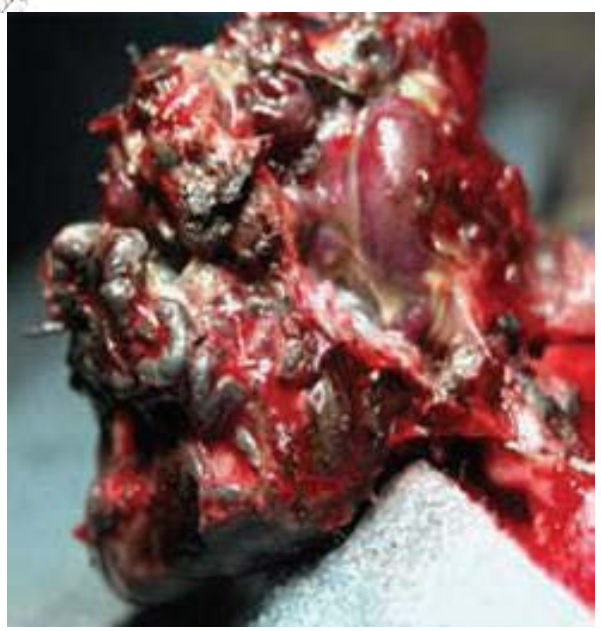


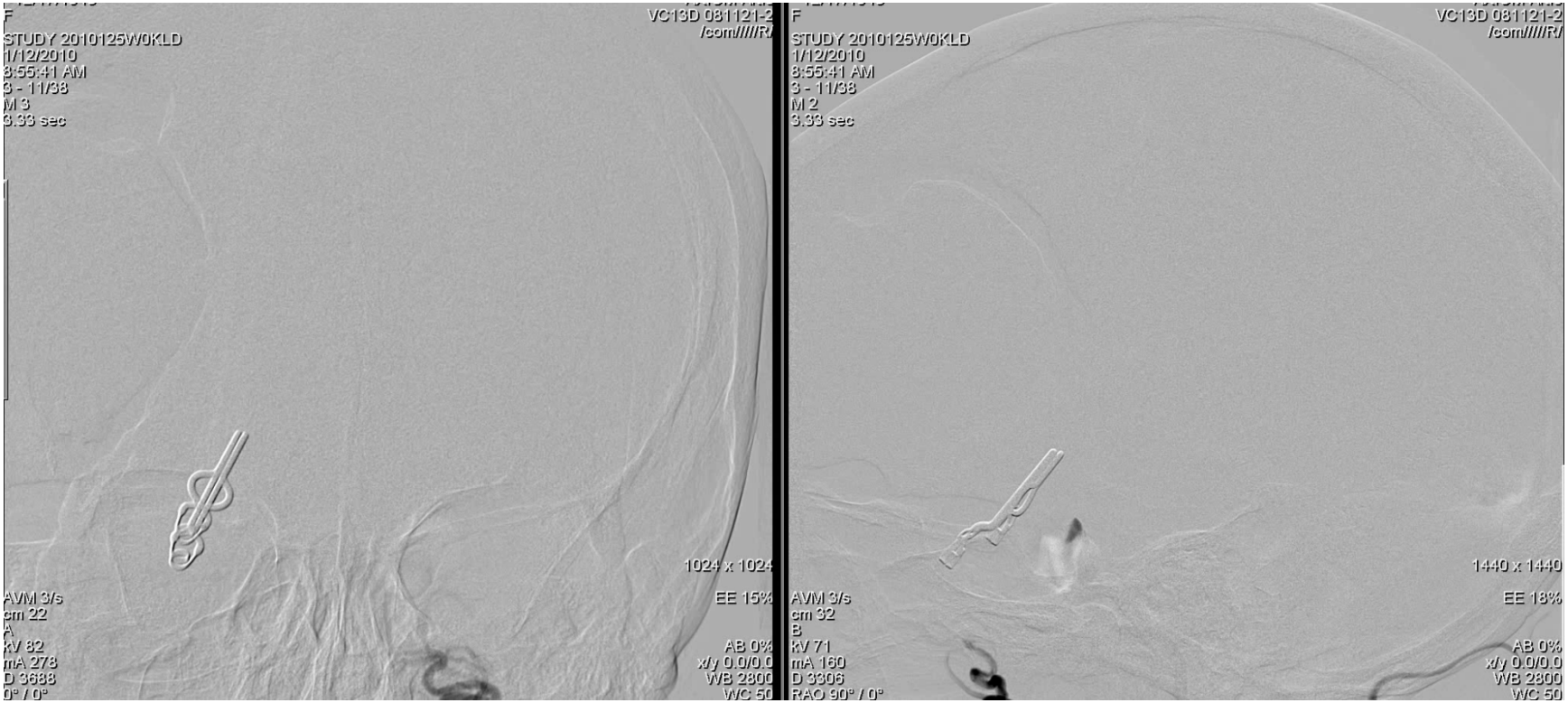


AVM POST EMBO

and after resection.



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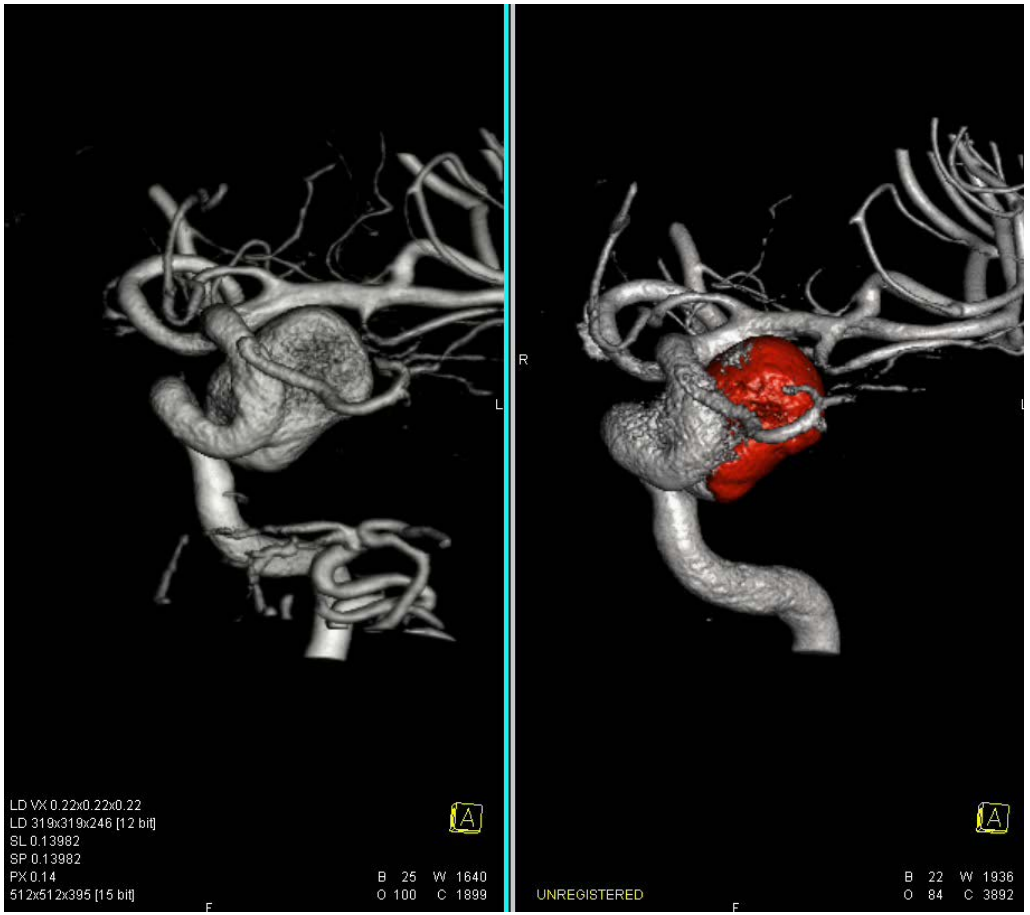
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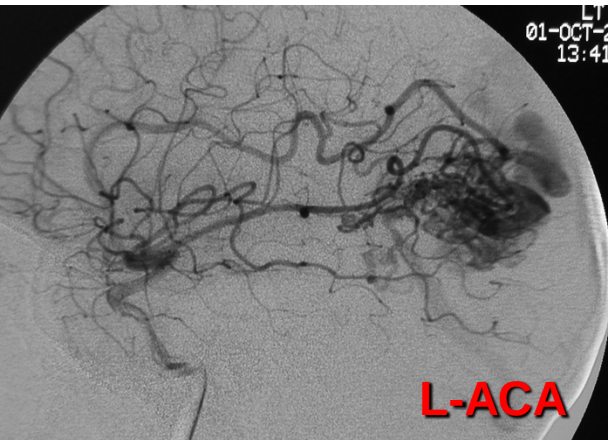
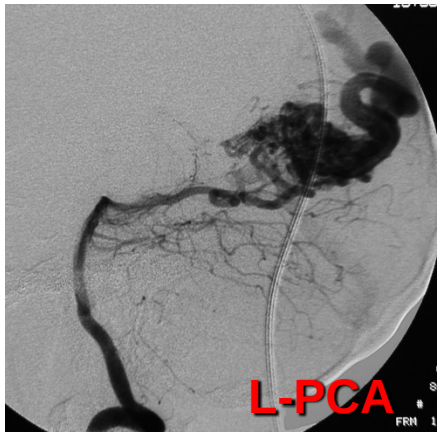
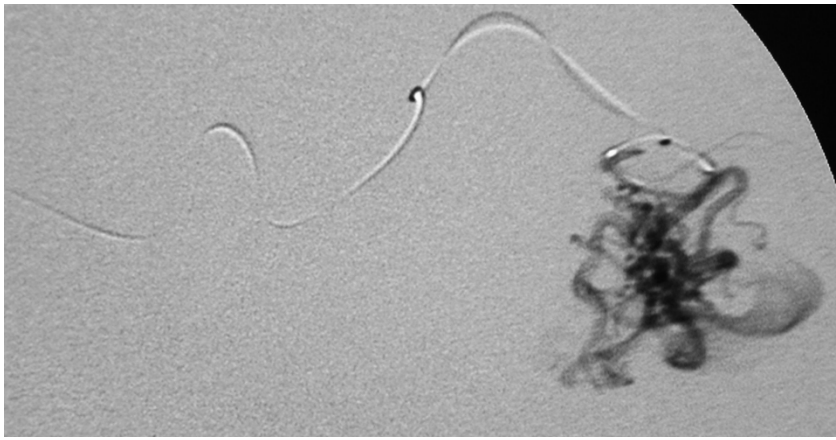
AVM: ENDOVASCULAR AND SURGERY

M 15, left fronto-parieto-occipital AVM, no hemorrhage

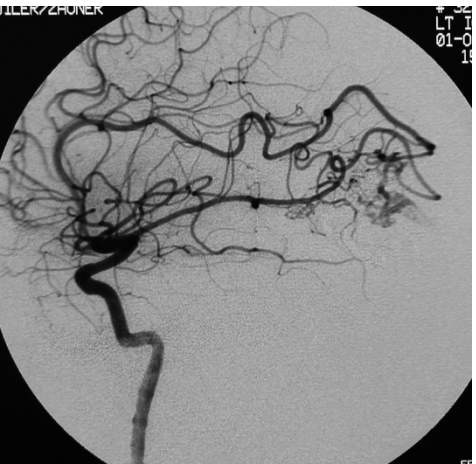
Flow directed catheters, NBCA, Onyx

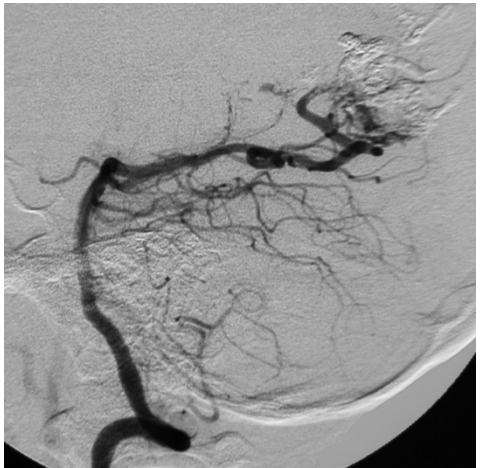


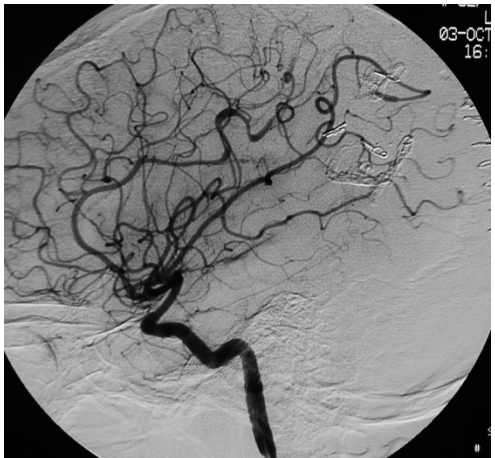


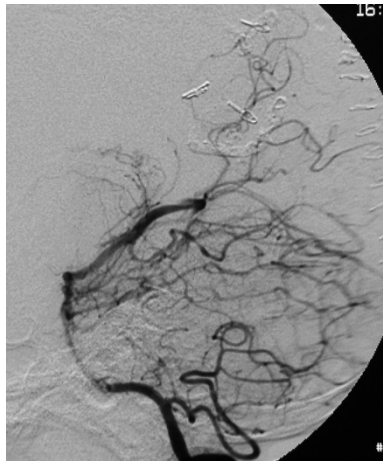


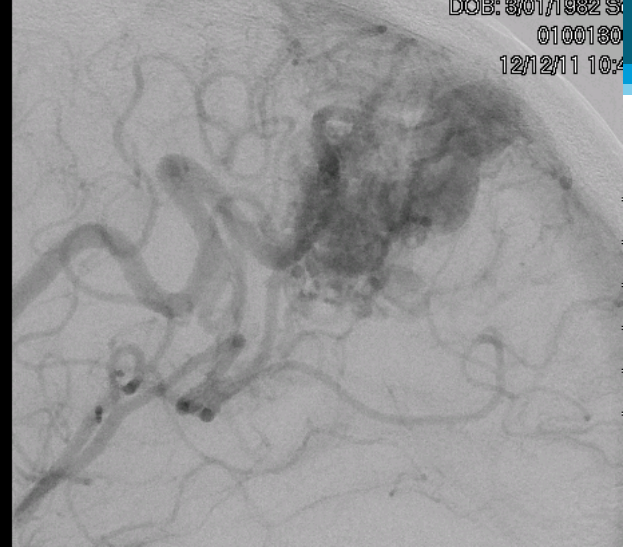
S/P Embolization (x 2) **Final Results: Surgery/Embo**

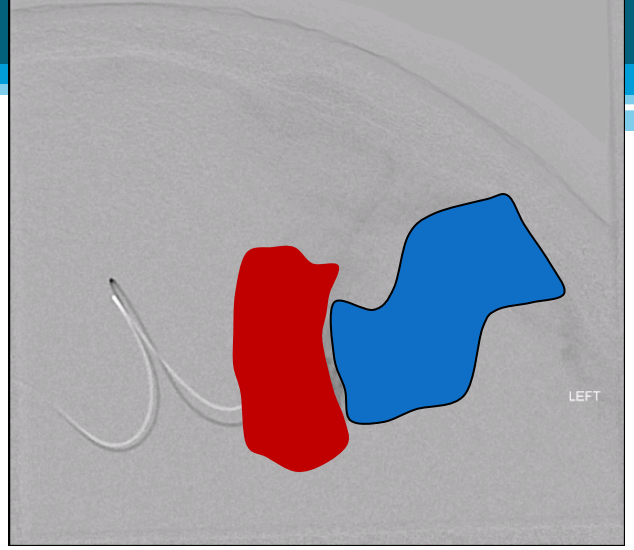


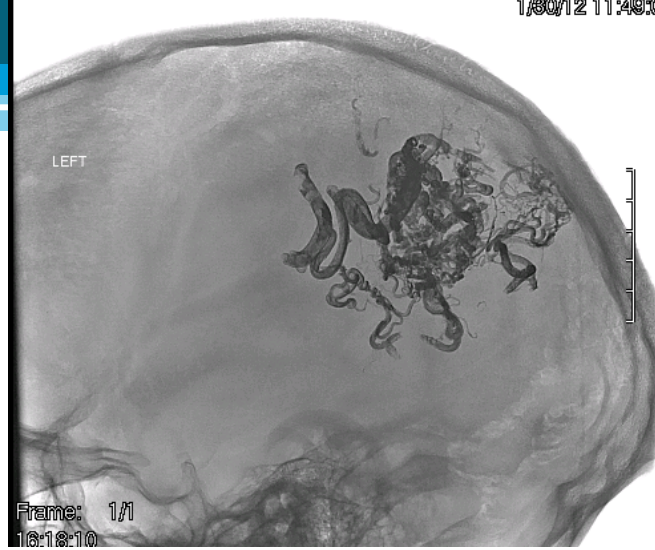








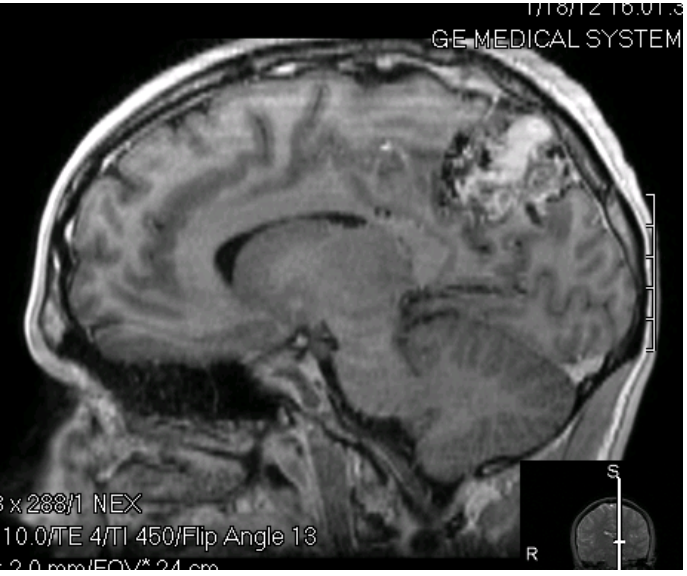


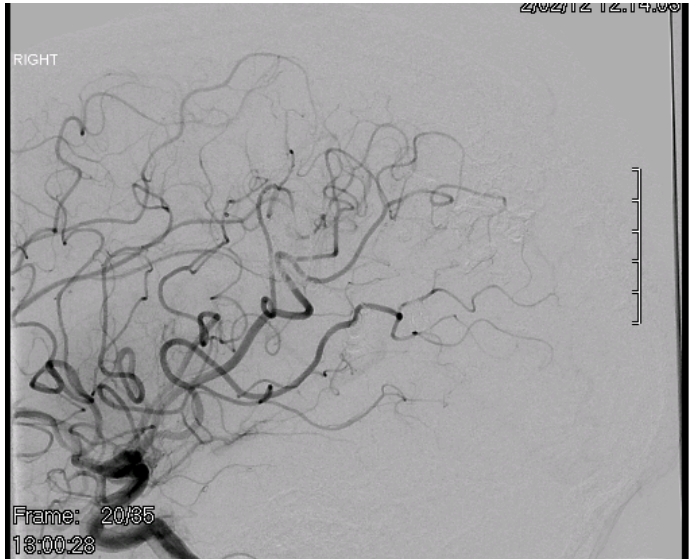


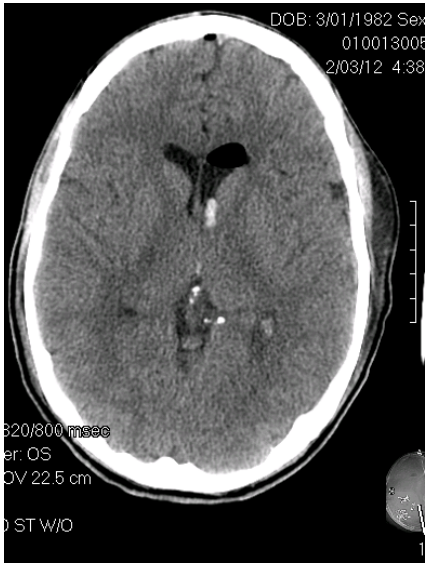
29M, grand mal seizure, Spetzler grade IV AVM, left parieto-occipital

X 3 Onyx/NBCA embolizations

Surgical resection of AVM (15 hour surgery)







CONCLUSION

- Endovascular procedures have changed how AVMs are treated.
- Embolization has made surgical resection safer and radiosurgery possible for larger vascular lesions.
- Grade III and IV AVMs can be completely obliterated with combination therapy.

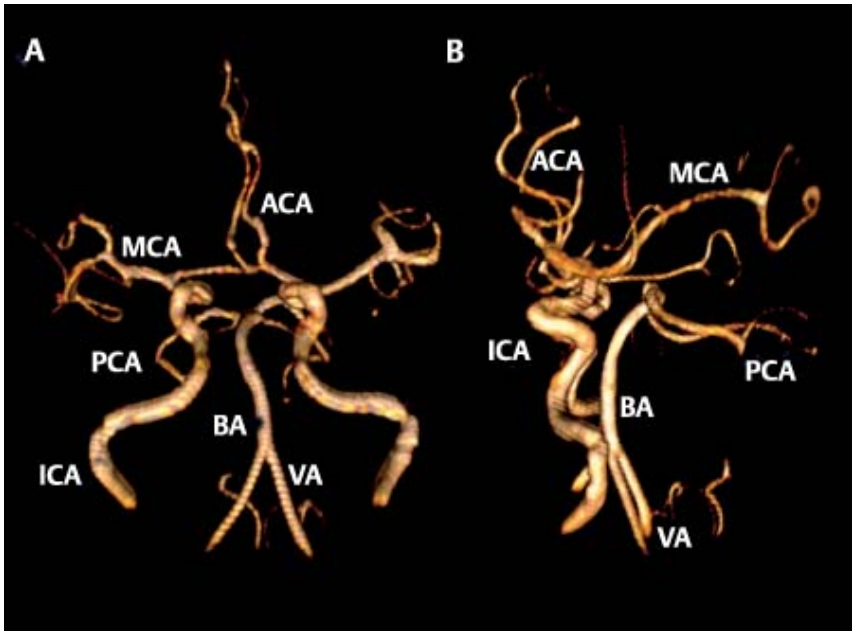
Neuroendovascular Treatment of Cerebral Aneurysms

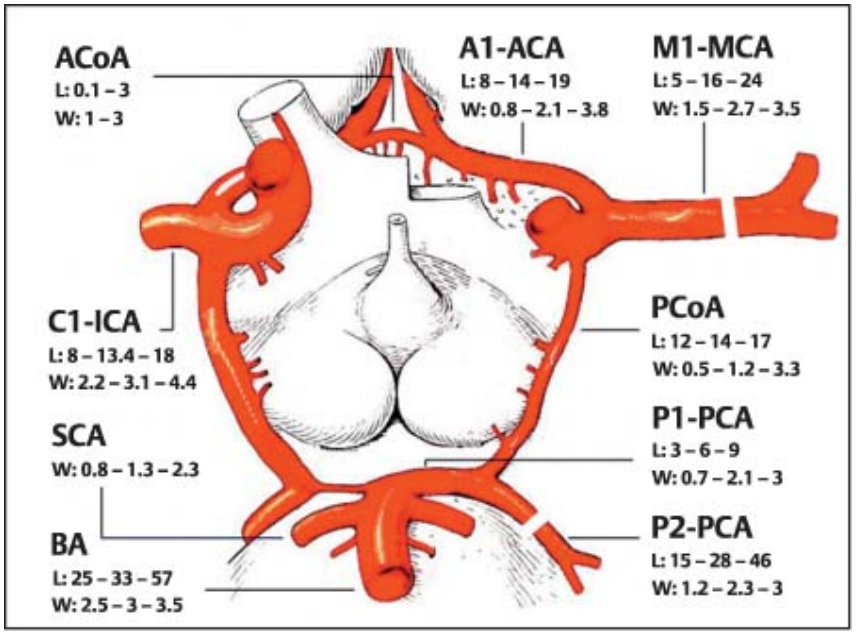
Emily Rorden MSN, RN, ACNP-BC, CNRN, SCRN, CCRN

- Aneurysm rupture can occur at any age
- Most commonly in the 5th decade
- Incidence approximately 10 in 10,000 a year
- Arise more commonly in anterior cerebral circulation

Etiology

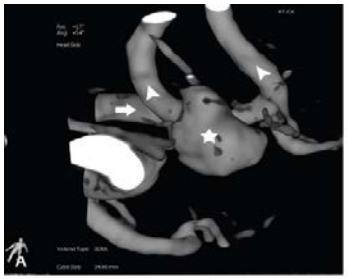
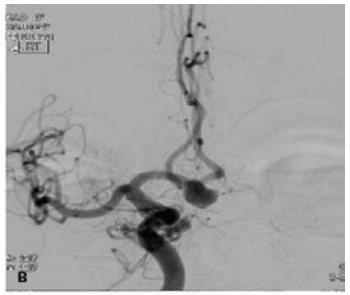
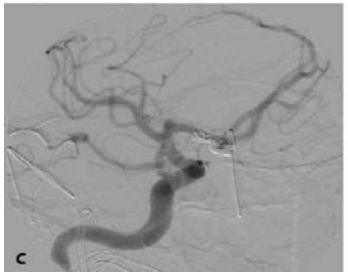
Circle of Willis





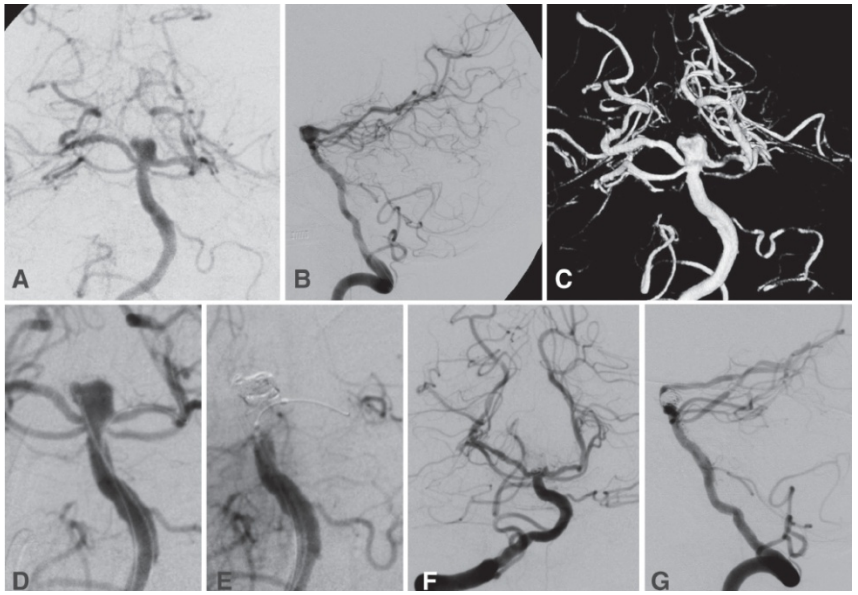
Saccular Aneurysm

- 85-95% Carotid system
  - 30% Anterior Communicating Artery (single most common)
  - 25% Posterior Communicating Artery
  - 20% Middle Cerebral Artery

Saccular Aneurysm

- 5-15% Posterior Circulation
  - 10% Basilar artery
  - 5% Vertebral artery
- 20-30% have multiple aneurysms

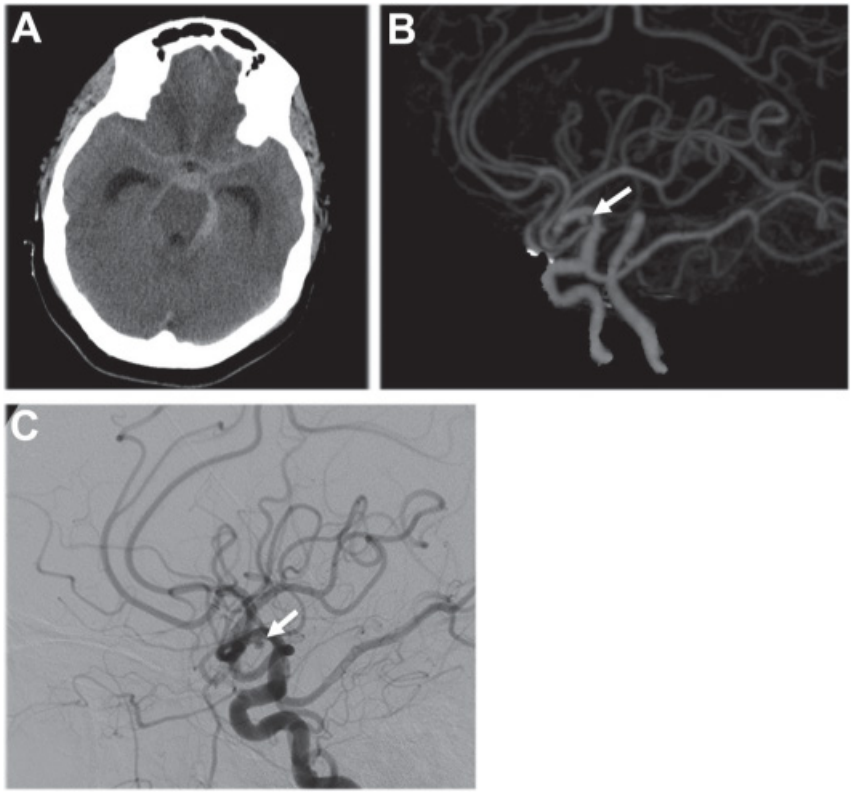


- Smoking
- Hypertension
- Atherosclerosis
- Connective tissue disorders
- Alcohol
- Hemodynamic stresses
- Illicit drugs
- Genetics/Family History

Risk factors for Aneurysm Formation

Diagnosis

- Unruptured
  - Chronic headaches
  - Third nerve palsy
  - Visual loss
  - Ill-defined neurological disorder
- Ruptured
  - Acute onset of headache
  - Meningisumus
  - Photophobia
  - Nausea and Vomiting



5 Year Rupture Risk

Location	<7mm no hx of SAH	<7 mm w/hx of SAH	7-12 mm	13-24 mm	25 mm+
Cavernous	0	0	0	3	6.5
AC/MC/IC	0	1.5	2.5	14.5	40
Post, Pcomm	2.5	3.5	14.5	18.5	50

Subarachnoid Hemorrhage

- Aneurysmal SAH accounts for 6-8% of all stroke
- Incidence of aSAH 8-10 cases per 100,000 annually
- Risk of aneurysm rupture and aSAH is positively correlated with:
  - Aneurysm size
  - Hypertension
  - Smoking

Mortality and Morbidity

- Approximately 10-15% aSAH die before obtaining medical attention
- For those who survive another 30-60% will die because of the initial hemorrhage or secondary sequelae
- Thirty day mortality is approximately 50%

Grade	Description
1	Asymptomatic or mild H/A and slight nuchal rigidity
2	Cr. N palsy, moderate to severe H/A, nuchal rigidity
3	Mild focal deficit, lethargy, or confusion
4	Stupor, moderate to severe hemiparesis, earlydecerebrate rigidity
5	Deep coma, decerebrate rigidity, moribund appearance

*Add one grade for serious systemic disease
(e.g. HTN, DM, severe atherosclerosis, COPD) or severe vasospasm
on arteriography

Hunt and Hess Classification

- Admission Hunt and Hess Grade I or II 20%
- Patient taken to O.R. (for any procedure) at H&H Grade I or II 14%
- Major cause of death in Grade I or II is rebleed
- Signs of meningeal irritation increases surgical risk

Hunt & Hess Grade Mortality

Treatment decisions: coiling vs clipping

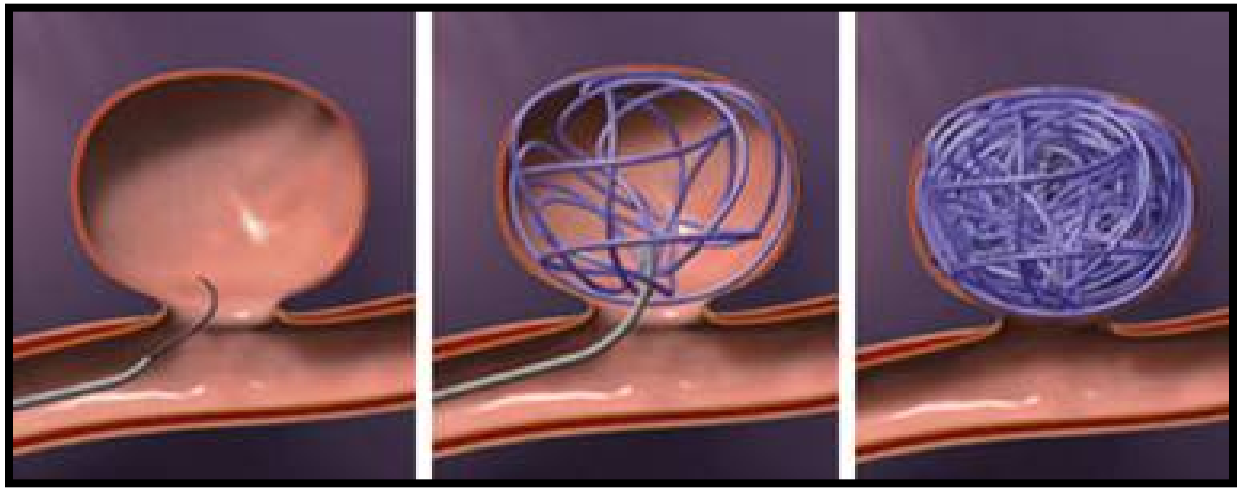
Coiling	Clipping
• Elderly Patients • Poor clinical grade • Inaccessible ruptured aneurysms • Aneurysm configuration • Patients on Plavix • Technically difficult to clip	• Younger age • MCA bifurcation aneurysms • Giant aneurysm • Symptoms due to mass effect • Small aneurysm • Wide aneurysm neck

Coil Embolization Procedure

- Vascular access via the femoral artery
- Vessel is engaged with guide catheter
- Several Techniques
  - Stent -assisted coiling
  - Balloon-Assisted coiling
  - Flow diverting stents

- Goal is to occlude the fundus of the aneurysm completely
- Maintain the patency of the parent vessel
- The ability to embolize an aneurysm fully is largely determined by its anatomy

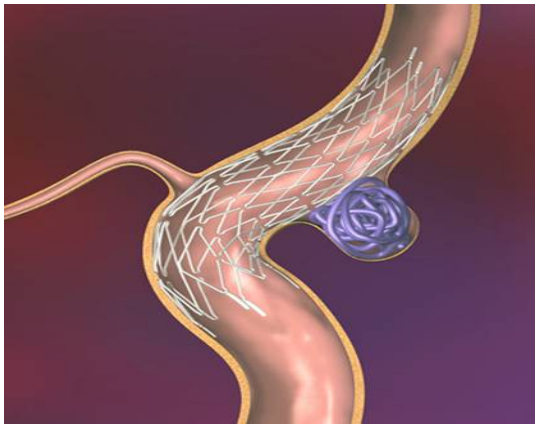
Coil Embolization



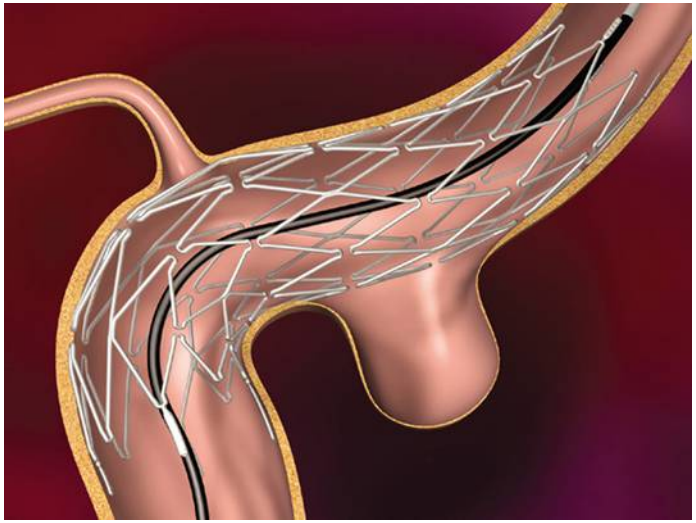
Coil Embolization

Stent Assisted Embolization

- Stent is deployed across the aneurysm neck

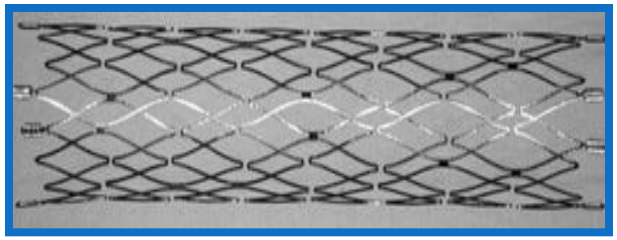


- Deployment of coils through the stent

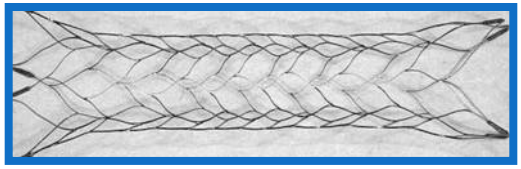


Stent Assisted Embolization

- Advantage: stent serves as a permanent buttress for the coil mass



- Disadvantage: long term use of antiplatelet agents and risk of in stent stenosis



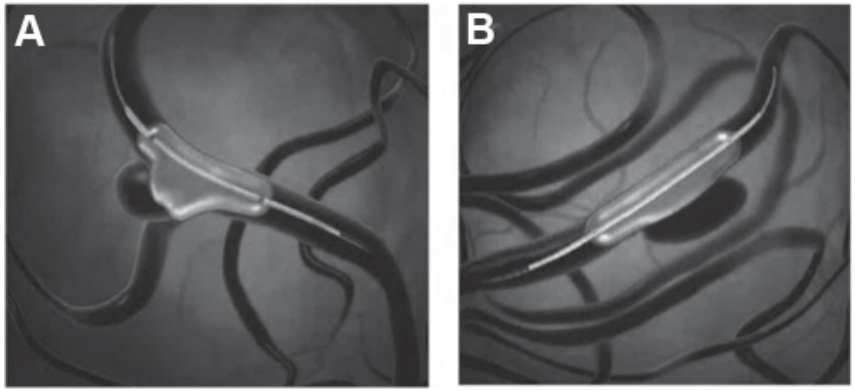
Balloon Assisted Embolization

- Inflation of a balloon in the parent vessel while coils are deployed within the aneurysm
- Once the coil or coils have been deployed, the balloon is deflated
- This technique is especially useful for treating ruptured wide-necked aneurysms

Balloon Assisted Embolization

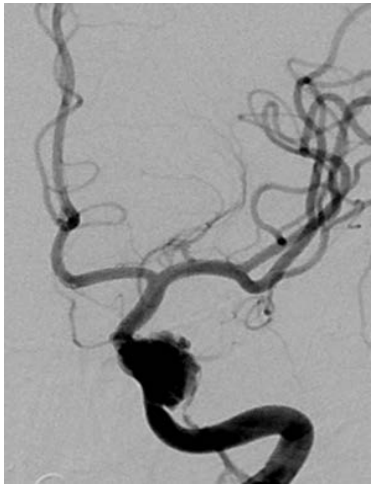
- Advantage:
  - No antiplatelet agents are required

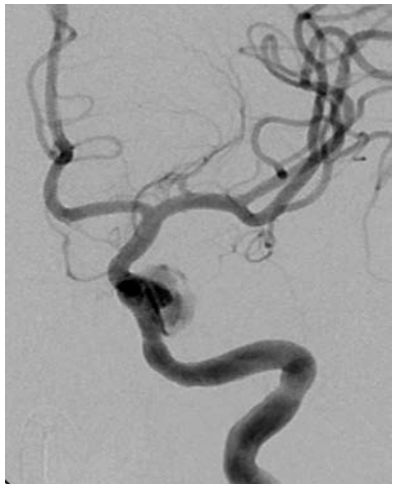
- Disadvantage:
  - ischemic complications
  - Dissection

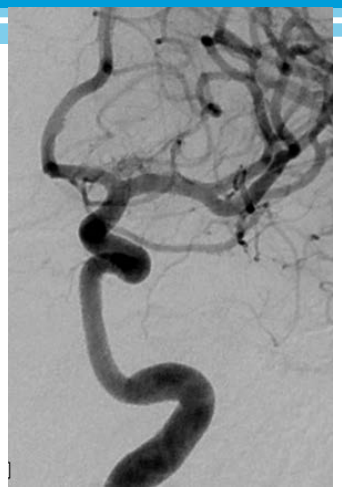


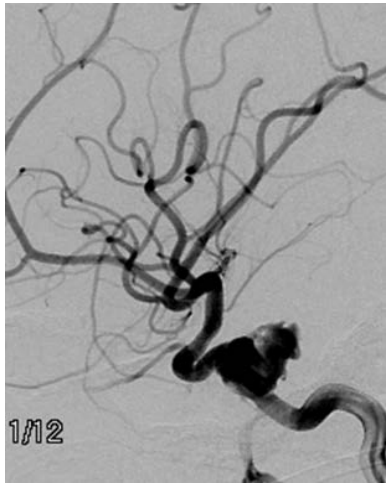
Flow Diversion

- The newest technologies for aneurysm embolization
- Primarily used for wide necked giant aneurysm
- Need long term antiplatelet therapy

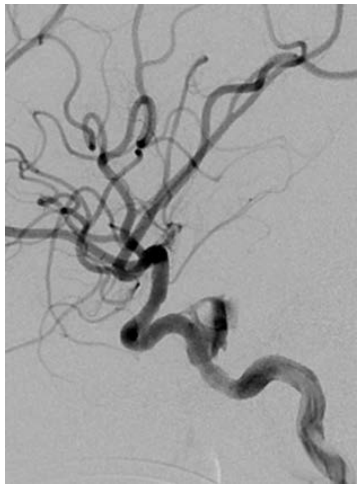








Pre



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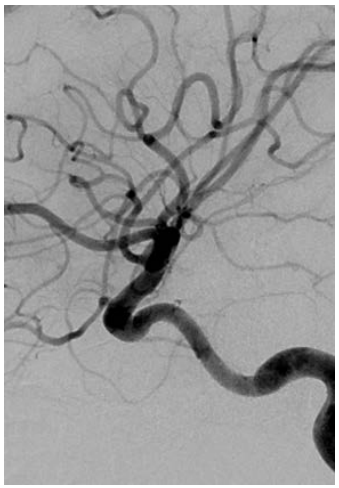


6 months

Flow Diversion

Potential Complications

- Aneurysm Rupture
  - Uncommon < 1%
- Aneurysm Recurrence
  - As high as 20% with bare platinum coils
- Thromboembolic Complications
  - Stroke is the biggest risk in non ruptured aneurysm
- Cranial Neuropathies
  - Neuropathies may worsen after emoblization from further compression of the CN by the coil mass

- Admission to a neurosceince observation unit or ICU
- Hourly neurological exams, vital signs, and arteriotomy site checks
- Keep access site immobilized
- Resume diet
- Adequate hydration to improve renal clearance of dye load
- Check hematocrit and and creatinine level next day

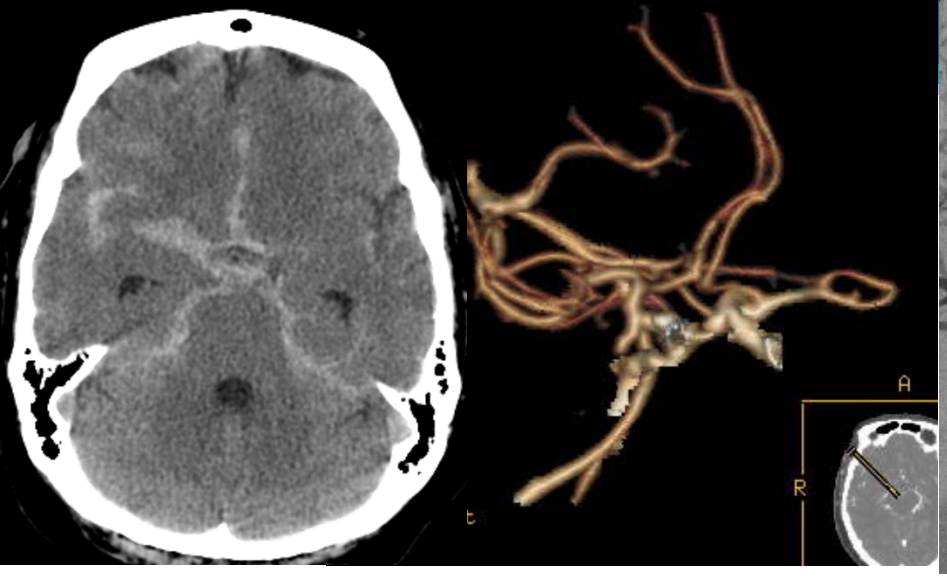
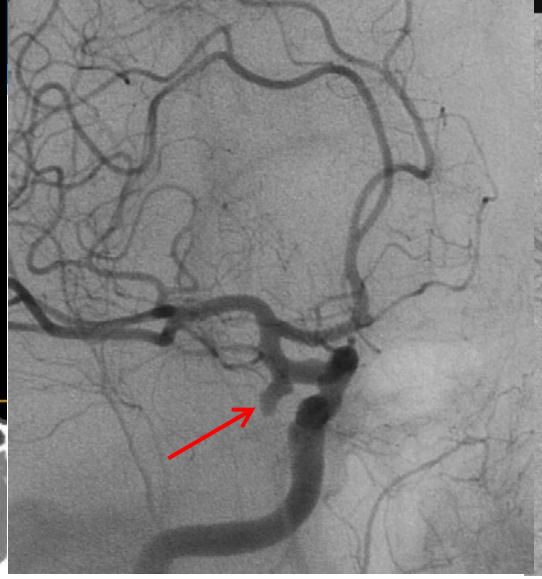
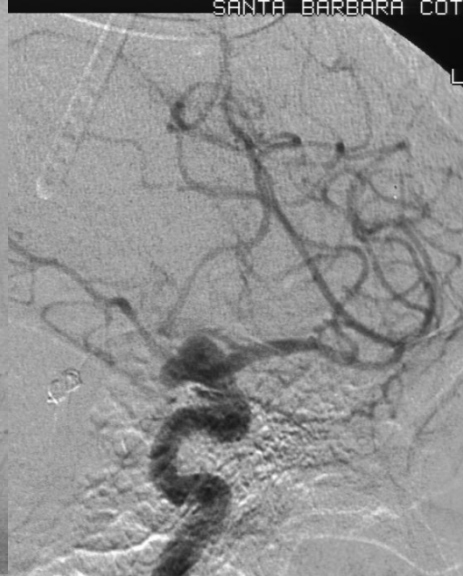
Postprocedural Care: Unruptured

Postprocedural Care: Ruptured

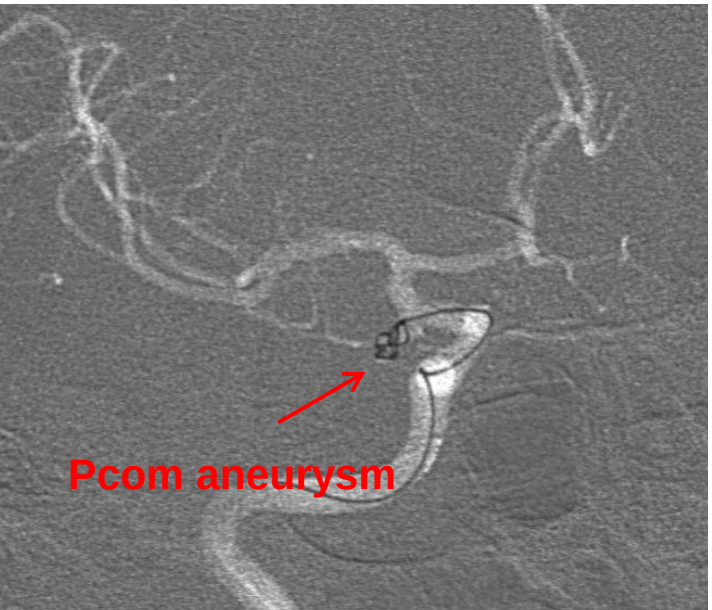
- Admission to ICU
- Hourly neurological, vital signs, and arterial line monitoring
- EVD when hydrocephalus is present or ICP/Licox monitoring when needed
- Strict monitoring of fluid balance
- Daily Transcranial doppler tod assess vasospasm
- Echocardiogram and EKG
- Head CT

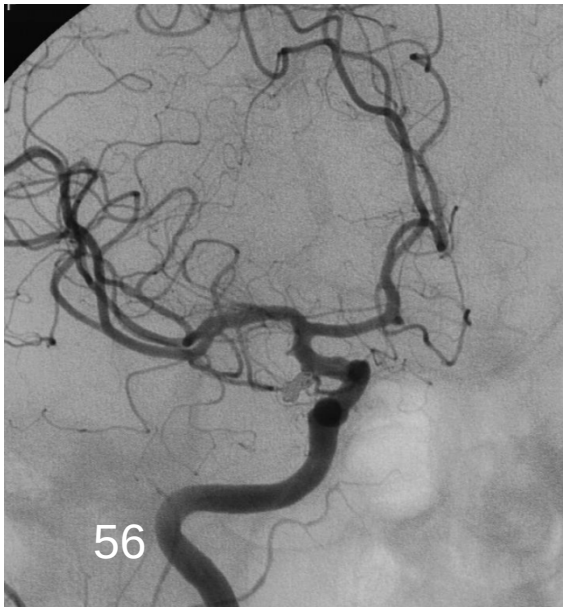
Follow Up Imaging

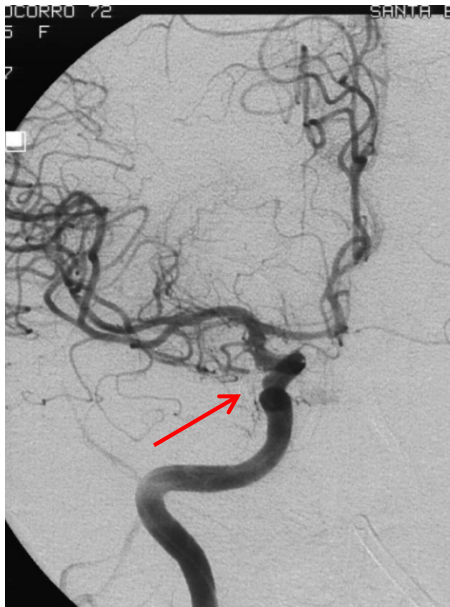
- There are no established guidelines for follow up imaging
- Cerebral angiogram or MRA are more useful imaging studies
- Suggested follow up Imaging from time of coiling
  - 3, 9, 15, 24, 36, 48, 60 (months)

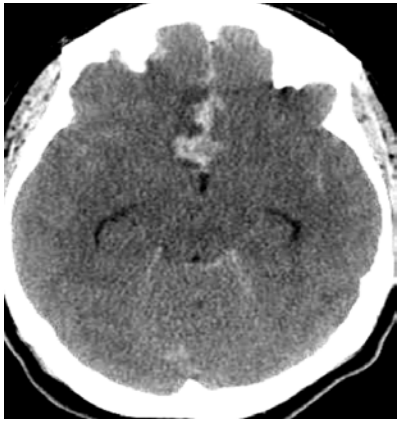




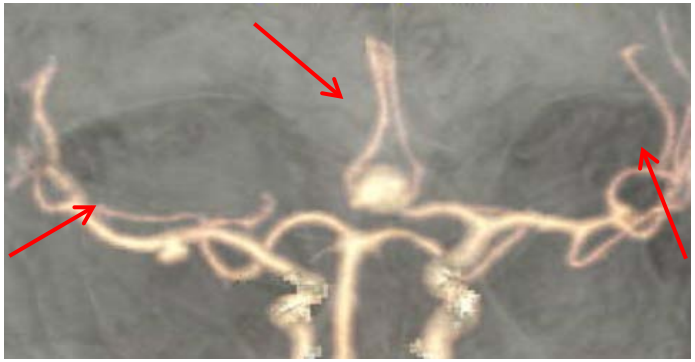
71F, SAH, H&H 2, Fisher # 3, IVH, R-Pcom and L-SHA Aneurysms, Coil embo R-Pcom, Cordis Orbit coils.

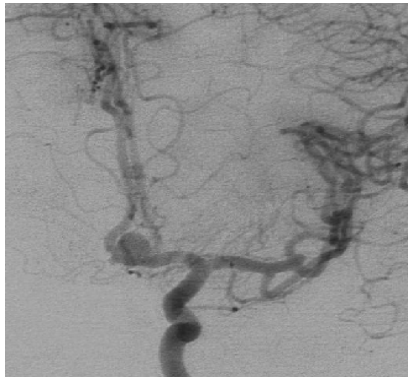




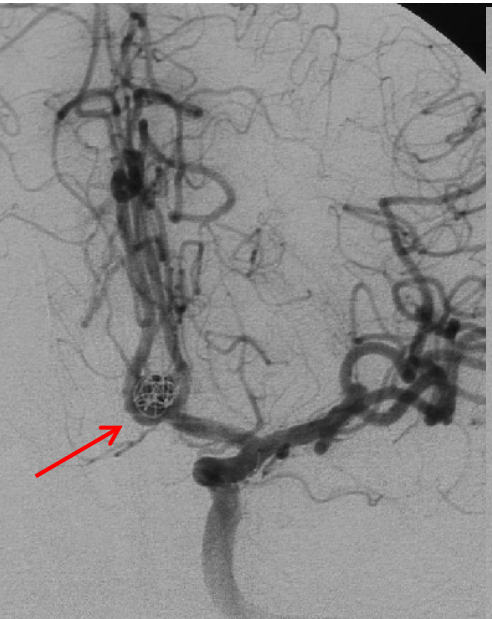


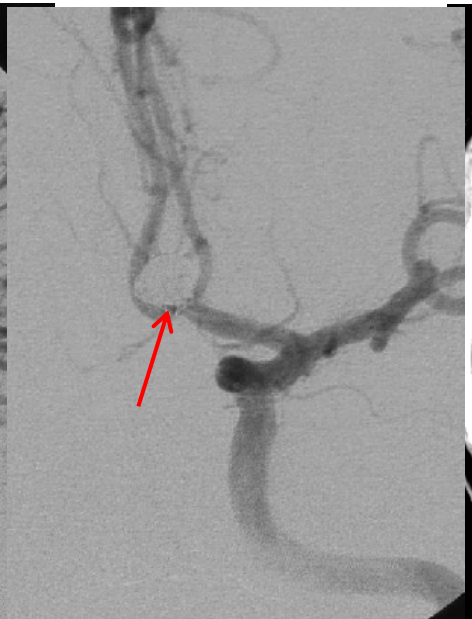


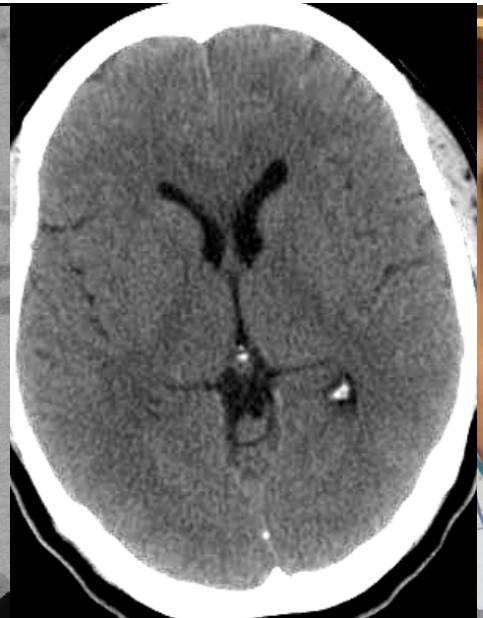


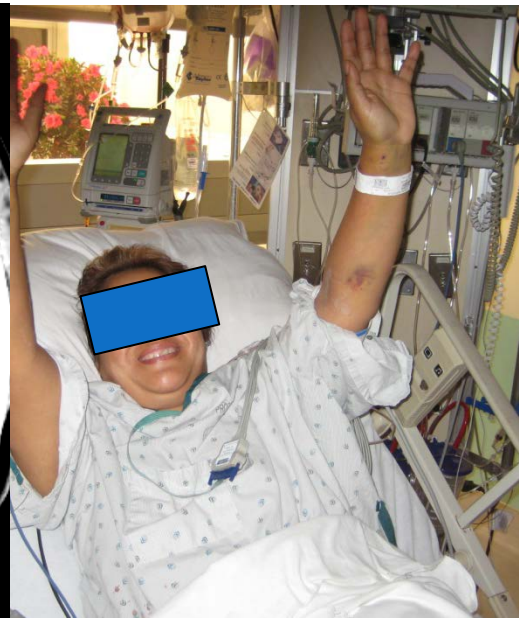


47F, SAH, Hunt & Hess II, Fisher grade 3, ruptured Acom aneurysm and bilateral unruptured MCA aneurysms.









Conclusion

- Cerebral aneurysms are complex
- A craniotomy is no longer the only treatment option
- Endovascular surgery is definitely the better treatment option in those with high surgical risks

THANK YOU