Emergent Stroke

RAPID EVALUATION AND TREATMENT FOR PATIENTS WITH SYMPTOMS OF STROKE

Objectives

- The learner will understand:
  - The emergent nature of stroke, and the need for rapid evaluation of symptoms and time of last known well
  - The emergent diagnostic evaluations needed for patients presenting with stroke symptoms
  - The risks and benefits of IV alteplase treatment, as well as contraindications for treatment
  - The risks and benefits of endovascular treatment for ischemic stroke

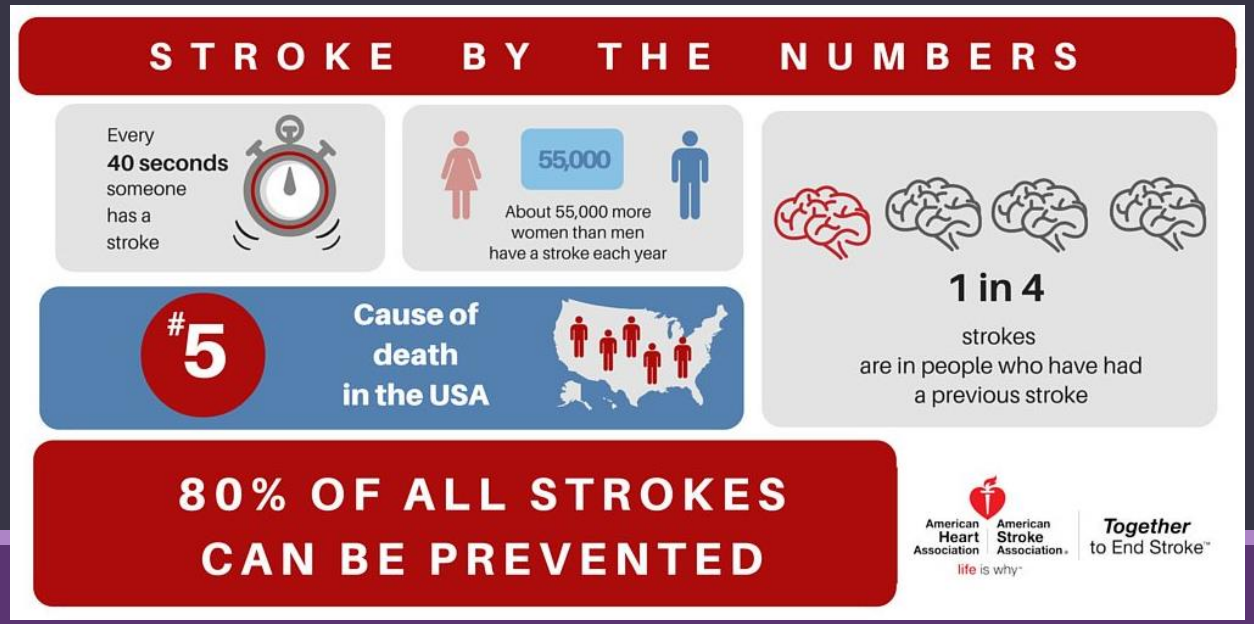
Stroke Epidemiology

Stroke is a leading cause of disability in the US

Someone in the United States has a stroke every 40 seconds

795,000 Americans have a stroke yearly

Strokes cost the U.S. $34 billion / year

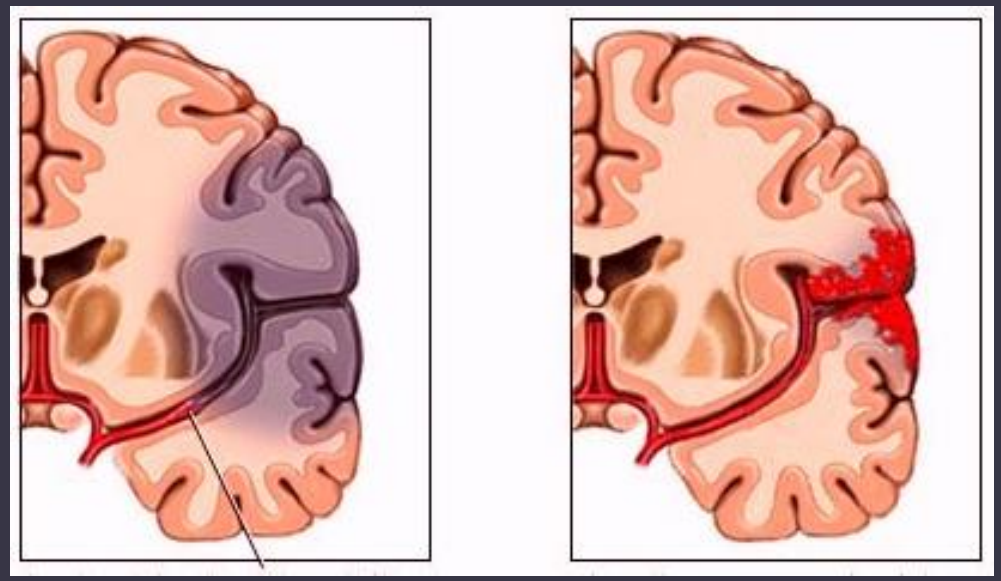


Types of Stroke Events

Hemorrhagic
- 13% of all strokes

Ischemic
- 87% of all strokes

TIA
- Treat as emergent



Hemorrhagic Strokes

Bleeding into or around brain tissue

Intracranial pressure rises, damage caused to surrounding tissue

Aneurysmal Subarachnoid Hemorrhage (aSAH)

- Bleeding within subarachnoid space caused by burst aneurysm

Intracerebral Hemorrhage (ICH)

- Spontaneous bleeding within the brain parenchyma

Aneurysmal Subarachnoid Hemorrhage Risk Factors

Age

Family history of aneurysm, aSAH

Cigarette smoking

HTN

High alcohol intake

Sympathomimetic drug use

- Cocaine, meth, weight loss drugs, cold remedies

High caffeine intake

aSAH Presentation

"Worst headache of my life" → High suspicion for aSAH
- Sudden onset, immediately excruciating

Neck stiffness, meningismus

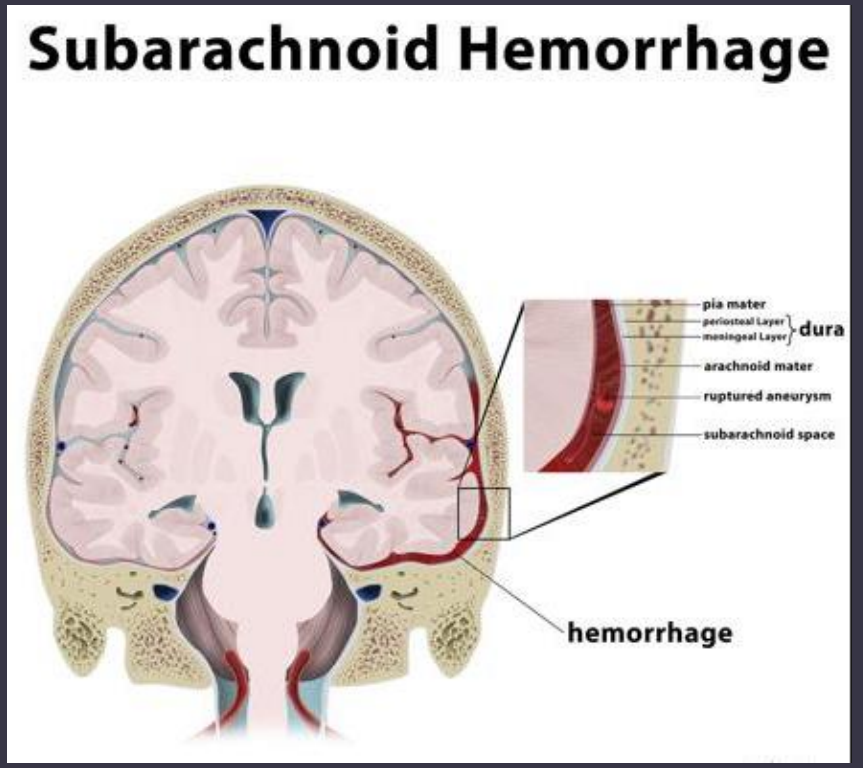
Nausea, vomiting

Only 40-50% of aSAH patients have change in mentation

Early brain injury caused by pressure from space occupying blood

Delayed ischemia caused by cerebral vasospasm
- Can occur up to 21 days after initial injury

Patients may experience re-bleeding without treatment
- Leads to poor outcome



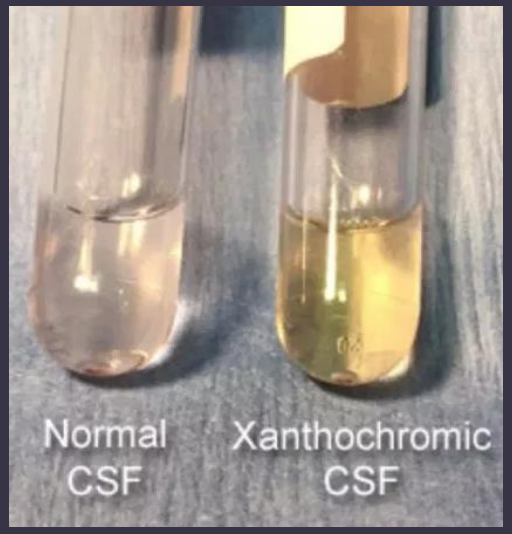
aSAH Diagnostics

Non-contrast Head CT

- Hyperdense blood in cisterns, subarachnoid spaces
- May be negative
  - CSF turnover
  - Anemia
  - Poor test quality

Lumbar puncture

- If suspicion for aSAH is high, CT negative
- Xanthochromic CSF indicates presence of broken down hemoglobin
- High red blood cells that do not clear by 4th tube



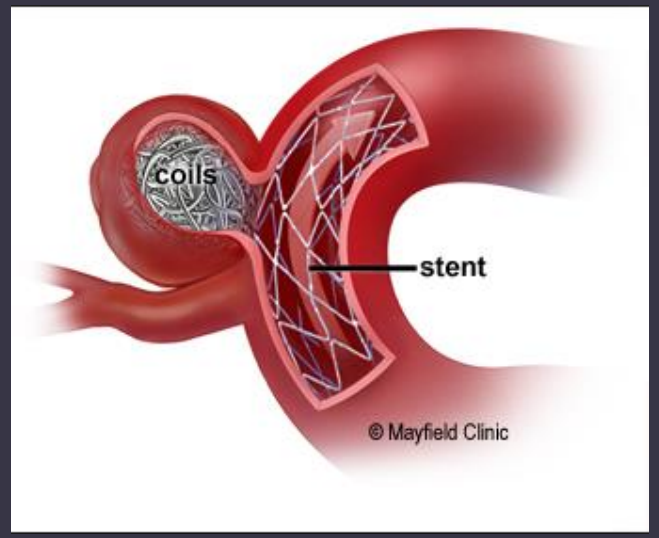
aSAH
Aneurysm Management

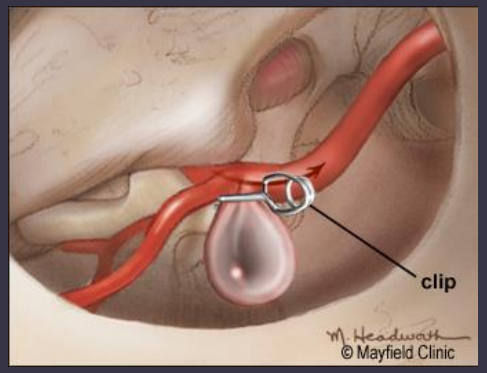
Endovascular procedure
- Coil
- Stent

Clipping
- Open surgery

Prevent aneurysm rerupture
- Seizure prophylaxis
- Blood pressure management
- Treat pain, anxiety, n/v

Prevent vasospasm
- Blood pressure management
- Nimodipine





Intracerebral Hemorrhage Risk Factors

Age

Family history, bleeding disorders

Hypertension

High alcohol intake

Oral anticoagulation therapy

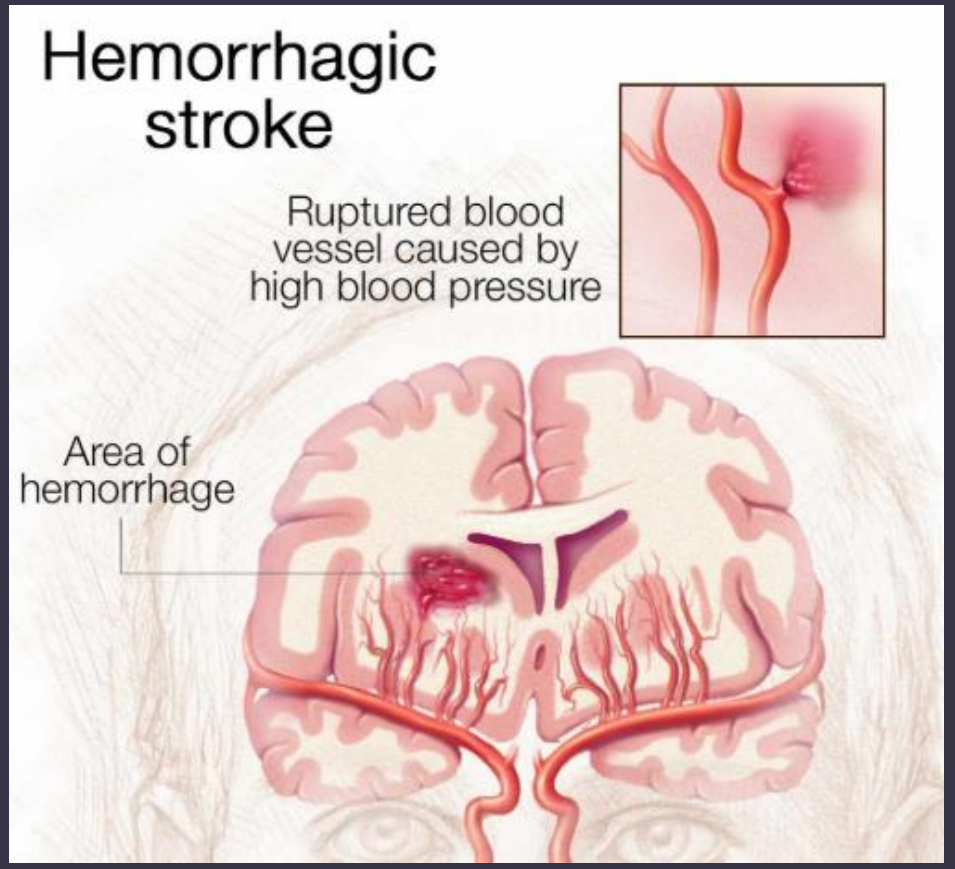
Sympathomimetic drug use

ICH Presentation

Sudden onset focal neurologic deficits

Mirrors ischemic stroke symptoms

Rapid deterioration



ICH Diagnostics

Emergent non-contrast head CT on presentation

- Determine course of treatment

Thorough H&P

- History of hypertension, anticoagulant use
- Recent falls, trauma, etc.

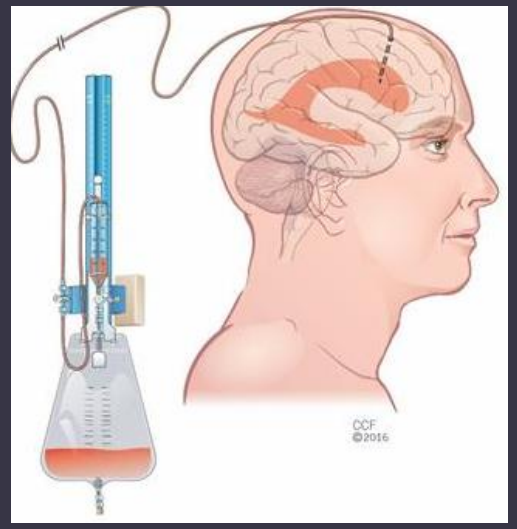
Emergent Treatment: Hemorrhagic Stroke

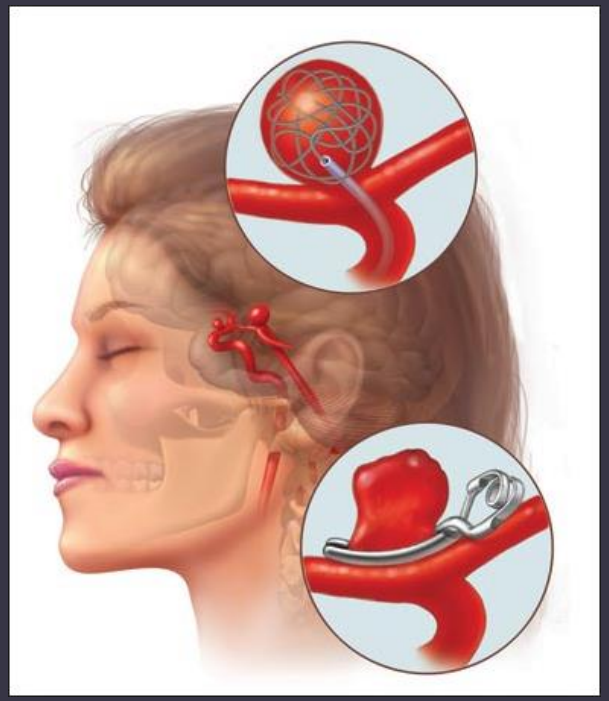
ABC's
- Monitor airway closely
- Have suction ready

Reverse anticoagulation

Tight blood pressure control
- Provider decision, typically SBP<140
- Utilize titratable medications

Neurosurgery consult
- Evacuation of hemorrhage
- Aneurysm clipping or coiling
- Ventricular drain placement





Emergent Treatment: Hemorrhagic Stroke

Management of Intracranial Pressure (ICP)

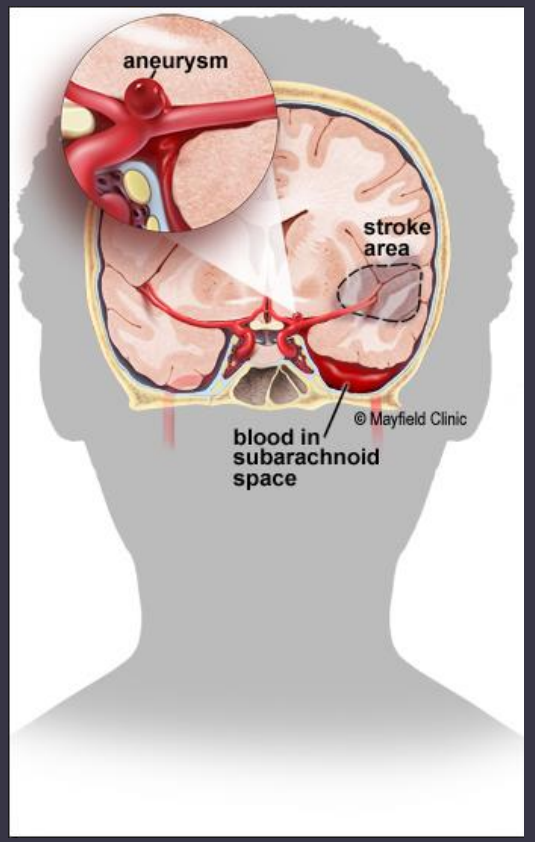
- Drain, ICP bolt for monitoring
- Hypertonic saline or mannitol

Treat pain, anxiety, nausea

- Prevent spikes in intracranial pressure

Seizure precaution

- aSAH : antiepileptic medications until aneurysm treated
- ICH : antiepileptic medications only if active seizure present



Anticoagulant Reversal

Coumadin (warfarin)

- Vitamin K 10mg IV one time plus *either* FFP or Kcentra
- 4-factor PCC (Kcentra)
  - INR 2-3.9 → 25 u/kg to max dose of 2,500u
  - INR 4-6 → 35 u/kg to max dose of 3,500u
  - INR>6 → 50 u/kg to max dose of 5,000u

Anticoagulant Reversal

Pradaxa (dabigatran)

- Direct thrombin inhibitor
- If taken in last 2 hours, give activated charcoal 50g PO/NG once
- Praxbind (idarucizumab) 5gm IV once
  - For life-threatening or uncontrolled bleeding
  - Give if last dose of Pradaxa was within 3-5 half-lives
    - Half life of Pradaxa is 12-17 hours
  - Monitor patient closely for DVT, PE throughout hospital stay

Anticoagulant Reversal

Xarelto (rivaroxaban), Eliquis (apixaban), Savaysa (edoxaban)

- Direct factor Xa inhibitors
- If taken in last 2 hours, give activated charcoal 50g PO/NG once
- PCC (Kcentra) 50u/kg to max dose of 5,000 units
  - Administer if last dose was within 3-5 terminal half-lives
    - Half life of Xarelto is 5-9 hours
    - Half life of Eliquis is 12 hours
    - Half life of Savaysa is 10-14 hours

Transient Ischemic Attack (TIA)

"Mini Stroke" or "Warning Stroke"

ABCD2 Score:

- Predictor of stroke after TIA event
- Admit scores >3 for workup
- Score 0-3 = 3% risk at 90 days
- Score 4-5 = 9.8% risk at 90 days
- Score 6-7 = 18% risk at 90 days

EDUCATION IS KEY

- Risk factor management
- Signs and symptoms of stroke
- Need for rapid treatment

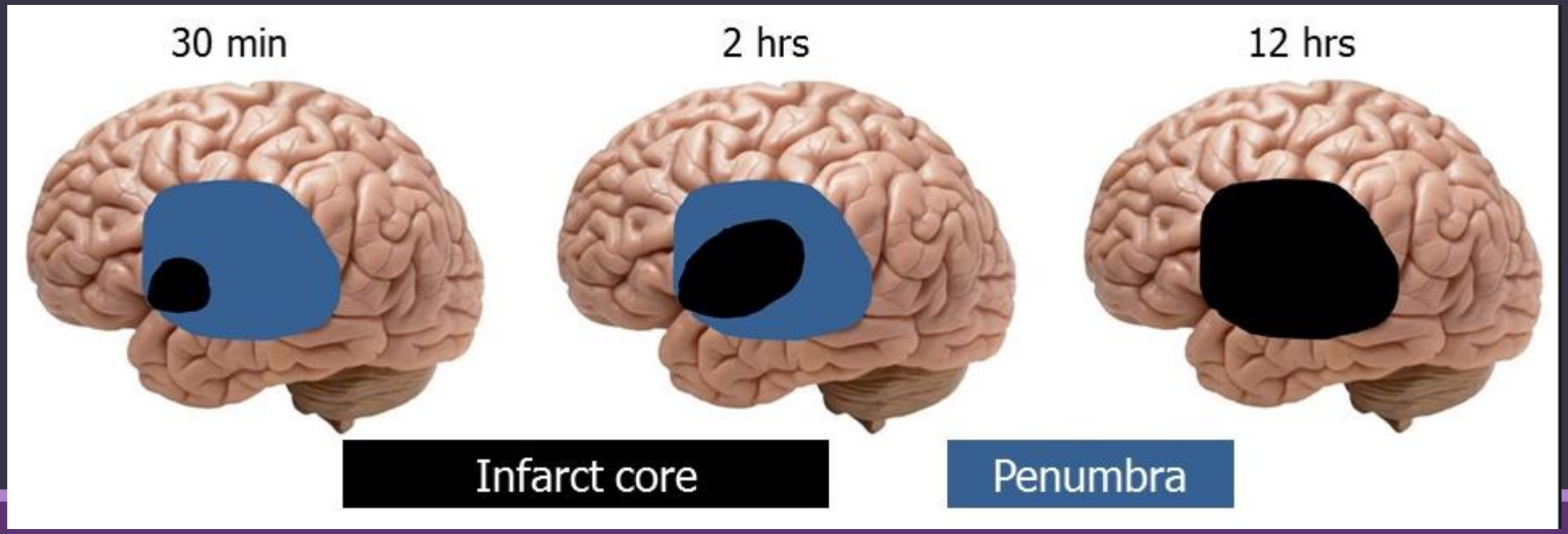
ABCD² Criteria	Points
Age ≥ 60 years	1
BP ≥ 140/90 mmHg at initial evaluation	1
Clinical Features of the TIA: • Speech Disturbance without Weakness, or • Unilateral weakness	 1 2
Duration of Symptoms: • 10-59 minutes, or • ≥ 60 minutes	 1 2
Diabetes Mellitus in Patient's History	1

Acute Ischemic Stroke

Arterial blood flow fails to meet metabolic demands, leading to ischemia and cellular death

PRIMARY GOAL of treatment is to restore blood flow

- Ischemic/infarct core is non-salvageable
- Penumbra is the area surrounding the ischemic core that may be rescued



Acute Ischemic Stroke

Non-modifiable risk factors:

- Age
- Gender
- Race
- Family history of stroke
- Previous stroke

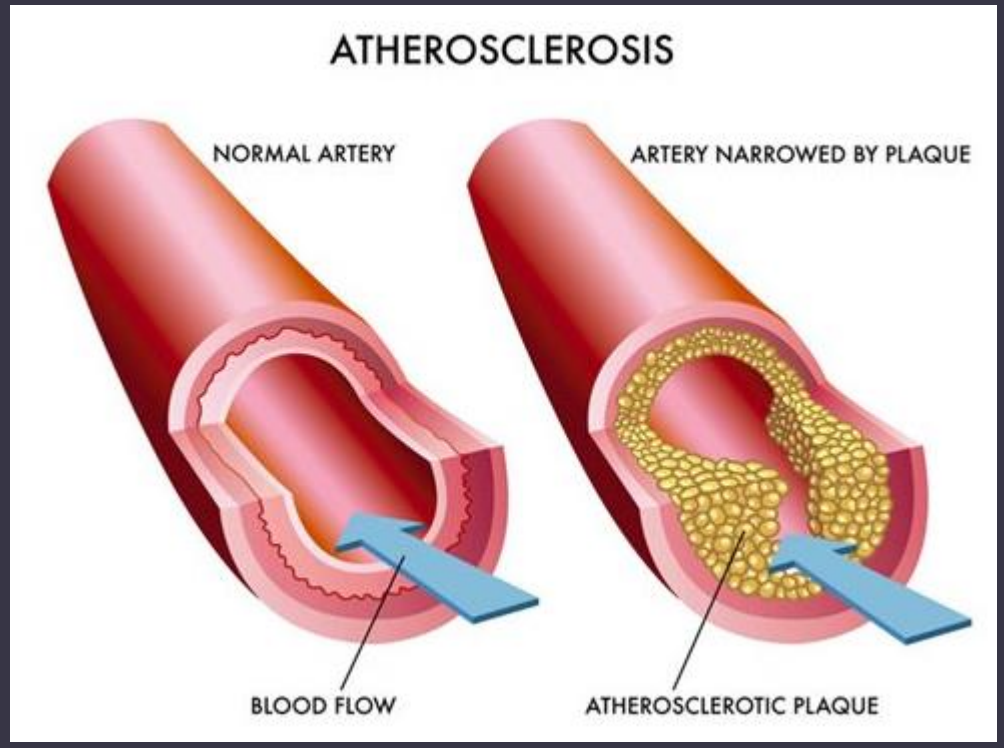
Modifiable risk factors:

- Hypertension
- Smoking
- Diabetes
- Hyperlipidemia
- Atrial fibrillation
- Obesity, inactivity

Acute Ischemic Stroke

Atherosclerotic stroke

- Narrowed blood vessels
- Hyperlipidemia, hypertension, diabetes
- Smoking
- Large vessels
- “Wake-up Strokes”



Acute Ischemic Stroke

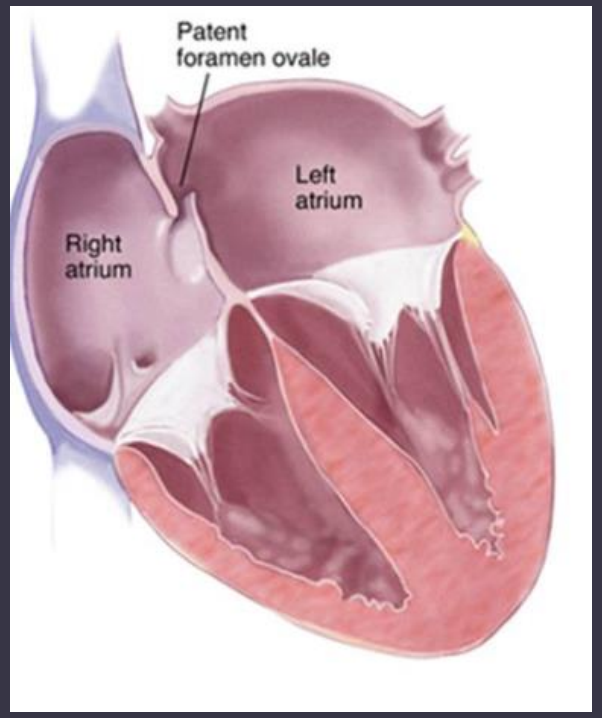
Small vessel, “lacunar” stroke

- Thrombosis of small, penetrating artery deep in the brain
- Chronic hypertension → thickening and blockage of tiny vessels
- Occur most commonly in basal ganglia, internal capsule, pons
- Deficits are significant compared to size of infarct

Acute Ischemic Stroke

Cardiogenic embolic stroke

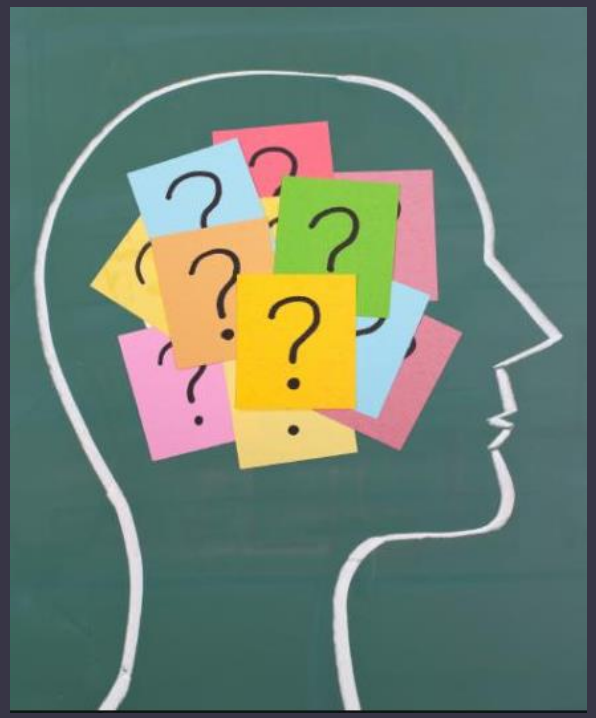
- Caused by atrial fibrillation, patent foramen ovale, valvular disease
  - Blood clot or debris travel to brain
- Treat the cause
  - Control atrial fibrillation
  - Anticoagulation
  - Antibiotic course
  - Close PFO



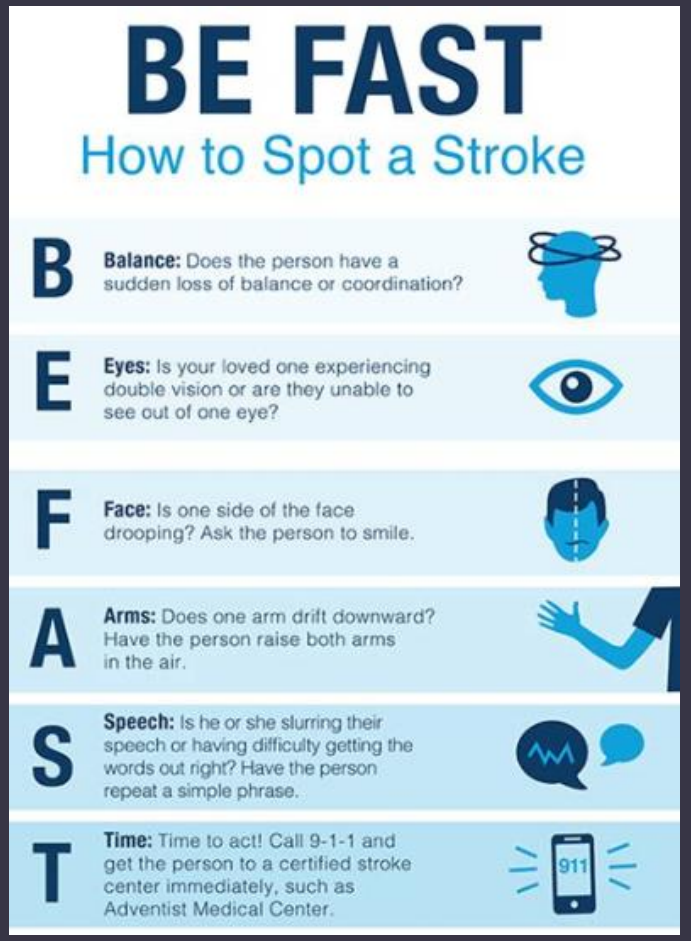
Acute Ischemic Stroke

Cryptogenic stroke

- No cause of stroke found on diagnostics
- Up to 30% of all strokes are cryptogenic
- Patient to be sent home with:
  - Heart monitor to capture paroxysmal a.fib
  - Close follow-up
  - Thorough education on symptoms of stroke



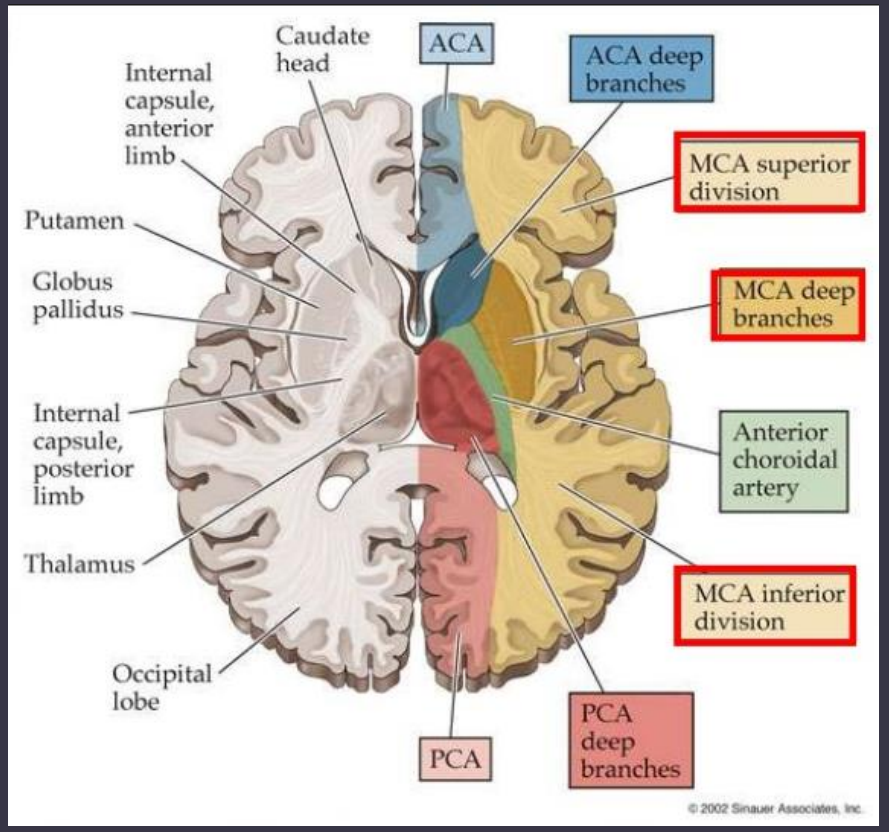
Acute Ischemic Stroke: Symptoms



Acute Ischemic Stroke: Symptoms

Neurologic deficits are specific to location of infarction

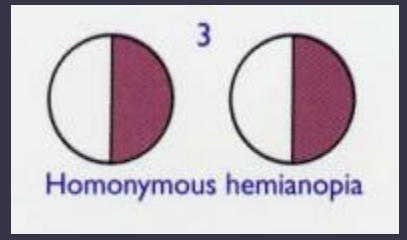
- Anterior circulation
  - Anterior Cerebral Artery (ACA)
  - Middle Cerebral Artery (MCA)
  - Internal Carotid Artery (ICA)
- Posterior circulation
  - Posterior Cerebral Artery (PCA)
  - Posterior Inferior Cerebellar Artery (PICA)
  - Anterior Inferior Cerebellar Artery (AICA)
  - Basilar Artery
  - Vertebral Artery



Acute Ischemic Stroke: Symptoms

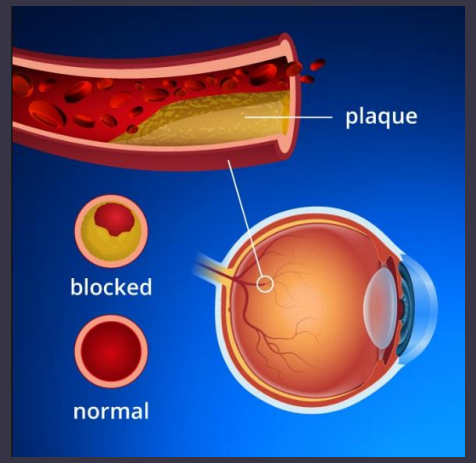
Internal Carotid Artery (ICA) CVA:

- Contralateral homonymous hemianopia
- Contralateral motor and sensory loss of the face, arm and leg
- Ipsilateral eye deviation
- Dominant hemisphere → aphasia
- Non-dominant hemisphere → neglect



Central retinal artery occlusion (CRAO)

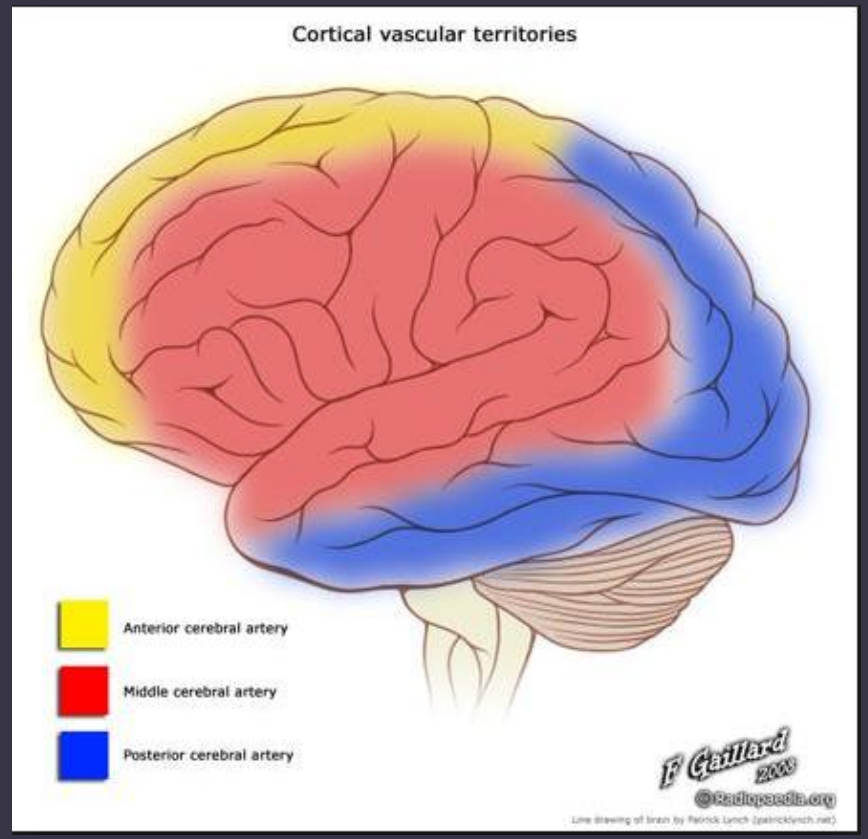
- Sudden, painless, unilateral loss of vision
- Result of ICA atherosclerosis



Acute Ischemic Stroke: Symptoms

Middle Cerebral Artery (MCA) CVA

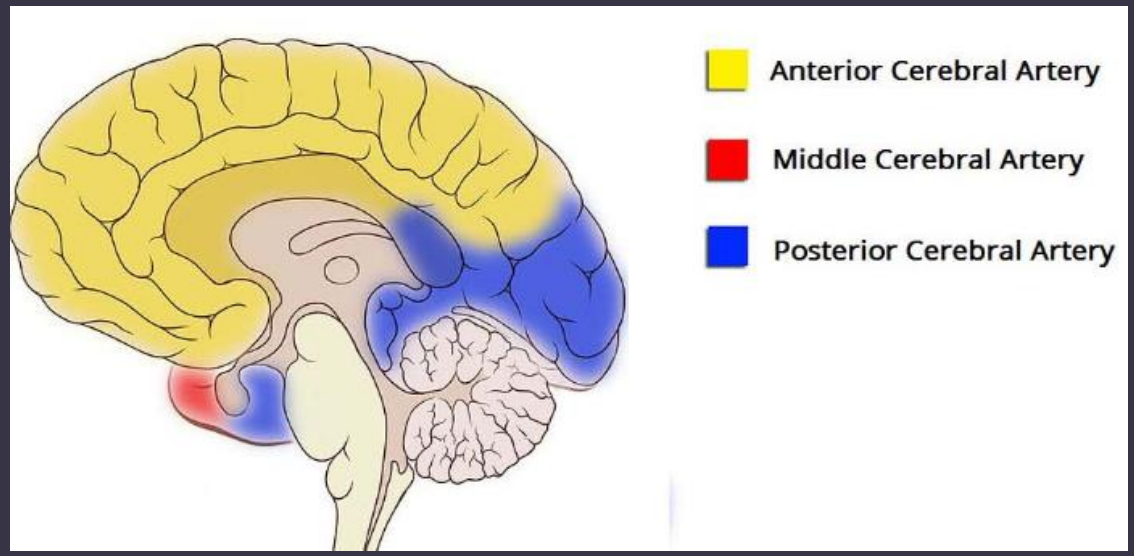
- Contralateral motor and sensory loss of the face, arm and leg
- **Upper > Lower extremity weakness**
- Homonymous hemianopia
- Eye deviation toward lesion
- Dominant hemisphere → aphasia
- Non-dominant hemisphere → neglect



Acute Ischemic Stroke: Symptoms

Anterior Cerebral Artery (ACA) CVA

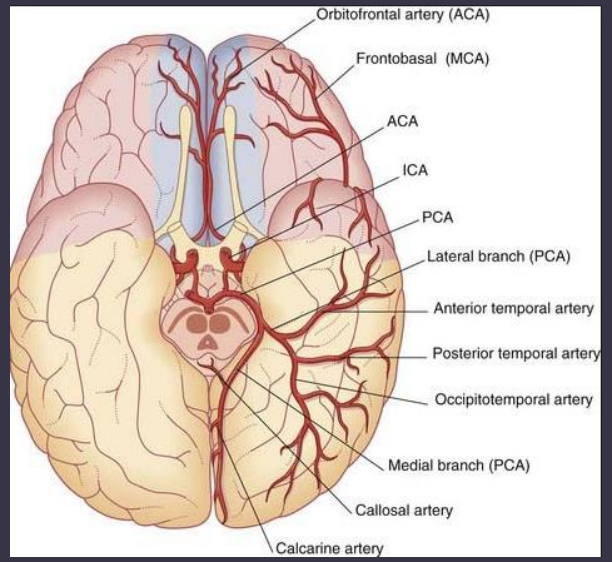
- Contralateral motor and sensory deficits of arm and leg
- **Lower > Upper extremity weakness**
- Face, tongue are spared
- Lack of concern and disinhibition may be present
  - Frontal lobe
- Frontal lobe reflexes may be present
  - Grasp, sucking
  - Severe injury



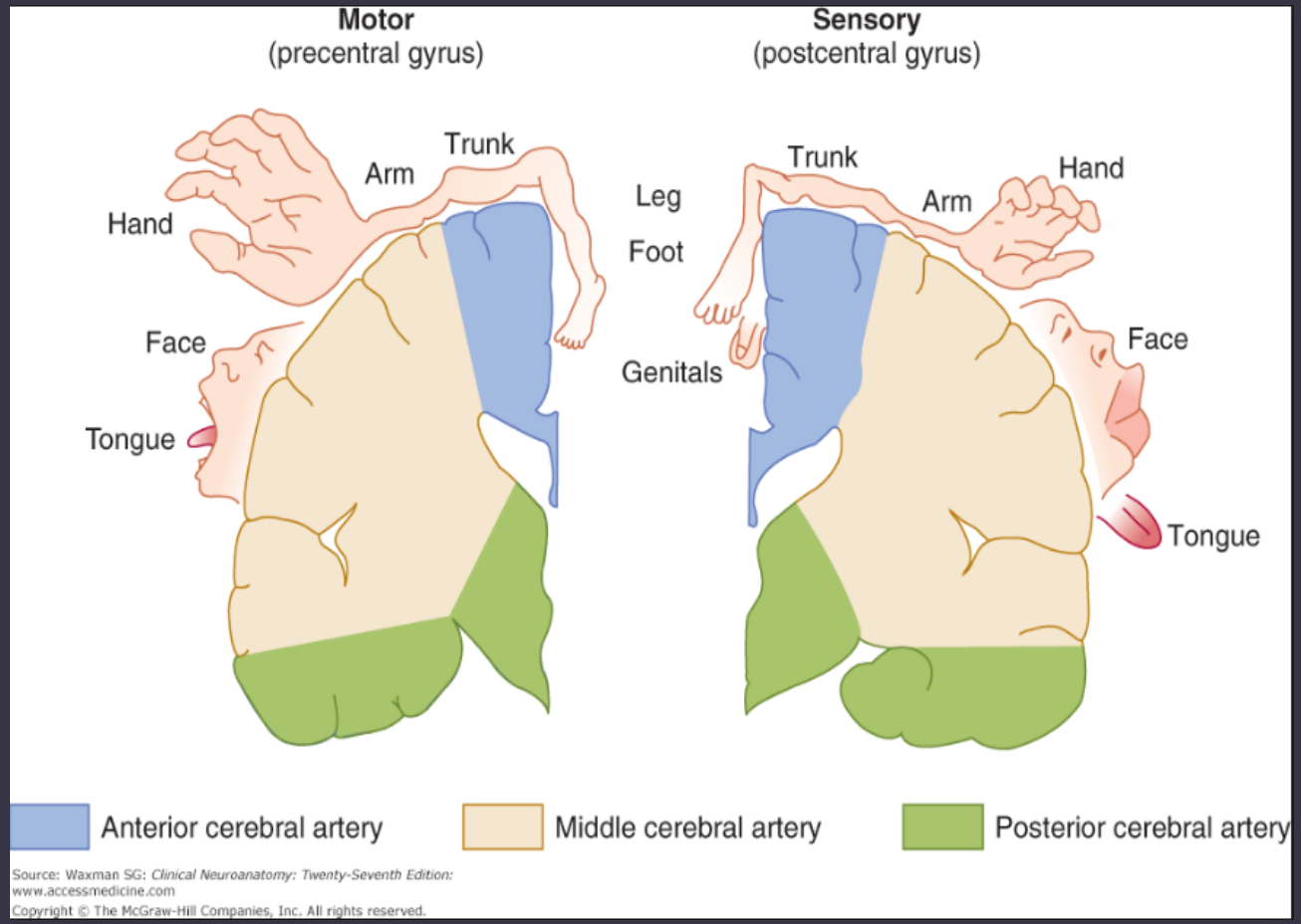
Acute Ischemic Stroke: Symptoms

Posterior Cerebral Artery (PCA) CVA

- Supplies the occipital lobe, portions of the temporal lobe, the thalamus, upper brainstem and midbrain
- Symptoms include:
  - Contralateral visual field homonymous hemianopia
  - Cortical blindness with complete blockage
  - Visual agnosia
  - Prosopagnosia
  - Dyslexia, anomic aphasia, color naming problems
  - Memory deficit
- **No paralysis, no aphasia**



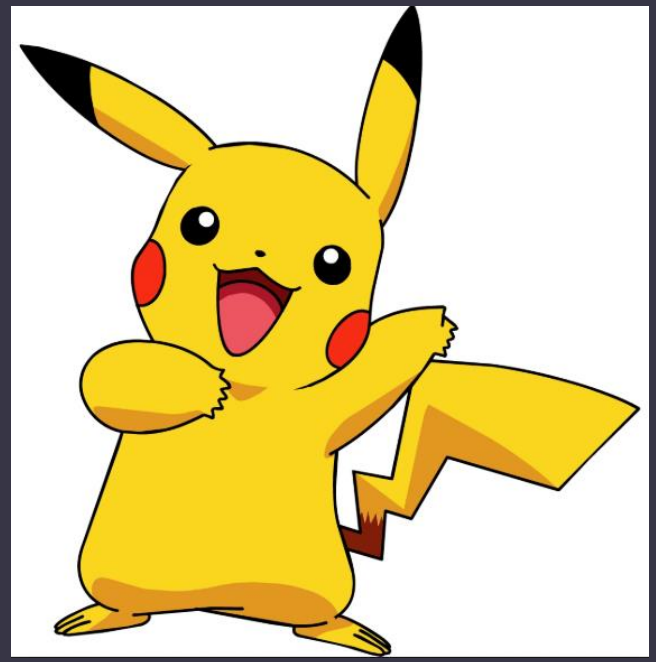
Acute Ischemic Stroke: Symptoms



Acute Ischemic Stroke: Symptoms

Posterior Inferior Cerebellar Artery (PICA) CVA

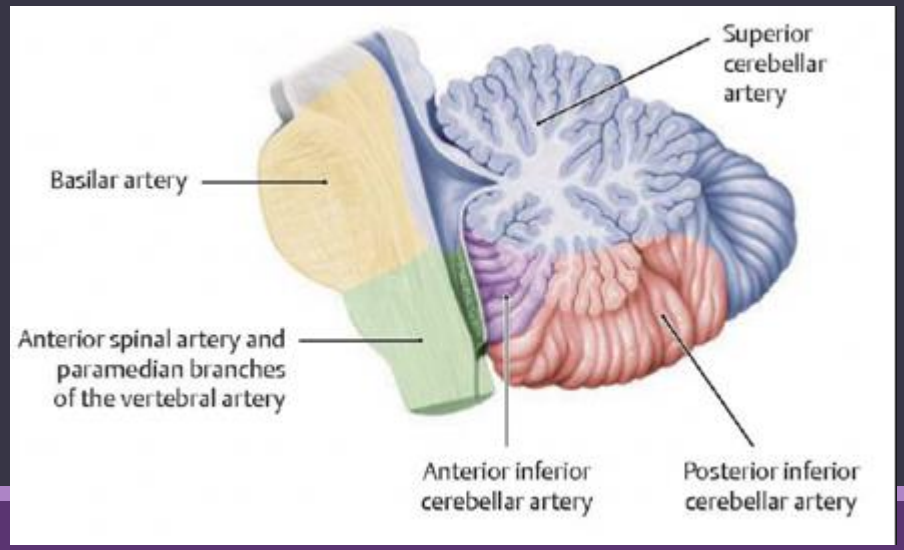
- Lateral Medullary syndrome (Wallenberg Syndrome)
  - Loss of pain and temp sensation in the contralateral trunk and ipsilateral face
  - Dysphagia, dysarthria, dysphonia
- Ipsilateral loss of corneal reflex



Acute Ischemic Stroke: Symptoms

Anterior Inferior Cerebellar Artery (AICA) CVA

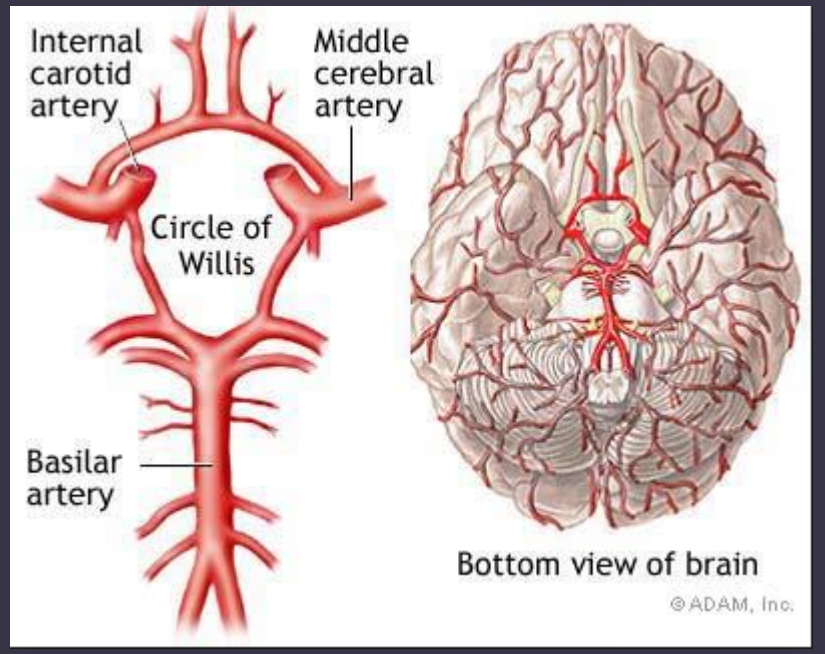
- Lateral Pontine Syndrome
  - Vertigo, vomiting, nystagmus, falling towards side of lesion
  - Ipsilateral loss of sensation/motion to face, ipsilateral hearing loss
- AICA and PICA strokes result in cerebellar findings:
  - Dysfunction of speech, tremor, nystagmus, abnormal gait and ataxia



Acute Ischemic Stroke: Symptoms

Basilar Artery CVA

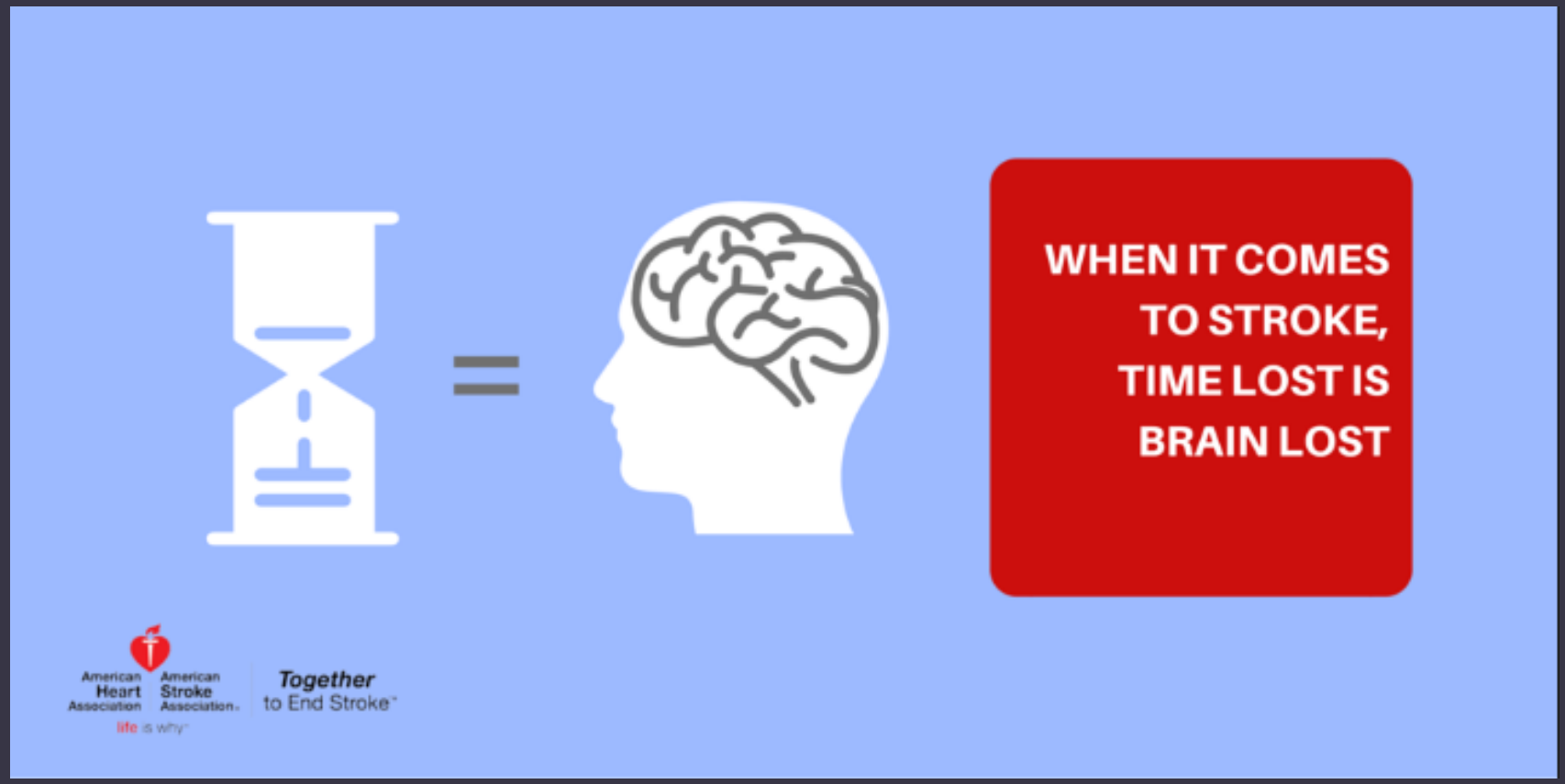
- Loss of perfusion to the cerebellum, brain stem, pons, thalamus and occipital lobe
- Coma
- Quadiparesis
- Ataxia
- Dysarthria
- CN dysfunction
- Locked-in syndrome
  - Unable to speak, cognition intact
  - Quadriparetic
  - Gaze paresis



Stroke Mimics

Processes that produce stroke-like symptoms:

- Hyper/hypoglycemia
- Seizure disorder
- Migraine
- CNS tumor, lesions
- MS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WHEN IT COMES TO STROKE, TIME LOST IS BRAIN LOST
American Heart Association
American Stroke Association
life is why
Together to End Stroke

Rapid Evaluation and Triage

~1.9 million brain cells are lost every second during stroke

During these events, the brain ages:

- 8.7 hours/second
- 3.1 weeks/minute
- 3.6 years/hour
- 11 years in 3 hours

Rapid Evaluation and Triage ED Arrival

EMS providers should communicate potential stroke patient en route

CT scanner should be held for immediate head CT upon arrival to ED

Personnel, equipment should be ready on patient arrival

Organized protocol in place for efficient evaluation and treatment administration

A stroke rating scale, preferably the NIHSS, should be utilized

Rapid Evaluation and Triage Timing is Key

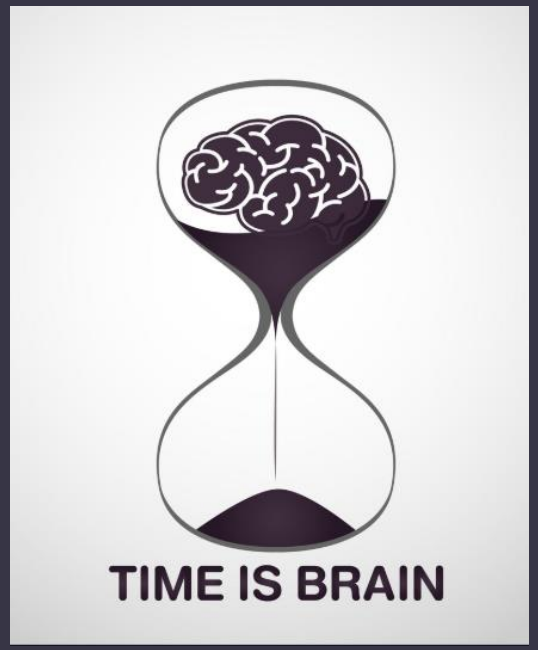
AHA recommendations for ED eval and triage:

- Door to physician ≤ 10 minutes
- Door to “Stroke Team” call ≤ 15 minutes
- Door to CT scanner ≤ 25 minutes
- Door to CT interpretation ≤ 45 minutes
- Door to needle (alteplase) ≤ 60 minutes
- Door to admission to stroke unit ≤ 3 hours

Rapid Evaluation and Triage Assessment

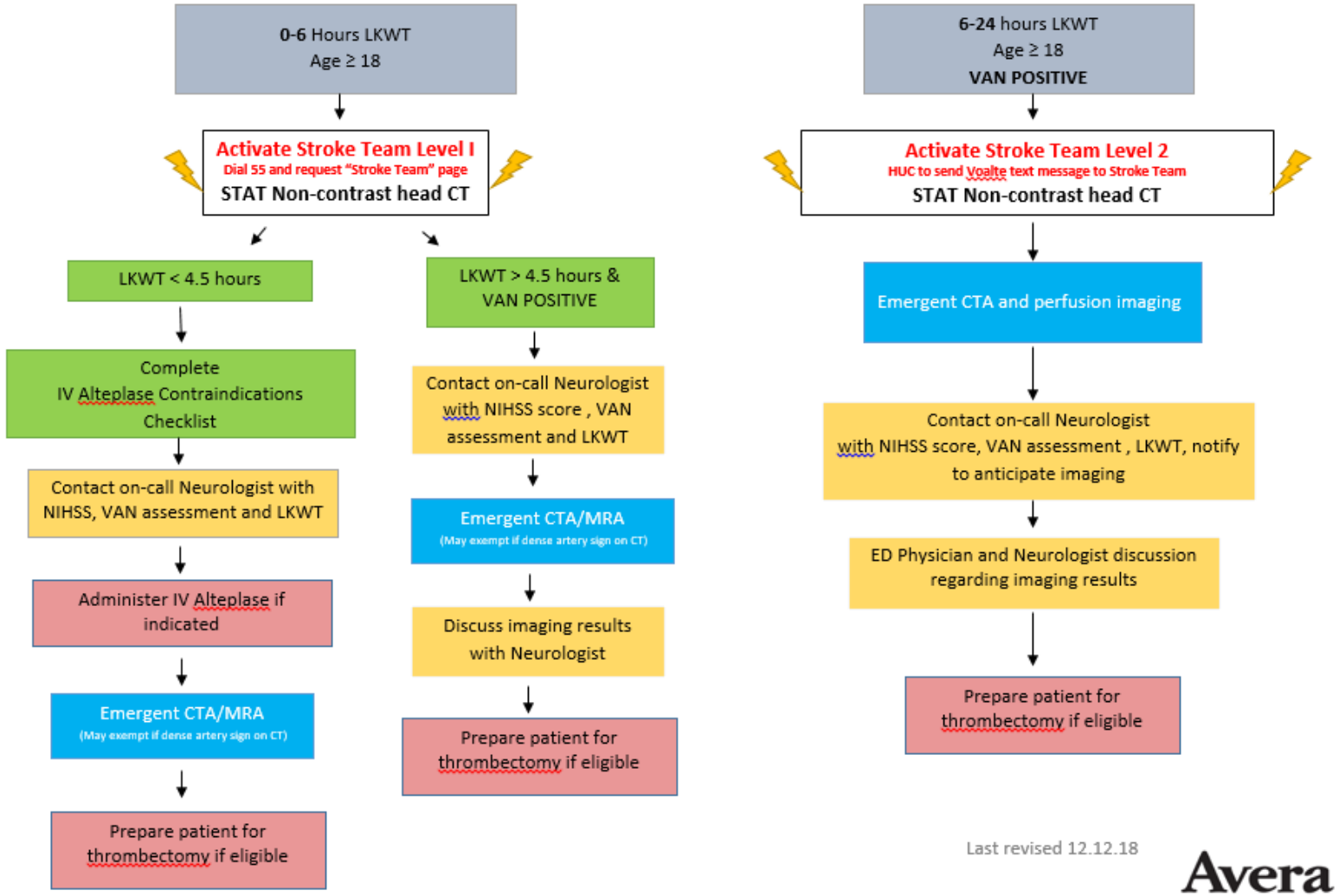
"Last Known Well" or "LKW" is CRUCIAL to identify

- Time and date that patient was completely symptom free
- Please note: if patient woke with these symptoms, the LKW is the last time they were symptom free



Stroke Team Activation Algorithm

- ✓ Obtain the last known well time (LKWT), or the last time the patient was without symptoms
- ✓ Activate stroke team based on the algorithm below



Last revised 12.12.18

Avera

Avera Stroke Team Process: Level 1 Stroke Team

If patient arriving by EMS with LKW<6 hours:

- EMS crew notifies ED triage of patient arriving with stroke like symptoms, “Stroke Team” call overhead
- Stroke Coordinator and neurology resource nurse respond to ED
- Blood sugar taken, patient rapidly assessed en route to CT scanner
- Patient transported back to room, thorough assessment performed, neurologist notified
- ED physician and neurologist communicate regarding treatment options
  - IV Alteplase
  - Advanced imaging needs
  - Endovascular treatment eligbility

If patient arriving by private vehicle with LKW<6 hours:

- Same process as above, initial assessment performed by triage RN

Rapid Evaluation and Treatment Assessment

ABCs

Blood sugar
- Required prior to initiation of fibrinolytics for all patients

Non-contrast head CT

Thorough, rapid neuro evaluation

Vital signs

Pertinent history
- Medical/surgical history
- Current medications
- Symptom onset

Rapid Evaluation and Triage Immediate Diagnostics

Labs*:

- Metabolic panel
- CBC, platelet count
- Cardiac markers
- PT/PTT/INR
- ECG
- **The results of these tests should not delay the administration of fibrinolytic therapies UNLESS patient has received heparin, warfarin, or if there is suspicion of a bleeding diathesis (low platelet count, etc.)*

Rapid Evaluation and Triage Treatment Decision

Telemedicine is of massive benefit to stroke patients in rural areas

Avera eEmergency plays a key role in assessing, treating and triaging stroke patients in the communities we serve

Rapid Evaluation and Triage Treatment Options

Fibrinolytic therapy:

- Alteplase administration
- LKW < 3-4.5 hours

Endovascular Treatment:

- Intra-arterial alteplase
  - LKW<6 hours
- Mechanical thrombectomy
  - LKW<24 hours

IV Alteplase Administration LKW<3 hours

FDA approved medication to treat stroke

Alteplase 0.9 mg/kg with a maximum dose of 90 mg is **recommended** for stroke patients who present within 3 hours of symptom onset

IV Alteplase Administration Criteria

Inclusion Criteria

- Measurable neuro deficit
- Symptom onset <3 hours before treatment
- Age ≥ 18yrs
- Glucose > 50mg/dL

Exclusion Criteria

- ICH/SAH on CT
- Active internal bleeding
- Intracranial, intraspinal surgery or head trauma in last 3 monhts
- Arterial puncture at non-compressible site in past 7 days
- Intracranial neoplasm, AVM, aneurysm or other intracranial condition that may increase the risk of intracranial bleed
- Acute bleeding diathesis (see next slide)
- Current, severe hypertension unable to be controlled with medication

IV Alteplase Administration: Criteria

According to the 2018 AHA/ASA guidelines, IV alteplase **should not** be given to patients with:

- Platelet count <100,000/mm^3
- History of warfarin use *and* INR>1.7
- Administration of LMW heparin in last 24 hours
- History of direct thrombin inhibitors or direct factor Xa inhibitors, unless the patient has not taken the medication in >48hours.

IV Alteplase Administration LKW<4.5 hours

Patients presenting with stroke-like symptoms within 4.5 hours of LKW may still be eligible for alteplase

Off-label use

Additional exclusion criteria:

- Age>80 years
- Severe stroke, NIHSS>25
- Taking oral anticoagulant, regardless of INR
- History of BOTH ischemic stroke and diabetes
- Imaging evidence of ischemic injury involving >1/3 of MCA territory

Alteplase Administration

Dosing

- 0.9 mg/kg, max dose of 90 mg
- 10% of dose given over 1 minutes
- Remainder given over 1 hour

Blood pressure management

- Must be safely lowered to <185/110 prior to administration
- Must be maintained at <180/105 after initiation of alteplase therapy
- Must be maintained at <180/105 for 24 hours after alteplase therapy

IV Alteplase Administration Post-Administration Assessment

Neuro checks, vital signs and orolingual angioedema assessments are completed AT LEAST:

- q15 minutes x 2 hours
- q30 minutes x 6 hours
- q1 hours x 16 hours

Avera Stroke Team Process: Level 2 Stroke Team

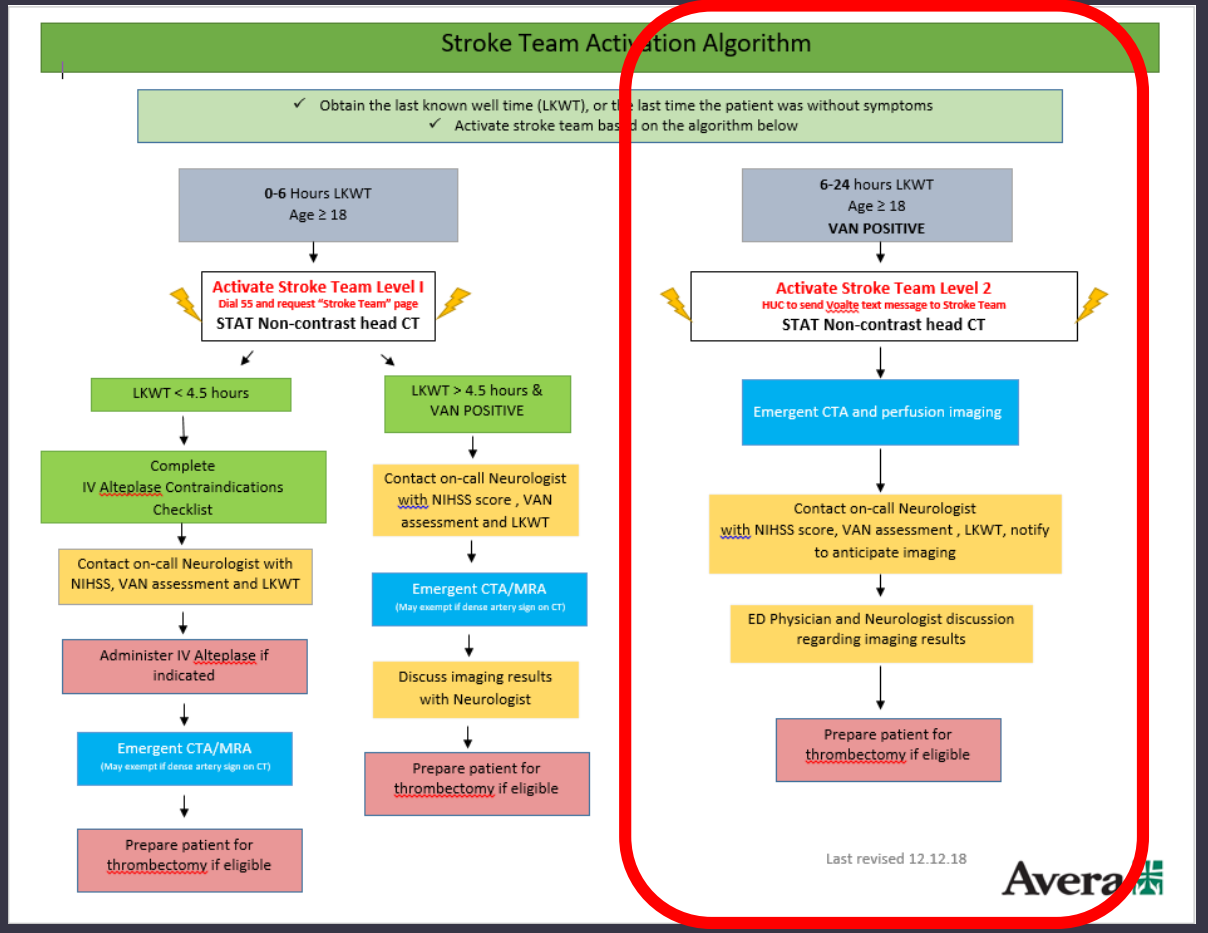
Patient arrives with LKW 6-24 hours

- Patient assessed by ED RN, blood sugar taken, LVO/VAN assessment performed
- If LVO/VAN Assessment “positive” Level 2 Stroke Team is called
- Neuro resource RN, Stroke Coordinator respond to assist with advanced imaging needs, potential endovascular treatment
- Communication between ED physician, neurologist and neurointerventionalist to determine course of treatment
  - If patient requires transfer for thrombectomy, 911 is called for emergent response and transfer

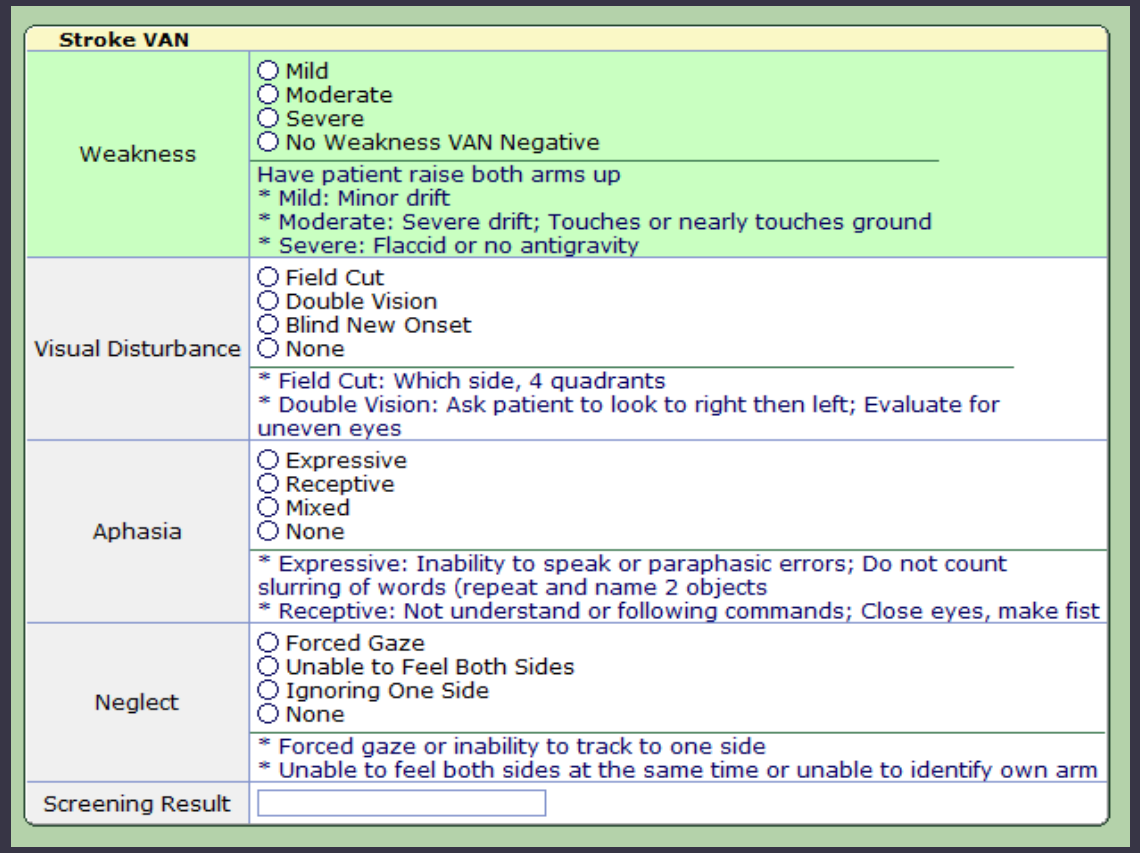
Endovascular Treatment: Mechanical Thrombectomy

Assess patient for large vessel occlusion (LVO):

- Avera McKennan utilizes the VAN Assessment tool for patients presenting with stroke symptoms with LKW<24 hours to rapidly triage
  - **Stroke Team** algorithm built to determine course of diagnostics, treatment



LVO/VAN Assessment Tool



Stroke VAN	
Weakness	○ Mild ○ Moderate ○ Severe ○ No Weakness VAN Negative Have patient raise both arms up * Mild: Minor drift * Moderate: Severe drift; Touches or nearly touches ground * Severe: Flaccid or no antigravity
Visual Disturbance	○ Field Cut ○ Double Vision ○ Blind New Onset ○ None * Field Cut: Which side, 4 quadrants * Double Vision: Ask patient to look to right then left; Evaluate for uneven eyes
Aphasia	○ Expressive ○ Receptive ○ Mixed ○ None * Expressive: Inability to speak or paraphasic errors; Do not count slurring of words (repeat and name 2 objects * Receptive: Not understand or following commands; Close eyes, make fist
Neglect	○ Forced Gaze ○ Unable to Feel Both Sides ○ Ignoring One Side ○ None * Forced gaze or inability to track to one side * Unable to feel both sides at the same time or unable to identify own arm
Screening Result	

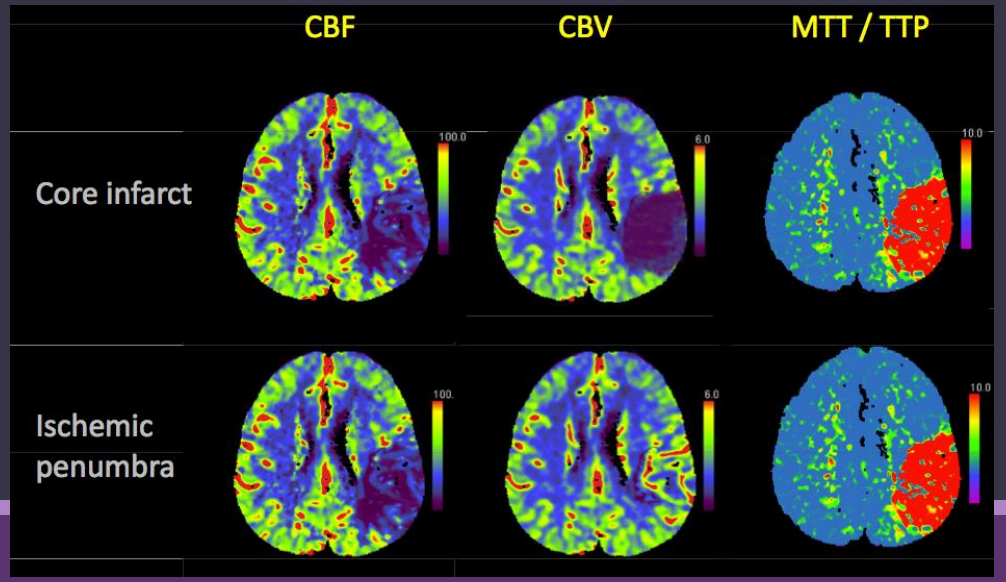
Endovascular Treatment: Mechanical Thrombectomy

Standard treatment option for patients with:

- LKW<24 hours
- Stroke being caused by blockage in a large vessel in the anterior circulation

Advanced imaging needs:

- LKW<6 hours → CTA to visualize blockage, determine eligibility for thrombectomy
- LKW 6-24 hours → CT Perfusion to visualize blockage, salvageable tissue



Endovascular Treatment: Mechanical Thrombectomy

PLEASE NOTE:

Patients who are eligible for IV alteplase should receive this medication ***without delay***, regardless of eligibility for thrombectomy

Endovascular Treatment: Mechanical Thrombectomy

Catheter is threaded through femoral artery up to the brain circulation to remove blockage causing stroke

Goal to reestablish perfusion, preserve quality of life

Often see almost complete resolution of symptoms

Endovascular Treatment: Mechanical Thrombectomy

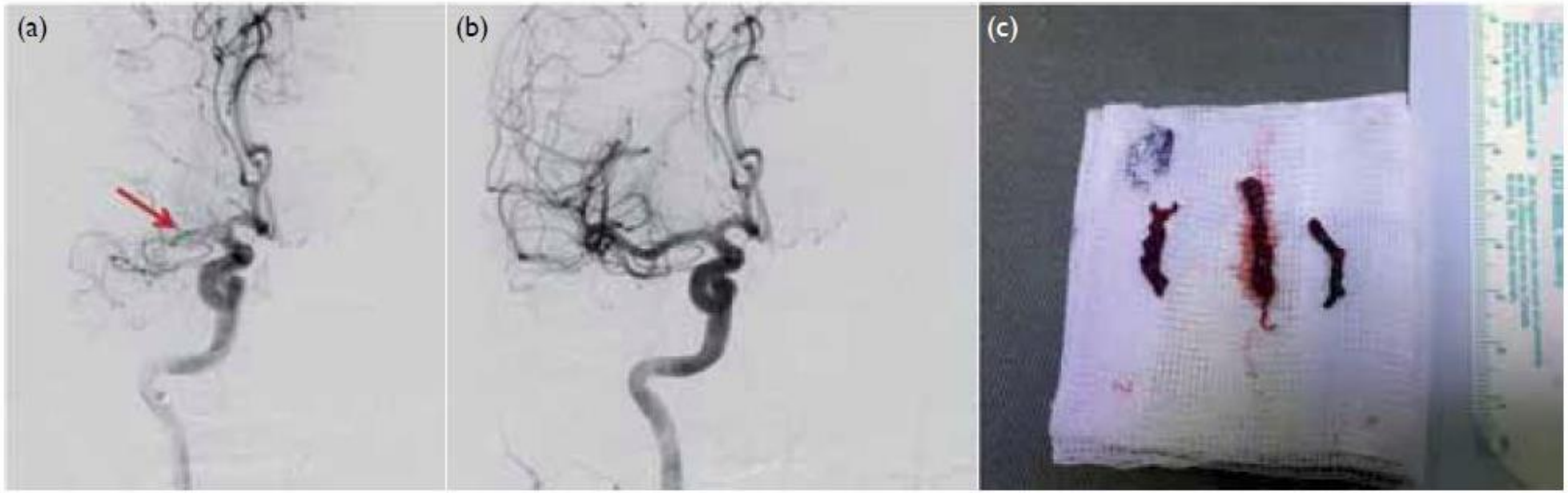


FIG 1. (a) Angiogram showing acute occlusion of the right middle cerebral artery (arrow). (b) Post-thrombectomy angiogram showing revascularisation of the right middle cerebral artery territory. (c) Thrombus removed by endovascular thrombectomy

Ongoing Supportive Cares

Airway and ventilator support recommended for patients with significant decrease in LOC, compromised airway status

Maintain oxygen saturation >94%

Cardiac monitoring

- Assess for dysrhythmias, correct as indicated

Blood pressure management

- Thrombolyzed patients: Maintain BP <180/105 for 24 hours
- Non-thrombolyzed patients: allow permissive hypertension up to 220/120 with gentle lowering over 48 hours
  - Reasonable to reduce blood pressure by 15% every 24 hours until normotensive

Ongoing Supportive Cares

Maintain normothermia

- Prevent and treat fever

Correct hypovolemia to maintain brain perfusion

Normoglycemia should be achieved and maintained

Serial neuro checks and vital signs should be performed to trend patient status

Remember that perfusion and oxygenation are primary goal to salvage brain tissue

Communication, Documentation: Chart What Happened!

Last Known Well (LKW)

- Date and time of LKW should be clearly documented and communicated

NIHSS

- Date, time and score should be clearly documented and communicated

Treatment decision making

- Reason for not utilizing IV alteplase should be clearly documented and communicated

Alteplase administration

- Date, time and dose of alteplase administered should be clearly documented and communicated
- Assessments and vital signs should be documented regularly per guidelines

Program Evaluation

Review step-by-step process for when your facility first receives notification of incoming stroke patient, consider the following:

- Opening and holding CT scanner
- Initiate a stroke protocol, make it visible and include alteplase indications/contraindications
- Ensuring alteplase is on hand, all supplies needed are kept together
- Utilize eED immediately upon patient arrival to assist
- Staff education, mock stroke patient situations

Review time parameters in your facility, such as:

- Door-to-physician
- Door-to-CT scanner and interpretation
- Door-to-Needle

Review patient outcomes to assess for any opportunities to improve quality of care in your facility


QUESTIONS?

Guidelines for the Early Management of Patients With Acute Ischemic Stroke : A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Edward C. Jauch, Jeffrey L. Saver, Harold P. Adams, Jr, Askiel Bruno, J.J. (Buddy) Connors, Bart M. Demaerschalk, Pooja Khatri, Paul W. McMullan, Jr, Adnan I. Qureshi, Kenneth Rosenfield, Phillip A. Scott, Debbie R. Summers, David Z. Wang, Max Wintermark and Howard Yonas

AHA/ASA Scientific Statement

Scientific Rationale for the Inclusion and Exclusion Criteria for Intravenous Alteplase in Acute Ischemic Stroke

A Statement for Healthcare Professionals From the American Heart Association/American Stroke Association

Emergency Neurological Life Support: Acute Ischemic Stroke

Hartmut Gross[1] · Noah Grose[2,3]

AHA/ASA Guideline

2015 American Heart Association/American Stroke Association Focused Update of the 2013 Guidelines for the Early Management of Patients With Acute Ischemic Stroke Regarding Endovascular Treatment

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Emergency Neurological Life Support: Subarachnoid Hemorrhage

Brian L. Edlow[1] · Owen Samuels[2]

AHA/ASA Guideline

Guidelines for the Management of Spontaneous Intracerebral Hemorrhage

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Emergency Neurological Life Support: Intracerebral Hemorrhage

J. Claude Hemphill III[1] · Arthur Lam[2]

AHA/ASA Guideline

2018 Guidelines for the Early Management of Patients With Acute Ischemic Stroke

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Reviewed for evidence-based integrity and endorsed by the American Association of Neurological Surgeons and Congress of Neurological Surgeons

Endorsed by the Society for Academic Emergency Medicine

References

Hickey, J. & Livesay, S. (2016). The continuum of stroke care: An interprofessional approach to evidence-based care. Wolters Kluwer.

Jauch, E., Saver, J., Adams, H., Bruno, A., Connors, J., Demaerschalk, B., … Yonas, H. (2013). Guidelines for the Early Management of Patients with Acute Ischemic Stroke: A Guidelines for Healthcare Professionals From the American Heart Association/American Stroke Association. Stroke, 870-947.

Livesay, S. (2014). Comprehensive review for stroke nursing. American Association of Neuroscience Nurses.

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