

A Review of Intracranial Aneurysms: a case based approach

Muhammad D. Altaf, DO
Christiana Care Radiology



Patient Presentation

- HPI: 52 yo female with no chronic medical conditions who presented unresponsive to the ED, accompanied by her daughter. The daughter stated that the patient was behaving normally throughout the day, until 10 minutes prior to arrival when she suddenly passed out and fell to the ground. The patient was unable to move her right extremities and demonstrated a right sided facial droop.
- PSHx: none
- Medications: none

Pertinent Labs/Physical Exam

- Unresponsive to painful stimuli
- HEENT - Both pupils dilated at 7mm and non reactive
- Cardiovascular – variable heart rate and rhythm
- Initial BP - 160/100
- Labs - none
- Patient was subsequently intubated and prepared for CT/CTA stroke protocol

Select the applicable ACR Appropriateness Criteria

Variant 3: New focal neurological defect, fixed or worsening. Less than 6 hours. Suspected Stroke

Radiologic Procedure	Rating	Comments	RRL*
CT head without IV contrast	9	Parenchymal brain imaging and CT or MR vascular imaging of the head and neck should be considered. Noncontrast head CT is often obtained first to assess for hemorrhage or large infarct. MRI is more sensitive than CT for acute infarct.	☼☼☼
MRI head without IV contrast	8	Parenchymal brain imaging and CT or MR vascular imaging of the head and neck should be considered. Can be useful if there is a contraindication to contrast. Noncontrast head CT is often obtained first to assess for hemorrhage or large infarct. MRI is more sensitive than CT for acute infarct.	○
MRI head without and with IV contrast	8	Noncontrast head CT is often obtained first to assess for hemorrhage or large infarct. MRI head with contrast can be helpful to determine the age of infarct and to evaluate for other causes of symptoms such as tumor or infection.	○
MRA head and neck without IV contrast	8	Can be obtained in conjunction with MRI head. Preferred MR vascular imaging of the head and neck includes noncontrast head MRA and contrast-enhanced neck MRA. Can be useful in patients with renal failure or contrast allergies.	○
MRA head and neck without and with IV contrast	8	Can be obtained in conjunction with MRI head. Preferred MR vascular imaging of the head and neck includes noncontrast head MRA and contrast-enhanced neck MRA.	○
CTA head and neck with IV contrast	8	CTA can be obtained after NCCT.	☼☼☼
CT head perfusion with IV contrast	6		☼☼☼
MRI head perfusion with IV contrast	5		○
Arteriography cervicocerebral	5		☼☼☼
CT head with IV contrast	3		☼☼☼
CT head without and with IV contrast	3		☼☼☼
US duplex Doppler carotid	2		○



This imaging modality was ordered by the ER physician

Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

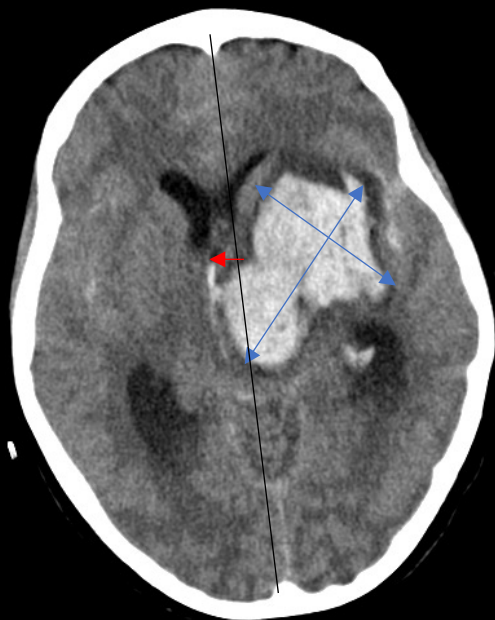
*Relative Radiation Level

Findings CT Head W/O contrast(unlabeled)



Findings: (labeled)

Red arrow shows 7mm right midline shift



Acute 5.6 x 4.4 cm intraparenchymal hemorrhage (blue arrows) involving the pons, left thalamus, and left lentiform nucleus with extension into lateral, third and fourth ventricles



Subarachnoid hemorrhage in the suprasellar cistern and bilateral sylvian fissure (red arrows)



Hyper-attenuating structure anterior to the cerebellum, requiring further evaluation (blue arrow)

Intra-ventricular hemorrhage seen in the fourth ventricle (red arrow)

Further Imaging: CTA head w IV contrast

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CT head perfusion with IV contrast	6		☼☼☼
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Arteriography cervicocerebral	5		☼☼☼
CT head with IV contrast	3		☼☼☼
CT head without and with IV contrast	3		☼☼☼
US duplex Doppler carotid	2		○

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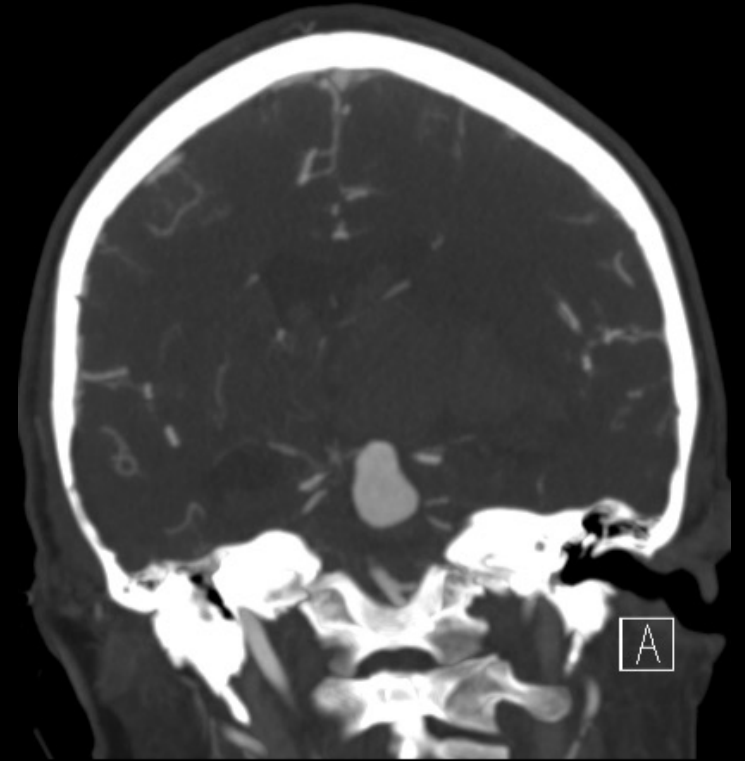
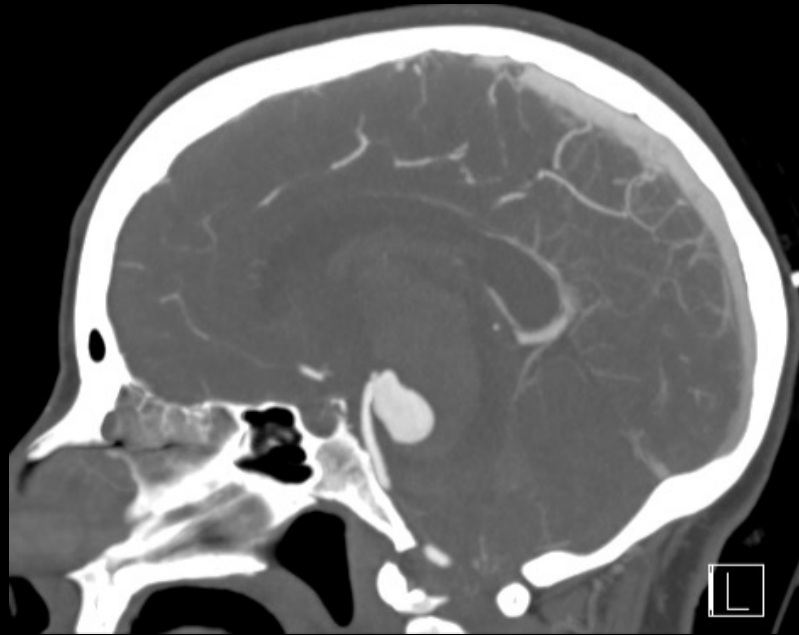
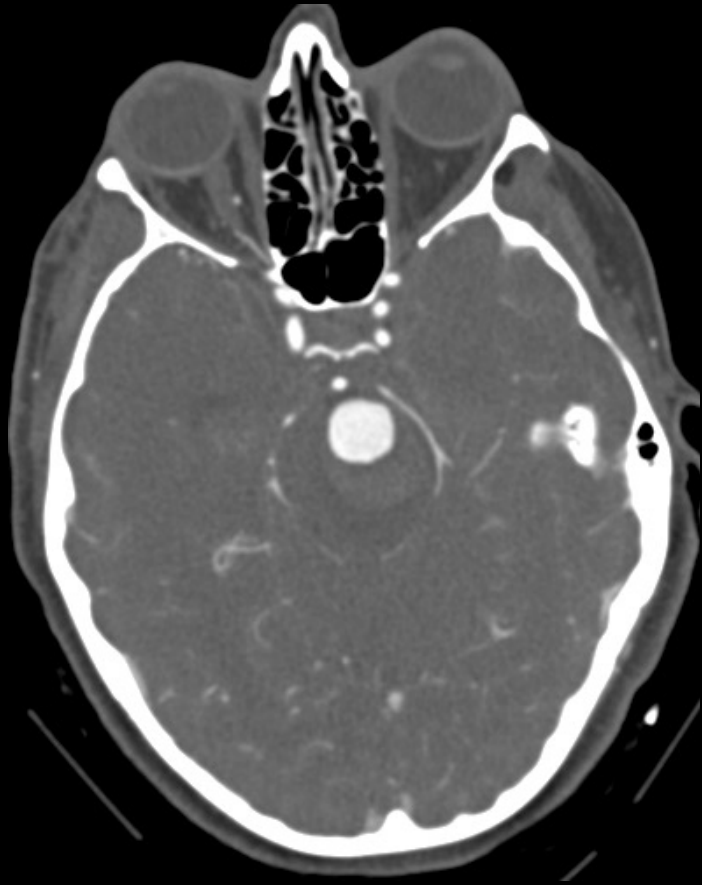
***Relative Radiation Level**

CTA head and neck with IV contrast is performed to evaluate a possible aneurysm responsible for this large intracranial hemorrhage.

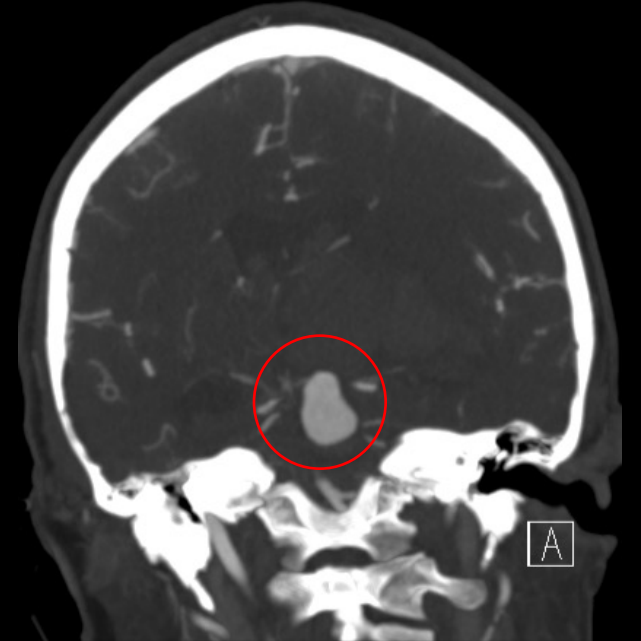
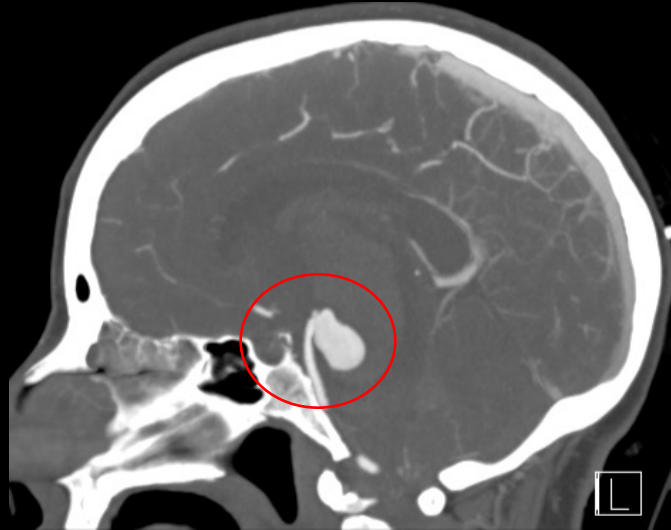
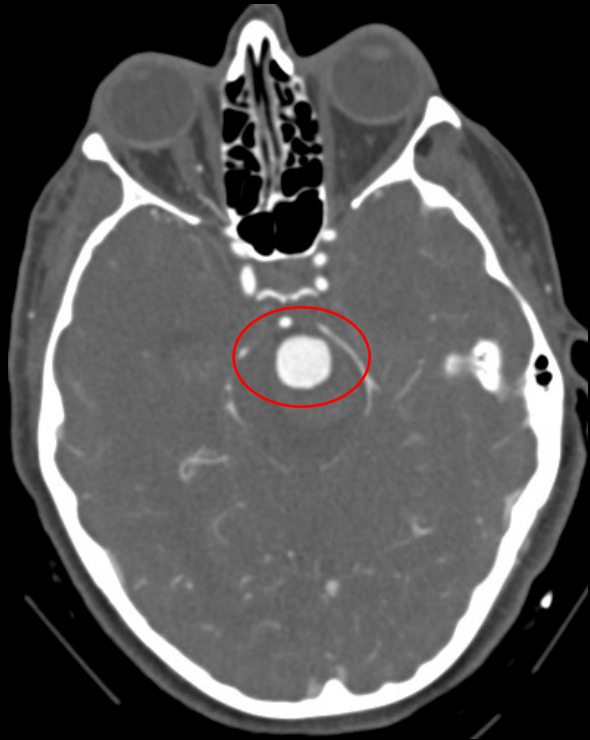
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Findings (unlabeled)

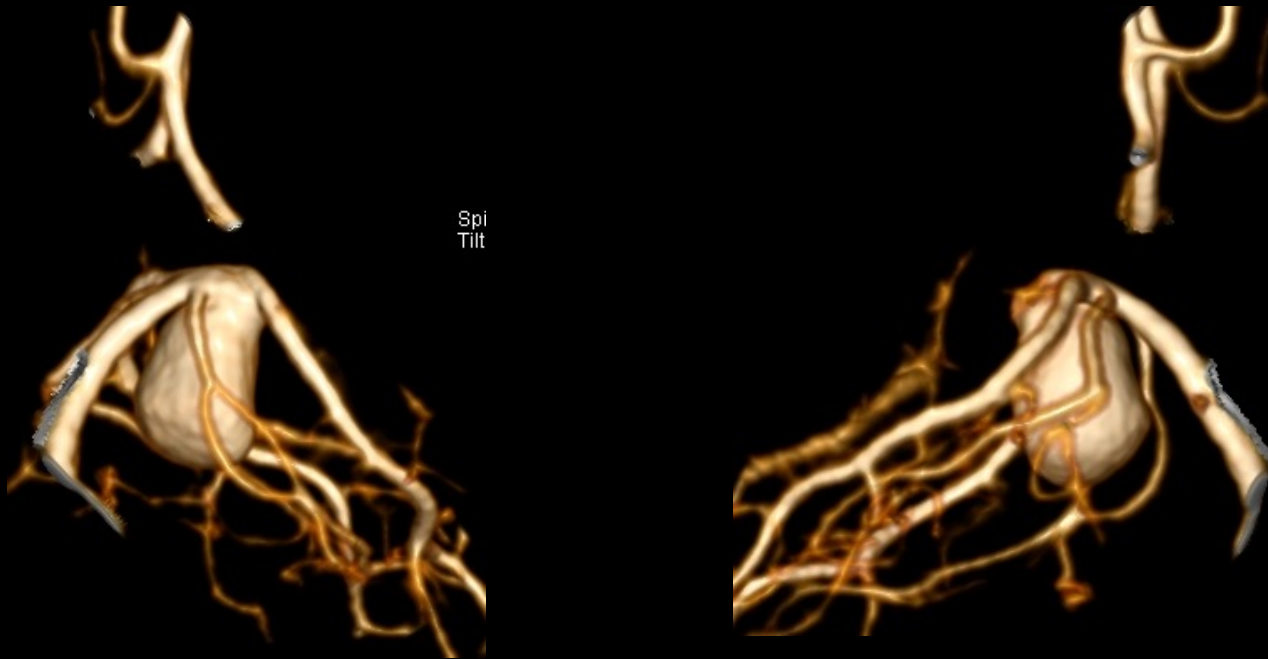


Findings: (labeled)

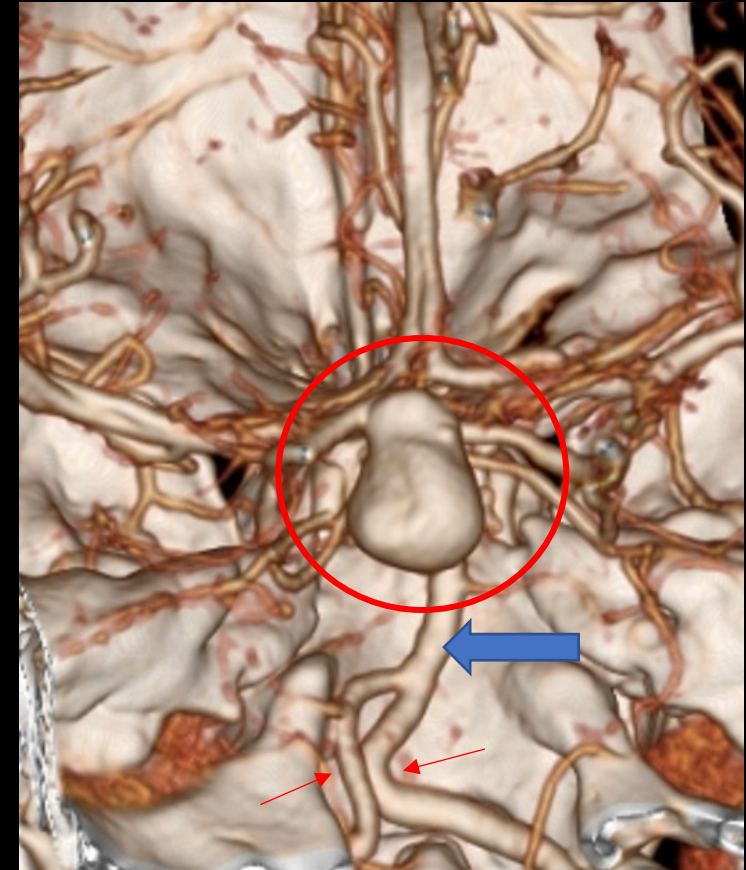


A 1.4 x 1.3 x 1.9 cm aneurysm is seen at the tip of the basilar artery in the axial, sagittal, and coronal plane respectively.

3D reconstruction of Basilar Tip Aneurysm



The right and left vertebral arteries (**red arrows**) join to form the basilar artery (**blue arrow**). A sizeable aneurysm is once again seen at the tip of the basilar artery.



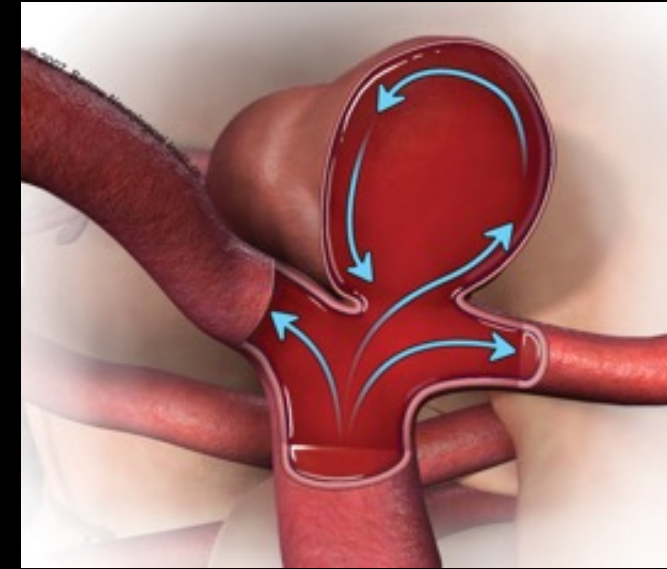
Final Dx:

Spontaneous Hypertensive Intracranial Hemorrhage
Secondary to Basilar Artery Tip Aneurysm

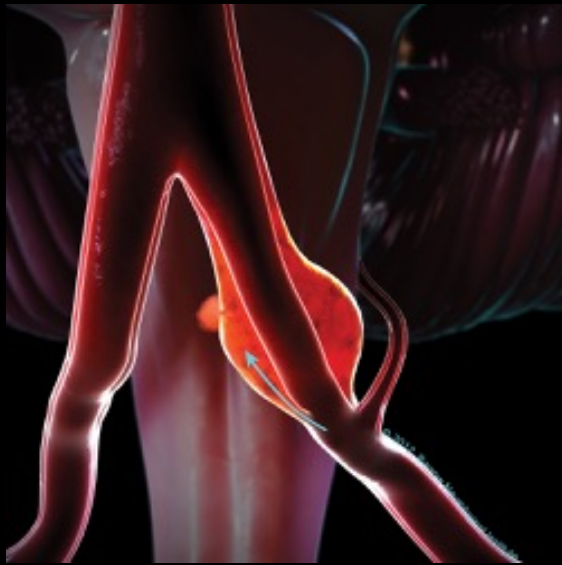
*The patient was determined to have a non-survivable hemorrhage and passed away a few days after admission.

Intracranial Aneurysms (terminology)

- Aneurysms – lobulated focal outpouchings of a vessel due to weakening of the inner muscular layer (true aneurysm – intima, media, adventitia present).
- Saccular (berry) cerebral aneurysms have characteristic round shape and are the most common type of aneurysm (~90%).
 - Prevalence in general (asymptomatic) population: 0.2 – 8.9%
- Giant cerebral aneurysms – typically larger than 25mm
- Charcot-Bouchard aneurysms – small (less than 300 micrometers), secondary to chronic hypertension and commonly found in areas such as basal ganglia, thalamus, pons, and cerebellum.

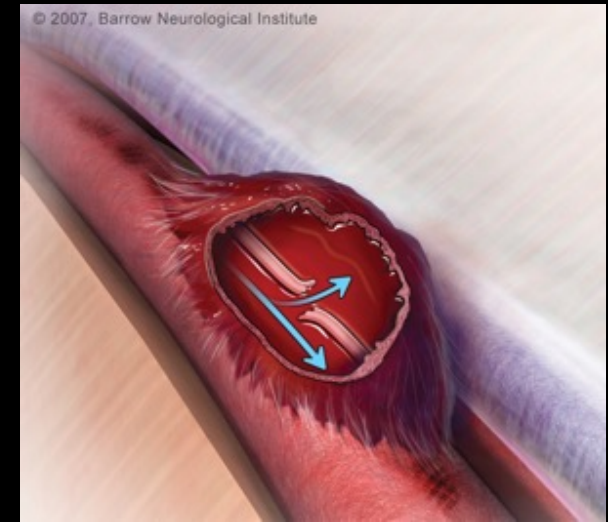
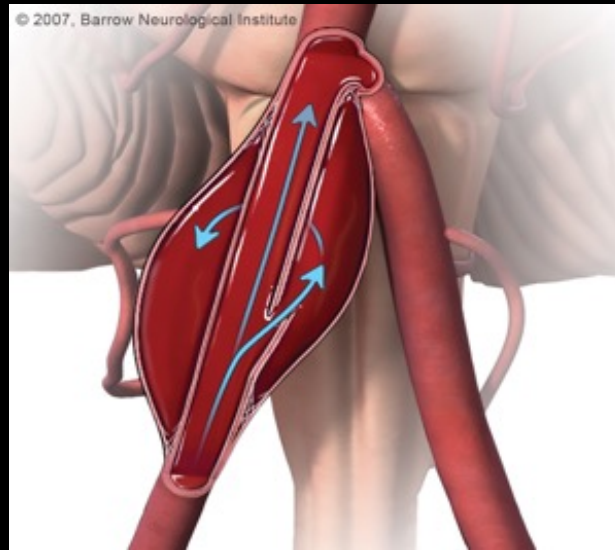


Less common types of aneurysms



Fusiform: non-saccular shape, involving entire vessel wall. Often secondary to atherosclerotic disease.

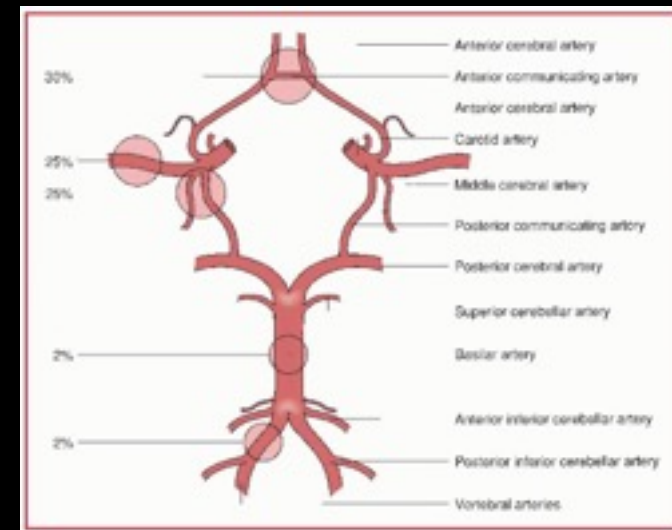
Pseudo (Dissecting): false aneurysm that does not involve all layers, often secondary to trauma.



Blister: aneurysm with blistering appearance, most commonly found in the internal carotid artery. Very fragile and prone to rupture. Etiology is poorly understood.

Location Prevalence

- Anterior circulation accounts for **~90%** of cerebral aneurysms
 - ❖ ACA/ACoA complex – 30-40%
 - ❖ Supraclinoid ICA and ICA/PCoA junction – 30-40%
 - ❖ MCA bi/trifurcation – 20-30%
- Posterior circulation accounts for only **~10%** of cerebral aneurysms
 - ❖ Basilar tip, SCA, PICA



Diagnostic Imaging Considerations

1. **Digital Subtraction Angiography (DSA)** – a fluoroscopic technique used in interventional radiology to directly visualize blood vessels.

- **Gold standard** for aneurysm assessment due to highest spatial and temporal resolution. Provides most accurate parameters for size/shape prior to endovascular management.
- Poor identification of intrasaccular thrombus and calcifications which can alter surgical management.
- Highly expensive and invasive.

2. **CT Angiography (CTA)**

- High sensitivity and specificity for detecting intracranial aneurysms (~97%)
- Wide availability and relatively non-invasive.
- Sensitivity diminishes for aneurysms smaller than 3mm (~61%)

3. **MR Angiography (MRA)**

- Avoids use of ionizing radiation
- Sensitivity ~95%, Specificity ~89%
- Less available, higher cost, longer acquisition time, motion artifact

Size based prognosis

Anterior Circulation (5 year risk of rupture)

- <7 mm: 0%
- 7-12 mm: 2.6%
- 13-24 mm: 14.5%
- >25 mm: 40%

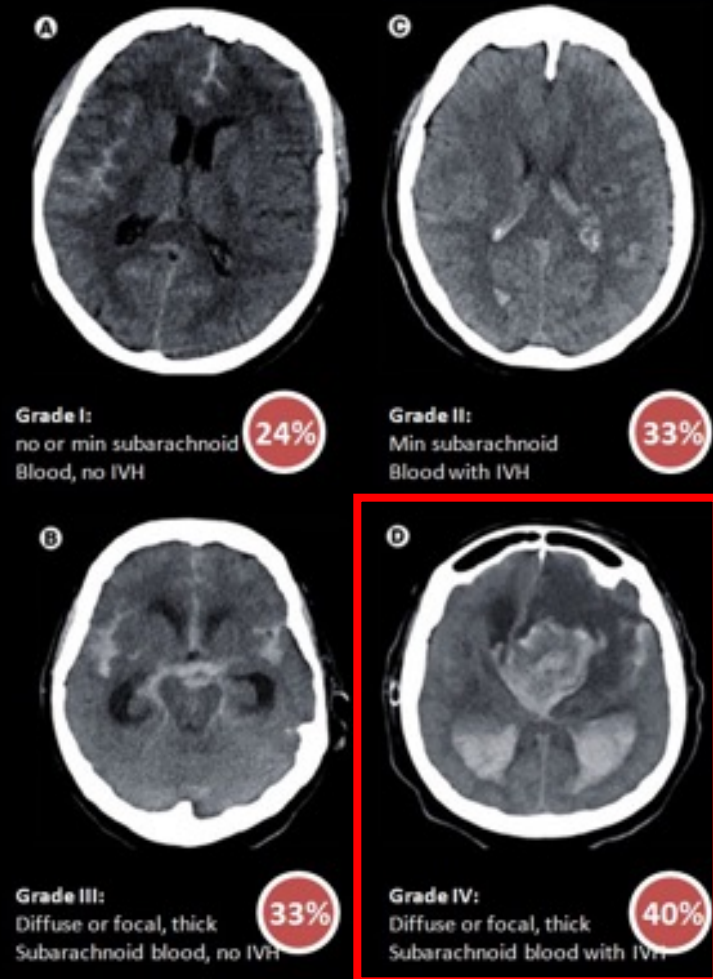
Posterior Circulation (5 year risk of rupture)

- <7 mm: 2.5%
- 7-12 mm: 14.5%
- 13-24 mm: 18.4%
- >25 mm: 50%

* Berry aneurysms are the most common cause of non-traumatic subarachnoid hemorrhage

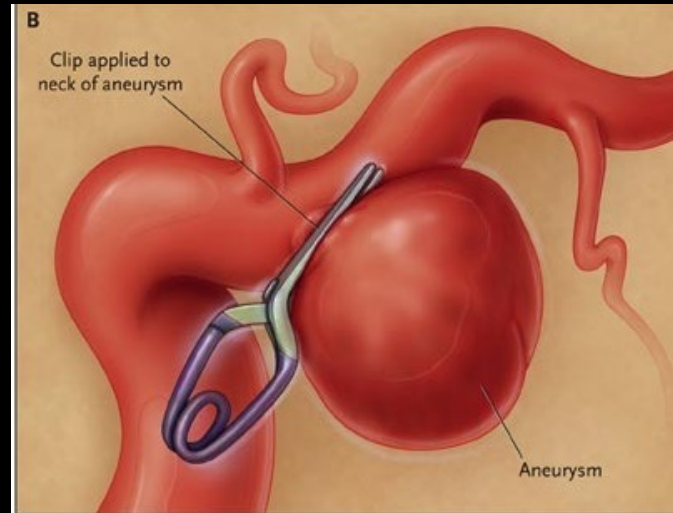
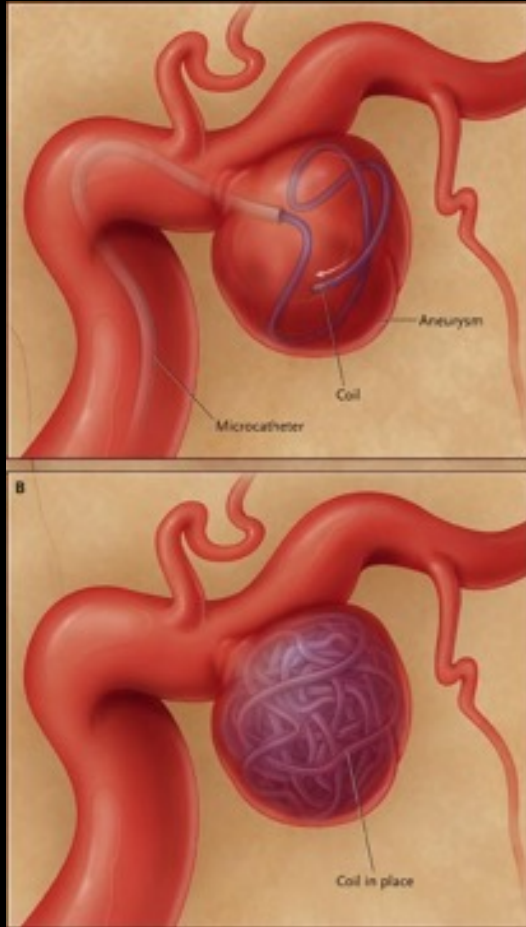
Modified Fisher Scale

Modified Fisher scale



- The Fisher scale is a method used by radiologists to grade the severity of a subarachnoid hemorrhage that is secondary to intracranial aneurysm rupture on a non contrast head CT.
- The percentages represent the increased risk of symptomatic vasospasm following hemorrhage.
- The *modified* Fisher scale improved this prediction of vasospasm by incorporating the effects of thick cisternal blood and intraventricular hemorrhage.
- The patient in our case was diagnosed with a Grade IV subarachnoid hemorrhage on the modified Fisher scale, with a 40% risk of vasospasm.

Treatment Options



- Cerebral aneurysms can be treated with either endovascular coiling, or by clip placement at the neck.
- The location of a basilar tip aneurysm poses a therapeutic challenge. A frequent complication of treatment is coil compaction in 24-36% of cases.
- Basilar tip aneurysms may carry a worse potential prognosis. Reports show a 12% risk of rupture at 7.5 years at the basilar tip, as compared to 3% in other locations for aneurysms less than 10mm in size.

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