

Acute Care Management

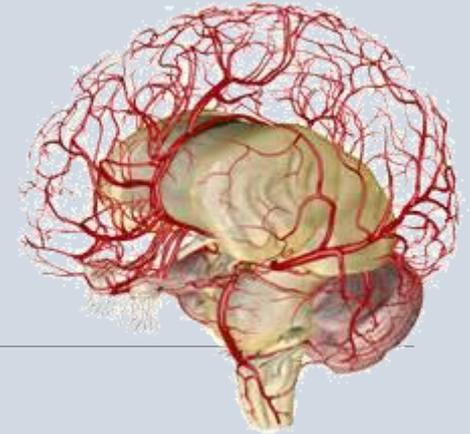


GEORGIA STROKE CURRICULUM

Learning Objectives

- Identify:
 - Types of stroke: Ischemic and Hemorrhagic
 - Evidence based stroke treatment
 - Stroke complications
 - Evidence based stroke quality programs

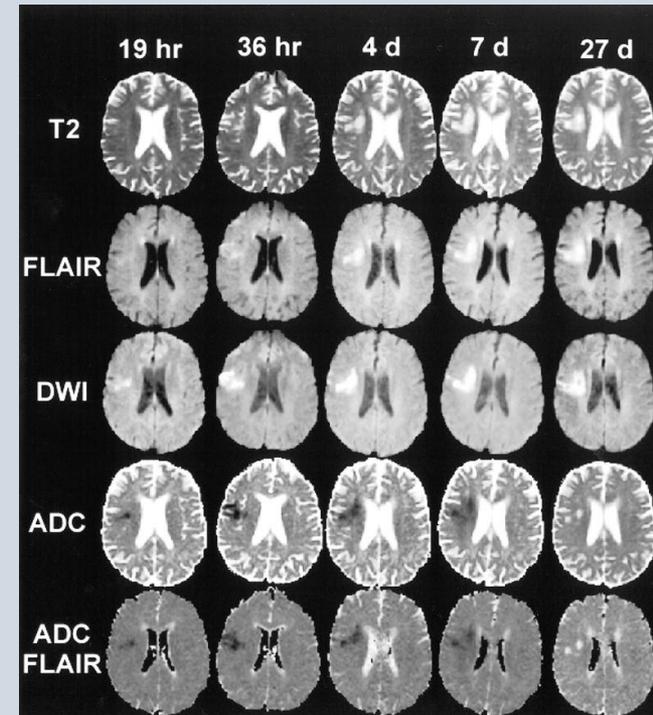
Ischemic Stroke



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Defining the Stroke Timeline

- **Acute Ischemic Stroke (AIS)**
 - Hyperacute stroke: first 24 hours
 - Acute stroke: first 24 – 72 hours
 - Subacute stroke: after 72 hours
 - Chronic stroke: 6 weeks or greater



Priority the first 24 hours is frequent assessment of neurological status

Neurologic Assessment Scales

- **ABCD2** (0-7) TIA score for stroke risk in 2-90 days
- **NIHSS** (0-42) Neurological function & stroke severity
- **GCS** (3-15) neurologic scale, not sensitive for focal deficit
- **Hunt/Hess** (1-5) Severity outcomes for SAH (mortality in 30 days)
- **Fisher** (1-4) Risk of vasospasms for SAH
- **ICH score** (0-6) Predicts 30-day mortality
- **Modified Rankin Scale** (0-6) 90 day follow up for disability

NIH Stroke Scale



You know how.
Down to earth.
I got home from work.
Near the table in the dining room.
They heard him speak on the
radio last night.

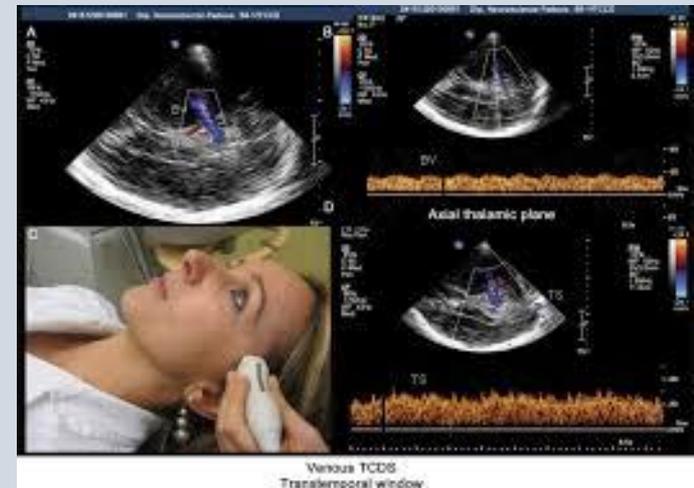


MAMA
TIP – TOP
FIFTY – FIFTY
THANKS
HUCKLEBERRY
BASEBALL PLAYER

- Evidence based, validated, standard tool used to measure neurological function over time (0-42)
- Communication tool between bedside staff and providers
- **NIHSS > 25 to 30 indicates long term neurologically impairment and increased morbidity and mortality**
- An increase or decrease of 4 points in the stroke scale indicates important neurological changes
- Best practice as initial stroke assessment tool and long-term outcome for AIS
- Providers certified a minimum of every 2 years

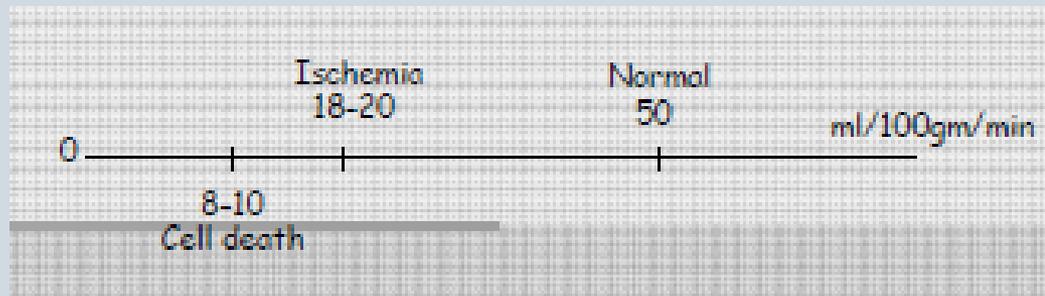
Acute Care Diagnostic Testing

- CT (non-contrast)
- **MRI:MR diffusion-weighted imaging (DWI) most sensitive and specific imaging technique for demonstrating AIS**
- Vascular imaging includes MRA and CTA/CTP (venous)
- Angiography evaluates the surface characteristics of the artery
- Carotid Doppler Ultrasound
 - Detects vessel occlusion or stenosis
- Transcranial Doppler (TCD)
 - Detects vasospasms
- Echo Cardiac diagnostics
- Additional lab work



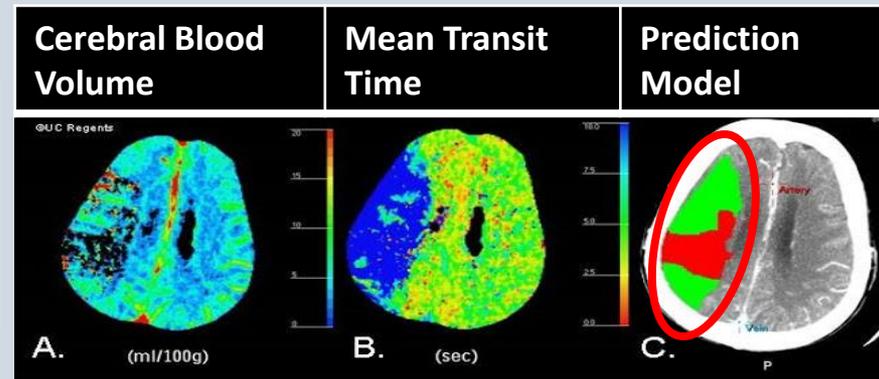
The Ischemic Cascade

- Brain tissue moves from reversible ischemia to irreversible infarction with blood-brain-barrier breakdown and vasogenic edema
- Cerebral Blood Flow drops below 10 ml/100 g/min



Malignancy Profile:

A small infarct volume, large area of penumbra and a short time to reperfusion are predictors for good outcomes



Cerebral Edema

Pathophysiology

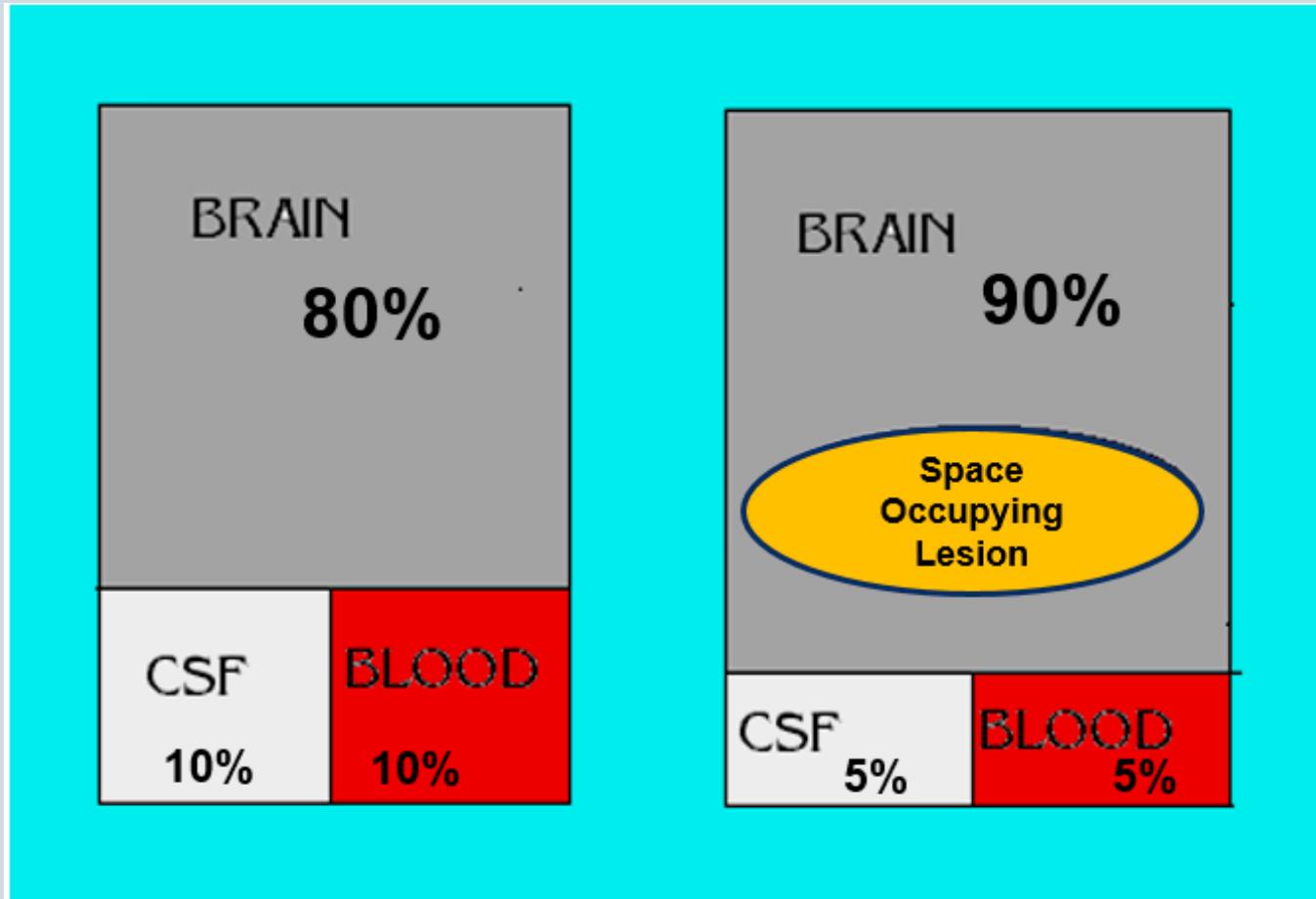
- **Ischemic stroke:** primarily **cytotoxic** edema
 - Cellular breakdown, cell membrane pump failure (Na^+/K^+)
 - Retention of *intracellular* Na^+ and Ca^{++} , rapid retention of water in gray matter
 - Blood brain barrier remains intact
 - **Vasogenic** extracellular edema primarily in white matter
- **ICH:** perihematoma edema primarily **vasogenic** edema
 - Aggravated by clot lysis and inflammatory factors
 - Extracellular edema, BBB is disrupted, capillary leakage
- **SAH:** primarily **cytotoxic** edema
 - Localized versus global edema

Management

- Symptom management for increased ICP or seizures



Intracranial Pressure (ICP) Compliance Principle



Hydrocephalus

Normal Pressure or Communicating

- CSF flow can “communicate” with Superior Sagittal Sinus
- Characterized by gait disorder, cognitive decline, urinary incontinence in the elderly → shunt treatment may improve symptoms



Obstructive or Non-communicating

- CSF flow “can’t communicate” with arachnoid villi in Superior Sagittal Sinus
- Arachnoid villi are damaged or obstructed by presence of blood (SAH) or infection (meningitis)

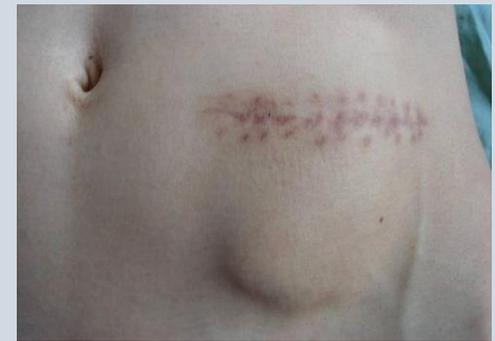
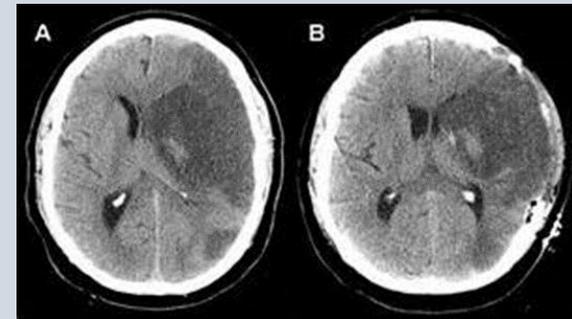


Hemicraniectomy

- Cerebral Edema: most common in MCA territory
- Allows room for swelling for a large AIS
- Timing is critical and controversial

Complications

- Contralateral hematoma (Epidural Hematoma)
- Herniation through bone window
- CSF leakage
- Infection
- Seizure



Bone flap storage

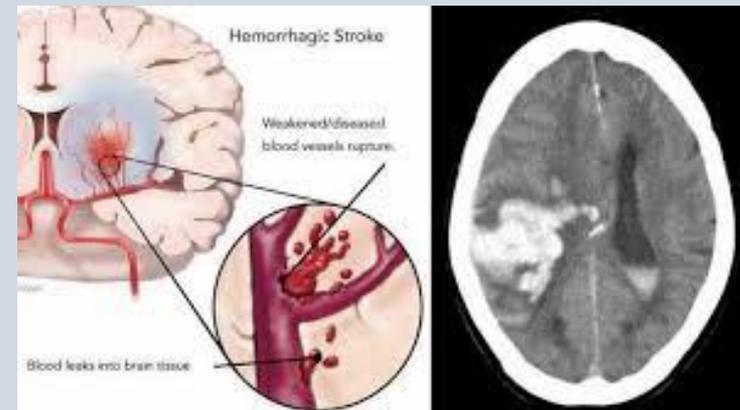
Hemorrhagic Stroke



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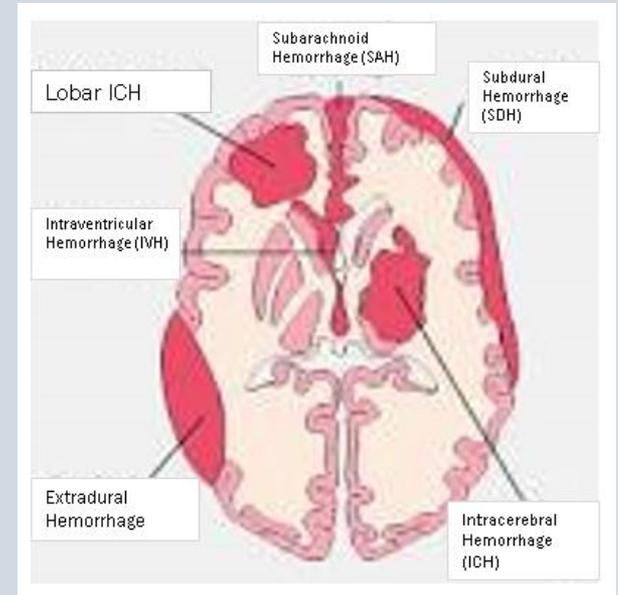
Hemorrhagic Stroke

- Subarachnoid Hemorrhage (SAH)
 - Aneurysm or AVM
- Intracerebral Hemorrhage (ICH)
 - Uncontrolled Chronic HTN
- Intraparenchymal Hemorrhage (IPH)
 - Uncontrolled Chronic HTN
- Intraventricular Hemorrhage (IVH)
 - Uncontrolled Chronic HTN
- Higher Morbidity and Mortality



Causes of Hemorrhage

- Stimulant abuse Cocaine, Amphetamines
- Cerebral Cavernous Malformation (CCM)
- Arteriovascular Malformations (AVM)
- Amyloid Angiopathy (lobar ICH)
- Hematologic disorders
- Anticoagulant use
- Neoplasms
- Vasculitis

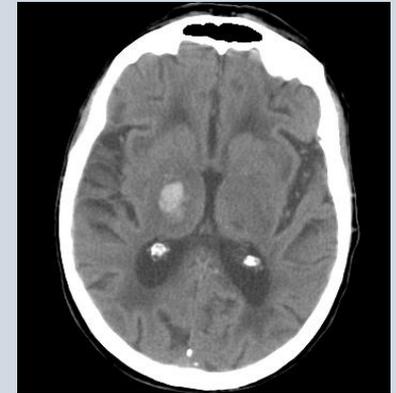
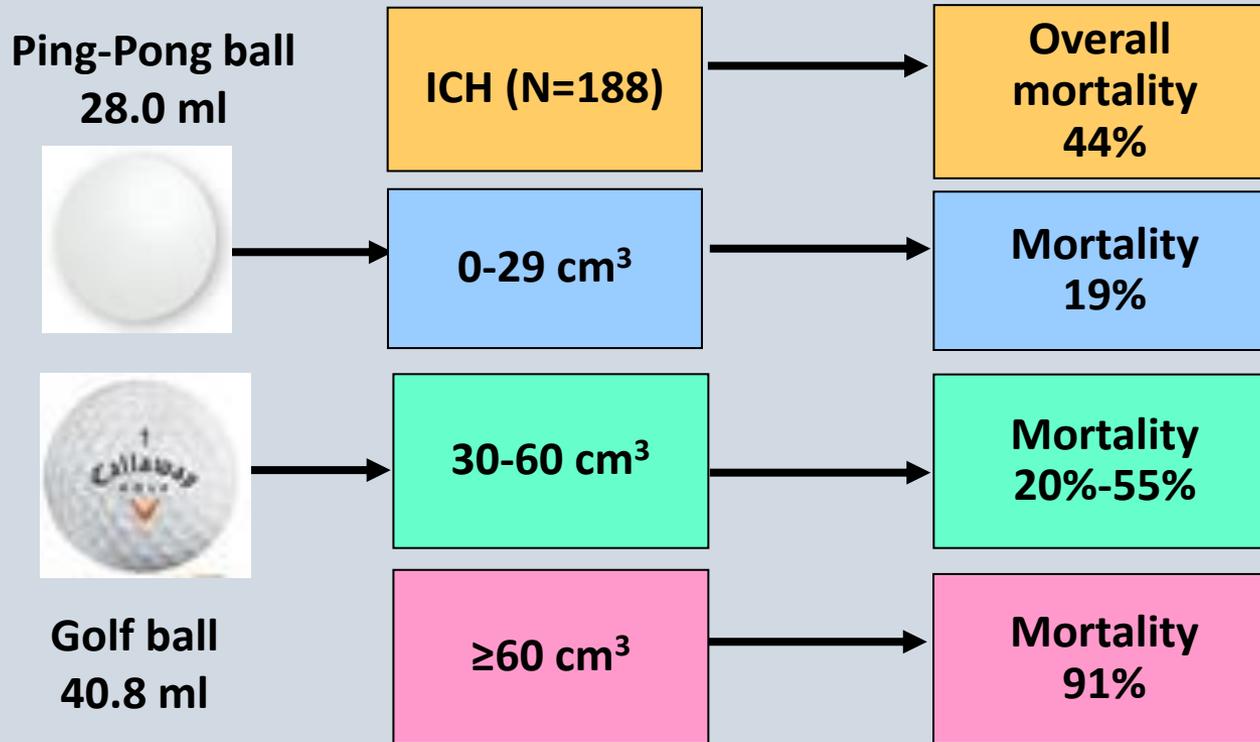


ICH High-Risk Populations

- Hypertensive patients (especially poorly controlled)
- Patients with multiple comorbid risk factors
- Patients with renal or liver failure
- Patients with dementia
- Anticoagulant users
- Age > 55 years
- Alcohol abusers
- Smokers
- Certain ethnic populations
 - Asians (especially Japanese)
 - African Americans
 - Hispanics



Hemorrhage Mortality



Only 1/71 patients with ICH volume ≥ 30 mL functions independently at 30 days

ICH Score

ICH Score (Hemphill et al.)

Feature	Finding	Points
GCS	3-4	2
	5-12	1
	13-15	0
Age	>=80	1
	<80	0
Location	Infratentorial	1
	Supratentorial	0
ICH volume	>=30cc	1
	<30cc	0
Intraventricular Blood	Yes	1
	No	0
ICH SCORE		0-6 points

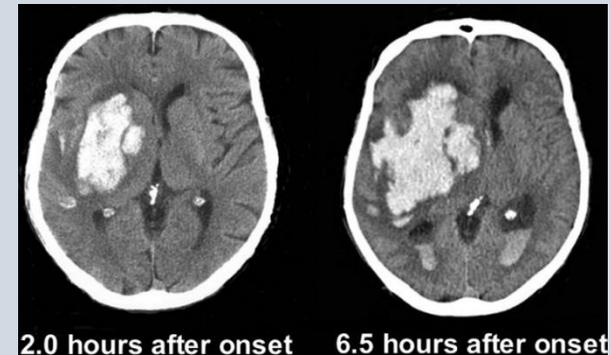
ICH Score	30 Day Mortality
0	0%
1	13%
2	26%
3	72%
4	97%
5	100%
6	100%

Must be documented within 6 hours of admission

Management of Hemorrhage

Goal: Provide general supportive care to manage the primary brain injury and limit secondary brain injury

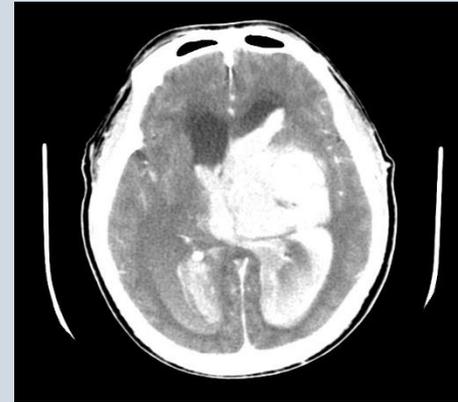
- Support ABCs
- Seizure management
- Reverse anticoagulation immediately
- Prepare for Intubation/Protect the Airway
- Monitoring (BP, fever, ICP, labs, arrhythmias)
- BP management (IV infusion of vasodilator – Cardene)
- VTE prophylaxis (SCD/IPC) (Pharmacological 24-48 hrs)



Hemorrhagic Stroke

Acquired Coagulopathies - Anticoagulation

- Warfarin/anticoagulation treatment for DVT, PE, A-Fib
- Incidence of anticoagulant associated ICH increases with INR 2.5 - 4.5
- Associated with longer duration of ICH expansion
- Doubles ICH mortality



Seizures and Hemorrhage

- Seizure risk 8% after ICH
- More frequent in ICH than AIS
- Onset usually ≤ 24 hours of ICH
- More associated with cerebral amyloid angiopathy ICH than deep ICH
- Seizures in ICH patients and outcomes
 - May contribute to coma
 - Results in neuronal injury and destabilization
 - Associated with deterioration of NIHSS and increase in midline shift



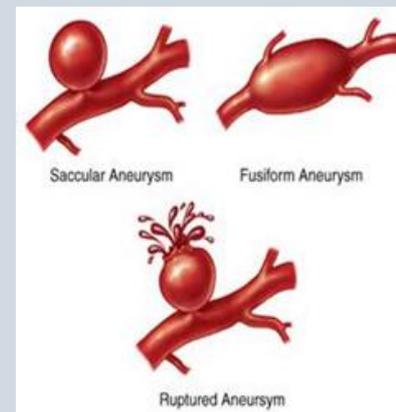
Subarachnoid Hemorrhage (SAH)

Aneurysm Risk factors:

- Genetic Syndromes: ADPKD or Ehlers-Danlos Syndrome, Type IV
- Family history
- Female > male (2.7:1 ratio)
- Japanese or Finnish Ethnicity
- Age \geq 40 years
- Vascular comorbidities: HTN, HLD, DM
- Smoking

Treatment clipping vs. coiling

- SAH mortality is 26-50%
 - 10-15% are fatal before hospital arrival
- Risk of recurrence is 10-25%
- Highest risk within first 6 months



Clinical Manifestations of SAH

- 80% report **“worst headache of my life”**
 - 10-43% have a ‘sentinel’ headache prior to event
 - Sentinel headache increases the risk of early re-bleeding
 - Often occurs within 2-8 weeks before overt SAH
- Nausea/Vomiting
- Decreased LOC
- Nuchal Rigidity
- **Photophobia**
- Seizure



Image courtesy of TEAM Scientific Committee

Diagnosis of SAH

- NCCT
 - Nearly 100% sensitivity within 6 hours
 - 87% sensitivity within 72 hours
 - 50% sensitivity after 5 days
- Lumbar Puncture can enhance sensitivity
 - Xanthochromia occurs > 12 hours after SAH
 - **Negative NCCT consider Lumbar Puncture (LP) as next diagnostic test**
- MRI further adds to sensitivity
- **Gold Standard is an angiogram**



Image courtesy of TEAM Scientific Committee

Hunt and Hess Scale for SAH

Grading system to classify the severity of SAH 1-5

Based on clinical picture (symptoms)

Predictor of patient prognosis/outcome

1. Asymptomatic/mild headache, slight nuchal rigidity
2. Mod/severe headache, nuchal rigidity, no deficit except oculomotor nerve palsy
3. Drowsiness/confusion & mild deficit
4. Stupor, moderate-severe hemiparesis
5. Coma – posturing/no motor response

Grade	Clinical features	Mortality Outcome*
I.	Asymptomatic or mild headache	11
II.	Moderate to severe headache, or with oculomotor palsy	26
III.	Confused, drowsy, or mild focal signs	37
IV.	Stupor (localizes pain)	71
V.	Coma (posturing or no motor response)	100

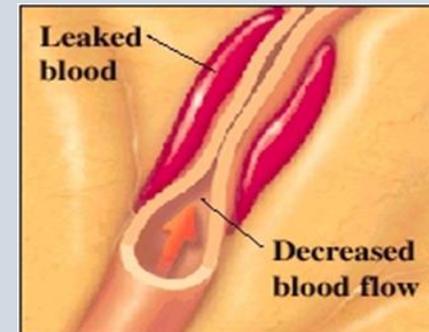
Cerebral Vasospasm & Rebleeding

Vasospasm causing Delayed Cerebral Injury (DCI)

- Risk for vasospasm day 3-21, **most common day 7-15**
- Oxyhemoglobin (blood breakdown) and Calcium channels trigger vasoconstriction

Management:

- Nimodipine – Calcium Channel Blocker
- Angiography with Angioplasty or direct Verapamil
- Induced Hypertension and Hypervolemia (HH)



Rebleeding

- Increased mortality, especially within first 2-12 hours after initial bleed
- Risk ↑ with initial sentinel headache, large aneurysm, elevated SBP

Management/Prevention:

- Early treatment
- BP management **Pre treatment: 140-160 mmHG**
- Post treatment: BP parameters liberalized to permissive hypertension

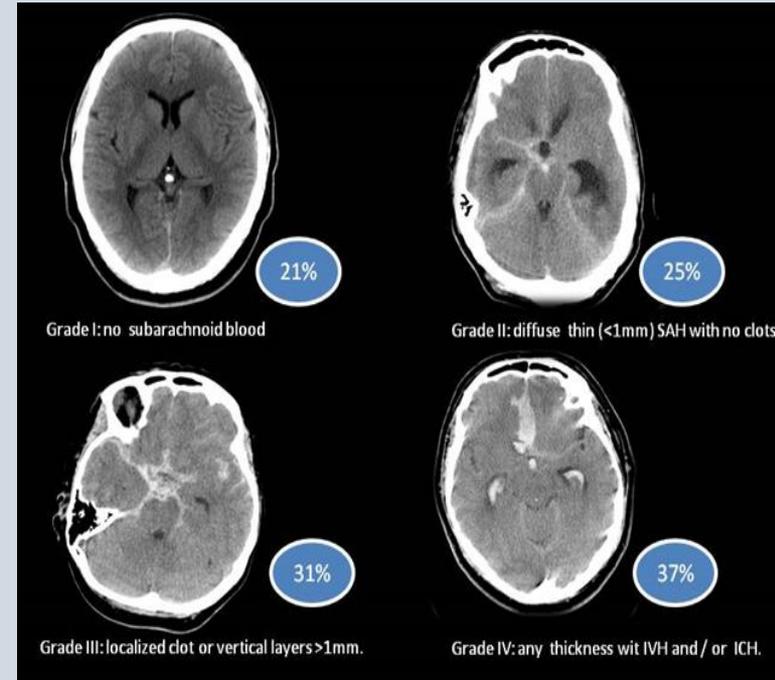
Fisher Scale for SAH

Predictor of Vasospasms

Based on blood volume on initial CT

Grades

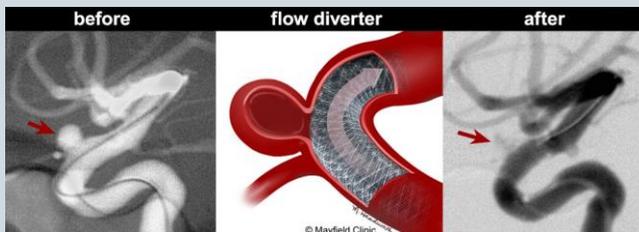
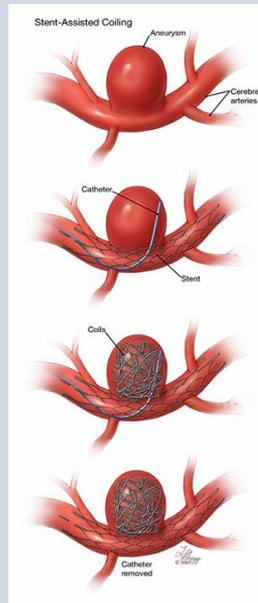
1. No hemorrhage evident
2. SAH < 1ml thick
3. SAH > 1ml thick
4. SAH any thickness with IVH or parenchymal extension



Subarachnoid Hemorrhage

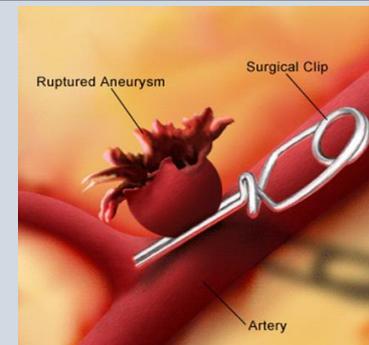
Endovascular Coiling

- Endovascular (Angio) approach
 - Primary Coil
 - Balloon Assisted Coil
 - Stent Assisted Coil
 - Flow Diversion
 - Stent
 - Intrasaccular
- Antiplatelet therapy post procedure
- Post angio care



Microsurgical Clipping

- Involves a craniotomy
- Clips are placed across the neck of the aneurysm blocking it from circulation
- **Favorable option for patients with an IPH volume > 50ml**
- May involve intra-operative angiogram & post-angio care
- General anesthesia
- Titanium clips are MRI compatible



Additional Stroke Disorders

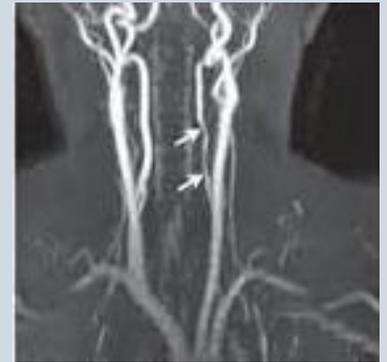
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Dissections and CVT

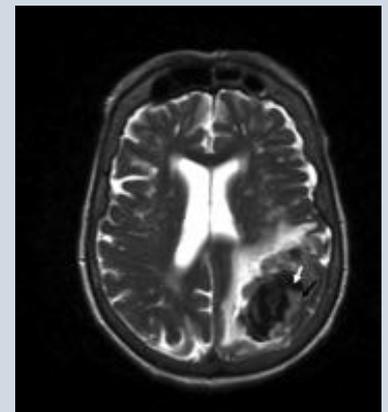
Cervical Cerebral Arterial Dissection

- Boxers, sports, wrestling, sneezing
- Carotid artery dissection: Horner's syndrome, ipsilateral deficits.
- Vertebral artery dissection: pressure headache, occipital throbbing, ipsilateral deficits
- **Most Common Cause: Trauma to vessel wall or connective tissue disease**
- Treatment: anticoagulants or antiplatelet



Cerebral Venous Thrombosis (CVT)

- Rare, young age
- Clot in dural sinus (vein)
- Inflammatory bowel disease, birth control, substance abuse, head trauma or hypercoagulable state
- Treatment: anticoagulation therapy (heparin infusion to oral anticoagulation for several months)

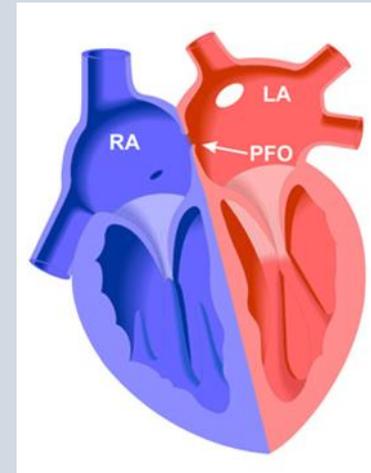
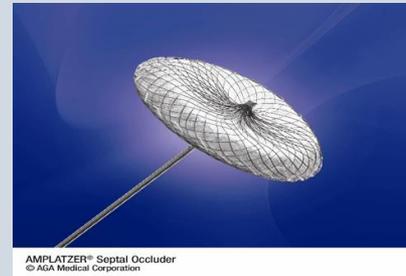


Patent Foramen Ovale (PFO)

Anatomical variant present in 25% of healthy adults

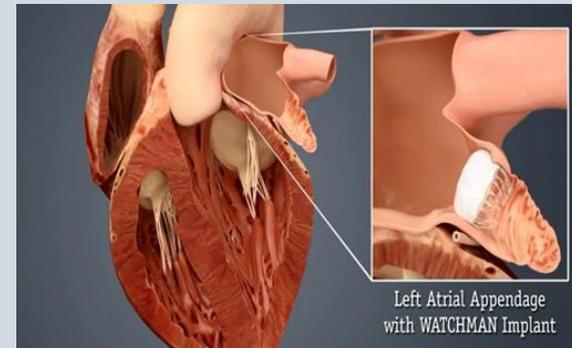
Emboli to left heart from abnormal blood flow

- Contributes to stroke < 55 years of age
- Diagnostic: TEE
- Transesophageal Echocardiogram



Management

- Medical Therapy: antiplatelet or anticoagulation
- Surgical Therapy: Percutaneous Closure Device
- Surgical closure may be superior to medical management, depend on PFO size



Carotid Endarterectomy (CEA)

Carotid Artery Stenting (CAS)

- Risk factors: HTN, smoking, alcohol consumption, high LDL/cholesterol
- Mild < 50% occlusion

Medical Management

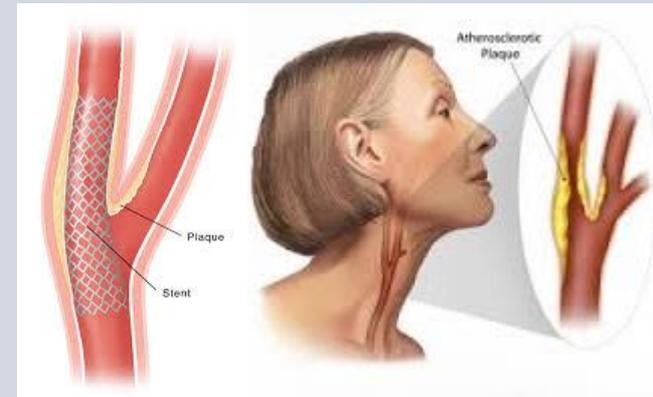
- Moderate 50-69% occlusion

Medical Management

- Higher Grade \geq 70%-99%

Surgery or Medical Management

- Intervention for symptomatic patients with carotid-territory TIA or stroke
- 100% occlusion can now be treated with angioplasty
- Post procedure: ICU overnight
- **Discharge on Plavix for 30 days, statin**
- No lifting 5lbs or greater, no driving for 7 days



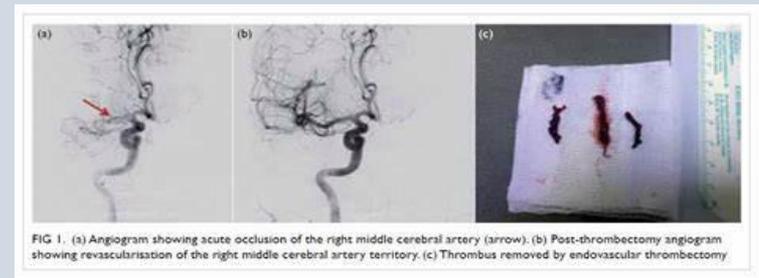
Post-Endovascular Care

- Assess for complications after Vascular Access
 - Recognition of Reperfusion Syndrome
 - Hematoma and suture line evulsion
 - Arterial Dissection/Thrombosis
 - Retroperitoneal Hemorrhage
 - Pseudo Aneurysm
 - MI and Stroke
- Cranial nerve and neuro assessment
- Site and distal extremity assessment
- Fluid management (euvolemic)
- Blood pressure management
- Arterial sheath management



Post Thrombectomy Care

- Vital signs include **extremity pulses, puncture site checks and neurological checks per protocol**
- If patient receives IV thrombolytic follow the IV thrombolytic protocol
- Maintain **BP < 180/105** during and for 24 hours after procedure or per protocol
- Notify provider for any decline in neuro status



Hyperperfusion/Reperfusion Syndrome

Hyperperfusion – increased blood flow to ischemic tissue

Reperfusion – normalization of flow in setting of fragile/damaged tissue

Reperfusion Syndrome – injury after revascularization

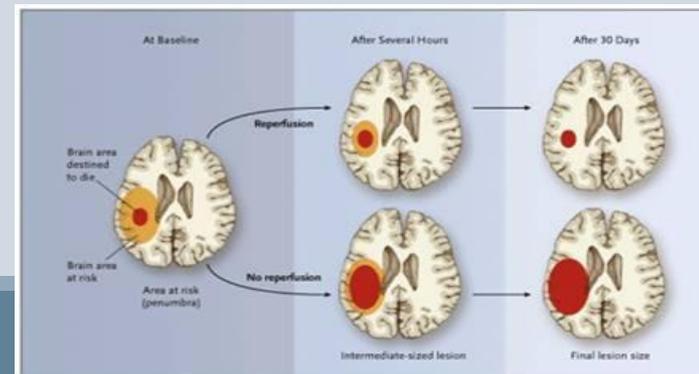
- Carotid endarterectomy and/or stenting, IV fibrinolytic
- Endovascular mechanical thrombectomy
- Large territory ischemic stroke with revascularization

Pathophysiology

- Inflammatory response, cytokine release, leukocyte adhesion, damage to the blood brain barrier
- Ipsilateral headache, contralateral neurological deficits, seizure (cortical area)

Management and Prevention

- Diligent blood pressure control
- Order NCCT head

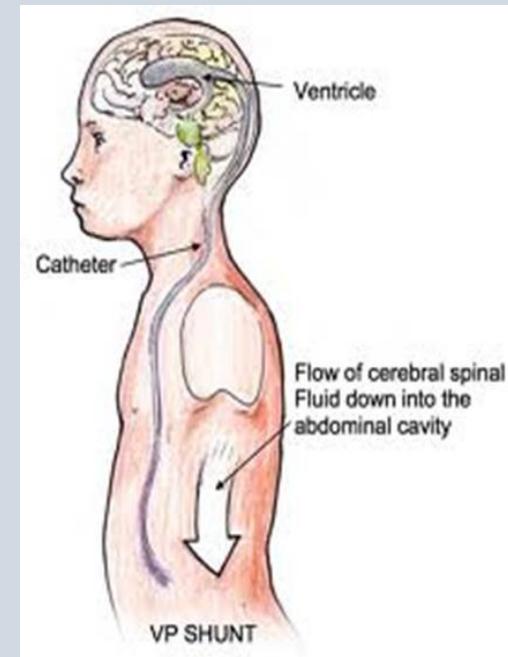


CSF Diversion Devices

External Ventricular Device (EVD)

- Removes CSF or Blood
- Reduces increased ICP
- Acute Ischemic Stroke (AIS)
 - Edema may prevent the flow of CSF causing hydrocephalus
- Intracerebral Hemorrhage (ICH)
 - For GCS < 8, IVH, hydrocephalus or herniation
- Subarachnoid Hemorrhage (SAH)
 - Acute hydrocephalous
 - Blood in the ventricles

Ventricular Peritoneal (VP) Shunt



Nursing Care Plan



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Blood Pressure Management

- Acute Ischemic Stroke (AIS) **without** IV thrombolytic $\leq 220/120$ mmHg
 - Permissive Hypertension first 24 hours
 - Avoid rapid drop in blood pressure
- Acute Ischemic Stroke (AIS) **with** IV thrombolytic $\leq 180/105$ mmHg
- Intracerebral Hemorrhage (ICH) \leq range 130-150 with a goal of 140 mmHg
- Subarachnoid Hemorrhage (SAH) (**ruptured**) ≤ 160 mmHg SBP
- Aneurysm (**unruptured**) ≤ 140 mmHg SBP



Blood Glucose Management

- **Treat if less than 60 mg/dl**
- IV Fluid: Normal Saline, no dextrose
- Hyperglycemia present in 30-40% of AIS patients
 - Correlated with hemorrhagic conversion and poor outcomes
 - Increases anaerobic metabolism and lactic acidosis causing decreased tissue oxygenation
 - Greater than 200 mg/dl is an independent indicator of volume expansion in AIS and poor outcome
- **Goal: 60-180 mg/dl**
 - Treatment in the first 24 hours is recommended



Temperature Management

Normothermia 37°C or 98.6°F

Hyperthermia > 38°C or >100.4°F

Antipyretics

- Tylenol: monitor liver function
- Advil: monitor renal function and platelets

Infection Surveillance

- UTI, aspiration pneumonia

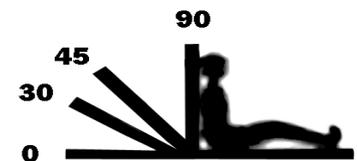
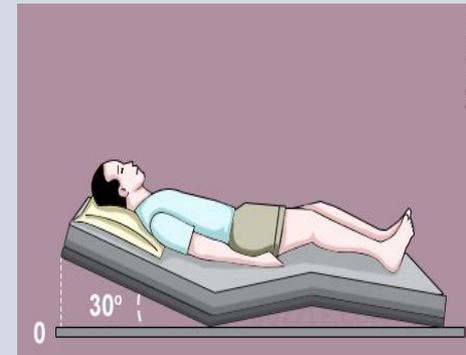
External and intravascular cooling

- Skin surveillance
- Shivering – medical prevention
- Skin warming (bear hugger)
- Sedation/paralysis



Stroke Management- Head of Bed

- **Best Practice** HOB elevated no more than 30°
- HOB lowering
 - Not indicated for majority of strokes
 - Increases cerebral blood flow
 - Increases risk of aspiration
 - Consider if blood pressure & HOB position correlate with improved neurologic exam in first 24 hours
 - Consider for **posterior circulation** strokes in first 24 hours
 - May recommend HOB 15 degrees or flat



Dysphagia Screening

- Dysphagia (difficulty swallowing)
- Standard of care: NPO until bedside screening
 - SLP consult for failed screening
- Dysphagia present in 50% of patients **within three days**
 - Higher risk for aspiration and silent aspiration



Increased mortality risk due to aspiration pneumonia

Management of Atrial Fibrillation

Telemetry during admission

Oral anticoagulation

Goal INR 2-3 which reduces mortality of AIS

- Timing: controversial generally wait 4-14 days after AIS or hemorrhagic stroke (size matters)
- CHA₂DS₂-VASc Score is a risk assessment tool to determine benefit of treatment
- HAS-BLED determines risk of bleeding

Definition of the HAS-BLED score, with point distribution¹

Score	Variable	Points
H	Hypertension	1 point
A	Abnormal renal or hepatic function	1-2 points
S	Prior stroke	1 point
B	Bleeding	1 point
L	Labile INR values	1 point
E	Elderly, i.e., over age 65	1 point
D	Concomitant use of other drugs or alcohol	1-2 points

Score	CHA2DS2-VASc
1	CHF + CAD (doubles the risk of stroke)
1	HTN
2	Age > 75 years
1	DM
2	Prior Stroke, TIA, or Thromboembolism
1	Vascular Dx: PVD, MI, Aortic plaque
1	Age 65-74
1	Sex category: female

Euvolemia

Most acute ischemic stroke patients are dehydrated on admission

- AIS have a 25% high risk of worsening outcomes
- Monitor I & O's closely (especially post contrast)
- IV solutions: isotonic or hypertonic solutions

Isotonic solution

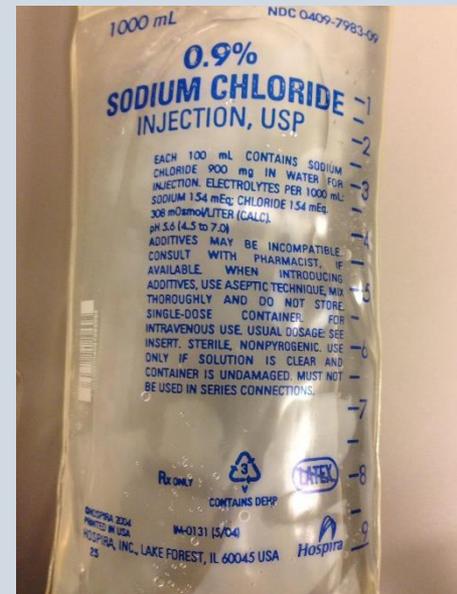
- Normal saline (monitor labs)
- Long-term use risk for acidosis/hyperchloremia

Hypertonic Solutions

- 3% -24% saline
- Manages increased ICP/cerebral edema

Hypotonic solutions

- **Avoid ½ NS, ¼ NS, Dextrose containing solutions**



Nursing Safety Measures

Personal Care Measures

- Elimination Q 2 hours while awake and Q 4hr @ HS
- Monitor heat/cold for sensory deficits
- Safety during and after treatments
- Positioning and early mobilization
- Divide activities into short steps
- Awareness of surroundings
- Support affected limb
- Frequent orientation
- Protect from injury

Realistic attainable goals

Removal of excessive environmental distractions



Safety Measures

Prioritize patient needs

- Comprehensive Neurological Assessment
- NIHSS, GCS, ICH, Hunt & Hess
- Diagnostic tests
- Discharge planning

Aspiration Precautions

- Stroke Associated Pneumonia (SAP)
- Increased risk: 50% in ICU and 11% in Rehab

VTE Prophylaxis/Immobility

- Mechanical: SCD/IPC
- Pharmacological: LMWH or heparin
- Early mobility and hydration



Safety Measures

Fall & Skin Precautions

Stress Ulcer Prophylaxis

Infection Prevention Protocols/UTI

- 60% have urinary incontinence or retention

Seizure Precautions

- ICH has increased risk in first 24 hours
- SAH not routinely treated prophylactically

Therapeutic Environment

- Coordinate care
- Quiet environment – promote sleep hygiene
- Reorientation, alternative means of communication



Stroke Pearls

- Respect culture and beliefs
- Encourage expression of feelings
- Identify positive coping mechanisms
- Include spiritual and psychosocial care
- Assess and manage depression, anxiety, and fatigue



Thank you!

The Expert in anything
was once a Beginner



Resources

Powers WJ, Rabinstein AA, Ackerson T, et al. Guidelines for the early management of patients with acute ischemic stroke: 2019 update to the 2018 guidelines for the early management of acute ischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2019;50:e344-e418.

Connolly, E. S., Rabinstein, A. A., Carhuapoma, J. R., Derdeyn, C. P., Dion, J., Higashida, R. T., Hoh, B. L., Kirkness, C. J., Naidech, A. M., Ogilvy, C. S., Patel, A. B., Thompson, B. G., & Vespa, P. (2012). Guidelines for the management of Aneurysmal Subarachnoid hemorrhage. *Stroke*, 43(6), 1711–1737. <https://doi.org/10.1161/str.0b013e3182587839>

Keigher, K. M., Livesay, S., & Wessol, J. (2020). *Comprehensive Review for Stroke Nursing*. American Association of Neuroscience Nurses.

Greenberg, S. M., Ziai, W. C., Cordonnier, C., Dowlatshahi, D., Francis, B., Goldstein, J. N., Hemphill, J. C., Johnson, R., Keigher, K. M., Mack, W. J., Mocco, J., Newton, E. J., Ruff, I. M., Sansing, L. H., Schulman, S., Selim, M. H., Sheth, K. N., Sprigg, N., & Sunnerhagen, K. S. (2022). 2022 guideline for the management of patients with spontaneous intracerebral hemorrhage: A guideline from the American Heart Association/American Stroke Association. *Stroke*, 53(7). <https://doi.org/10.1161/str.0000000000000407>