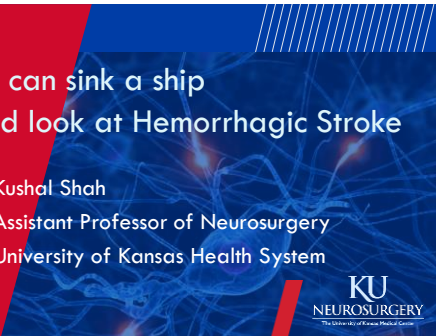



One leak can sink a ship
A detailed look at Hemorrhagic Stroke

- Kushal Shah
- Assistant Professor of Neurosurgery
- University of Kansas Health System



1



No disclosures



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Objectives

- Understand the various types of Hemorrhagic Stroke
- Understand the treatment and surgical role of ICH
- Review SAH and various management



3

Which is the most common cause of Stroke?

- A – Ischemic
- B – Hemorrhagic



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Types of Stroke

Ischemic stroke



80-85%

Hemorrhagic stroke



15-20%

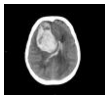


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Hemorrhagic Stroke

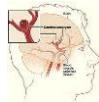
Intracerebral hemorrhage (ICH)

- 59%
- Spontaneous non-traumatic bleeding into the brain tissue



Subarachnoid Hemorrhage (SAH)

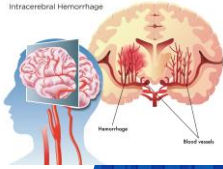
- 41%
- Bleeding into subarachnoid space usually from aneurysm rupture or trauma



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Intracerebral Hemorrhage (ICH)

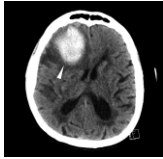
- 2nd leading cause of stroke
 - ▣ Accounts for 10-15% of all strokes
- 30-day mortality is 35 – 52%
 - ▣ 5 times the mortality of ischemic stroke



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Causes of ICH

- Primary (hypertensive) ICH (most common)
- Ruptured aneurysm, AVM, vascular malformation
- Trauma
- Hemorrhagic Disorders
- Hemorrhage into tumor
- Amyloid angiopathy



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Locations of ICH



9



Diagnose ICH

- CT head w/out contrast
- CTA head
- MRI brain w/ & w/out contrast



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Should this patient have surgery for evacuation of ICH?

- A – Surgical evacuation
- B – Medical management alone
- C – Both
- D – Endovascular evacuation



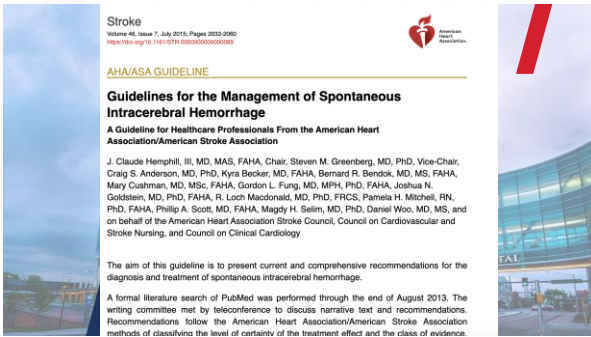
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Treatment of ICH

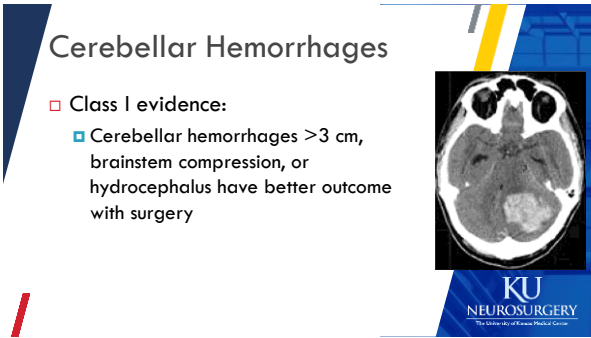
- Manage Blood pressure
- Reverse coagulopathy
- Surgery*
- No role for steroids
- Prophylactic antiepileptic medications aren't recommended



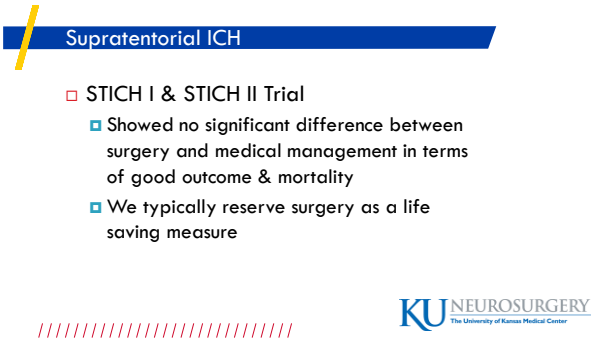
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Minimally Invasive?



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Intraventricular Hemorrhage

- Treatment: CSF diversion
 - EVD placement
- Role for tPA?



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Question

Which unruptured aneurysm has the highest risk of rupture

- A. 12 mm cavernous carotid aneurysm
- B. 10 mm posterior communicating artery aneurysm
- C. 6 mm middle cerebral artery aneurysm

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Subarachnoid Hemorrhage (SAH)

- Life-threatening type of stroke from bleeding into the space surrounding the brain
- Causes
 - Trauma (most common)
 - Ruptured aneurysm
 - Ruptured AVM
 - Other less common causes

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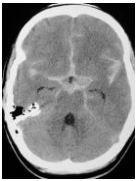
Signs & Symptoms

- Headache – thunderclap type
 - ▣ “Worst headache of my life”
- Nuchal rigidity
- Change in mental status, coma



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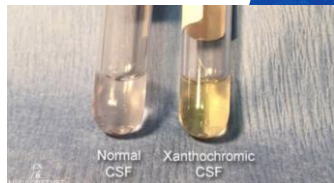
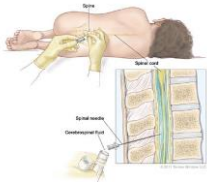
22



<https://emedicine.medscape.com/article/1164341-overview>

Park et al. Traumatic Rupture of the Middle Cerebral Artery Followed by Acute Basal Subarachnoid Hemorrhage: Tailoring Approach in Forensic Pathology by Aid of Post-mortem CSF Xanthochromia Findings. Korean J Leg Med. 2019 Feb;31(1):27-37.

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<https://auresearch.org>

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Hunt & Hess Score

Grade	Criteria	Index of Perioperative Mortality (%)
0	Aneurysm is not ruptured	0-5
I	Asymptomatic or with minimal headache and slight nuchal rigidity	0-5
II	Moderate to severe headache, nuchal rigidity, but no neurologic deficit other than cranial nerve palsy	2-10
III	Somnolence, confusion, medium focal deficits	10-15
IV	Stupor, hemiparesis medium or severe, possible early decerebrate rigidity, vegetative disturbances	60-70
V	Deep coma, decerebrate rigidity, moribund appearance	70-100

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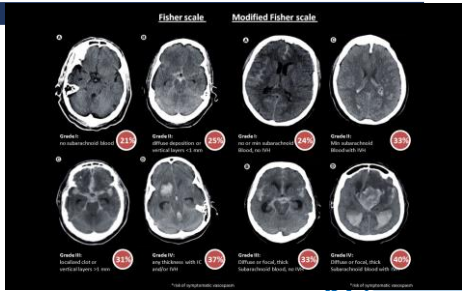
Fisher Scale

TABLE 2
Computed tomographic grading scales for subarachnoid hemorrhage

Grade	Fisher scale ^a	Modified Fisher scale ^b	Risk of vasospasm ^c
0	—	No subarachnoid or intraventricular hemorrhage	0%
1	No subarachnoid hemorrhage or intraventricular hemorrhage	Minimum or thin subarachnoid hemorrhage, no intraventricular hemorrhage in either lateral ventricle	6%
2	Diffuse, thin subarachnoid hemorrhage on axial CT less than 1 mm in thickness	Minimum or thin subarachnoid hemorrhage, with intraventricular hemorrhage in both lateral ventricles	15%
3	Localized thick layer of subarachnoid clot > 1 mm in thickness	Thick subarachnoid hemorrhage, no intraventricular hemorrhage	35%
4	Predominant intraventricular hemorrhage or intracerebral hemorrhage without thick subarachnoid hemorrhage	Thick subarachnoid hemorrhage with intraventricular hemorrhage in both lateral ventricles	34%

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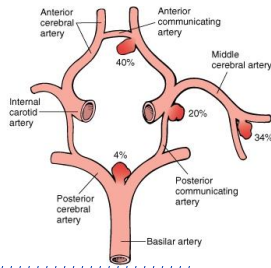




<https://pubmed.ncbi.nlm.nih.gov/2015/03/24/modified-fisher-grading-scale-for-sah/> KU NEUROLOGY The University of Kansas Medical Center

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Where do Aneurysms occur?



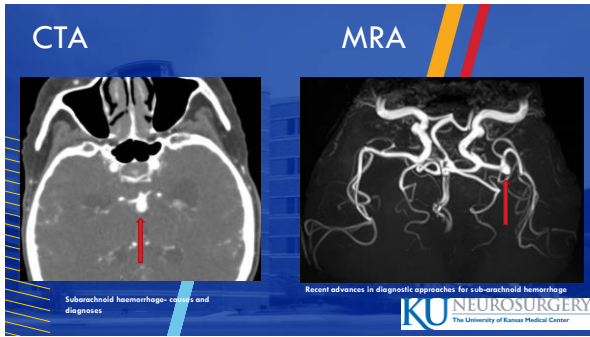
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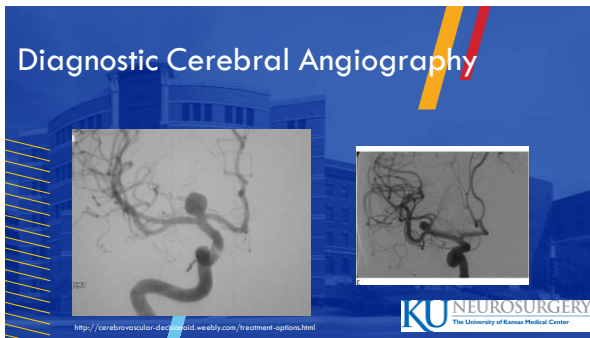
How do you diagnose aneurysms?



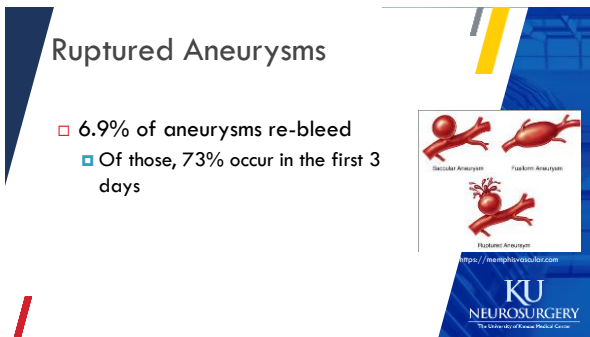
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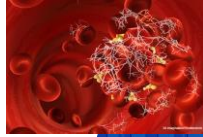
32



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How to prevent re-rupture

- BP management
- Antifibrinolytic agents
 - Aminocaproic acid
 - Tranexamic acid
- Early aneurysm treatment



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To CLIP or To COIL?



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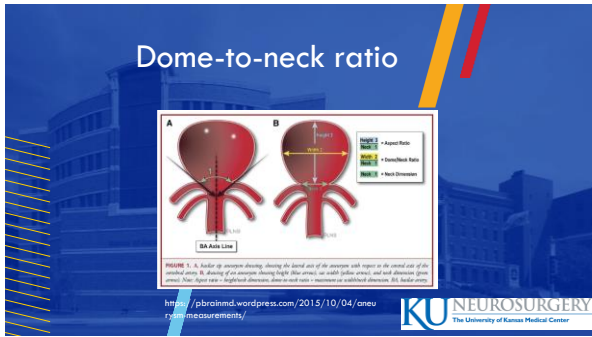
Factors to make your decision

- | | |
|--|---|
| <input type="checkbox"/> For Clipping | <input type="checkbox"/> For Coiling |
| <input type="checkbox"/> Younger age | <input type="checkbox"/> Older age |
| <input type="checkbox"/> Large neck, favorable anatomy | <input type="checkbox"/> Narrow neck, Favorable anatomy |
| <input type="checkbox"/> Anterior Circulation | <input type="checkbox"/> Posterior Circulation |
| <input type="checkbox"/> Good grade SAH | <input type="checkbox"/> Higher grade SAH |
| <input type="checkbox"/> YOUR EXPERIENCE | <input type="checkbox"/> YOUR EXPERIENCE |

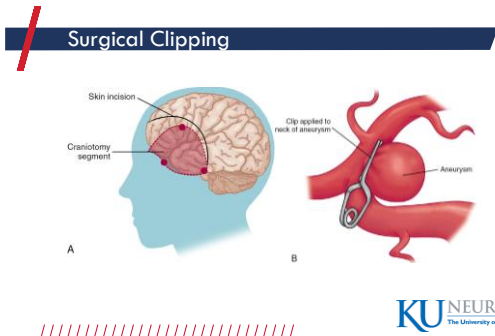
Data is difficult to interpret



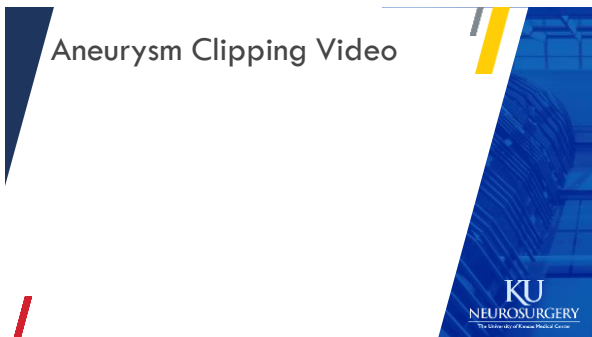
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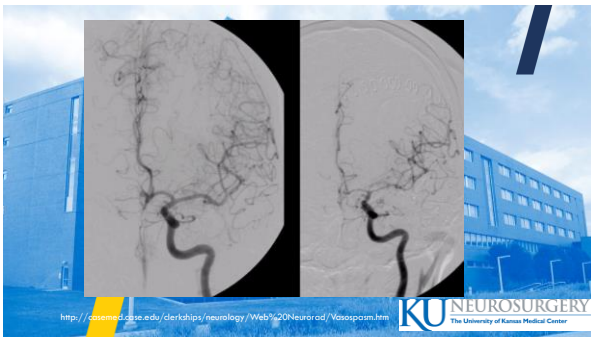
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Vasospasm

- Definition: AKA Delayed ischemic neurologic deficit
 - ▣ Delayed ischemic neurologic deficit following SAH
- Radiographic vasospasm ~ 70%
- Clinical vasospasm ~30%
- Typically occurs day 4 - 14



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Vasospasm

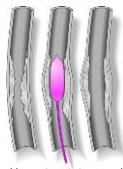
- Triple H Therapy
 - ▣ Hypertension
 - ▣ ~~Hypervolemia~~
 - ▣ ~~Hemodilution~~
- Outdated!
- Nimodipine – Calcium Channel Blocker



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Vasospasm

- Resistant Treatment
 - ▣ Angiography
 - Intra-arterial calcium channel blockers to allow vasodilation
 - Angioplasty



<https://www.dicardiology.com/>



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Conclusions

- Hemorrhagic stroke is broken down between ICH/IVH & SAH
- ICH treatment is predominantly medical, but surgical treatments are offered in certain specific circumstances.
 - ▣ Surgery can be a life saving measure
- SAH is an important cause of hemorrhagic stroke. Aneurysm rupture is important cause and should be treated appropriately with clipping or coiling
- Think of other causes of hemorrhage: hemorrhagic tumor, AVM, fistula, cavernoma, and more



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