

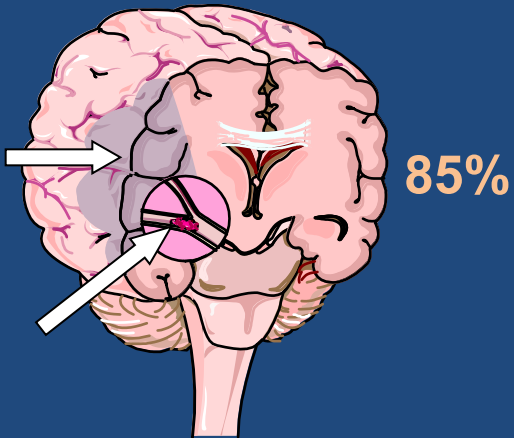
Acute Stroke Diagnosis and management

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TYPES OF STROKE

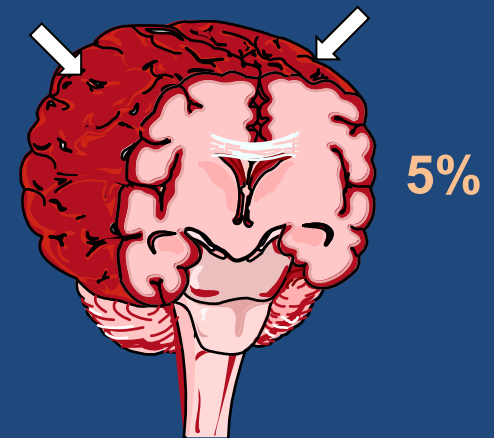
Ischemic
Stroke



Intracerebral
Hemorrhage



Subarachnoid
Hemorrhage



The High Socioeconomic Cost of Stroke

Morbidity and Mortality

- A leading cause of serious, longterm disability
- The increase in life expectancy will increase the incidence of stroke
- A second to only heart disease in causing death world-wide
- According to the WHO 15 million people worldwide suffer a stroke each year
- 30-day mortality is 8-12%

The High Socioeconomic Cost of Stroke

For survivors aged > 65 years:

- 50% have hemiparesis
- 30% are unable to ambulate
- 19% are aphasic
- 35% are depressed
- 26% resides in nursing home

Ischemic Stroke: some facts

- Low blood flow to focal area of the brain
- Mainly caused by thromboembolism
- Occasionally caused by hypo perfusion from low blood flow circulatory failure
- A remarkably effective treatment for acute stroke was introduced in recent years
- 2° prevention depends on source of thromboembolus

Transient Ischemic Attack (TIA)

- Sudden transient focal neurological deficit
- Symptoms lasting less than 24 hours **less than an hour!**
 - complete resolution
- Symptoms maximal at onset
- Normal CT/MRI of brain

ER:

Among TIA pts who go to ED:

- 5% have stroke in next 2 days
- 25% have recurrent event in next 3 months

Stroke risk decreased with proper therapy

History taking

- Onset: **Acute focal neurologic deficit**
- Symptoms:
 - ✓ Unilateral weakness(whole or in part)
 - ✓ Unilateral sensory symptoms
 - ✓ Slurred speech
 - ✓ Language difficulty
 - ✓ Visual symptoms (monocular, homonymous hemianopsia, double vision)

History taking

- Symptoms:
 - ✓ Difficulty swallowing
 - ✓ Simultaneous bilateral weakness
 - ✓ Imbalance
 - ✓ Vertigo
 - ✓ Crossed motor or sensory loss
 - ✓ Difficult dressing, combing hair
 - ✓ Visuospatial neglect

History taking

- Any history of previous symptoms
- Age
- Gender
- Prior DVT
- Illicit drugs
- Trauma
- Heart valve disease

History taking

- Fever
- Medications (OCP, sympathomimetic)
- Clues to vasculitis (arthralgia, skin rash etc.)
- Vascular risk factors:
 - ✓ Hypertension
 - ✓ Diabetes
 - ✓ Dyslipidemia
 - ✓ Tobacco
 - ✓ Ischemic heart disease

Differential diagnosis

- Migraine aura
- Seizure
- Multiple sclerosis
- Metabolic (hypoglycemia)
- Brain tumor
- Syncope Conversion/somatization

Neurological Examination

- Cognitive assessment:
 - ✓ Orientation (time, place and person)
 - ✓ Attention (serial 7s)
 - ✓ Language
 - ✓ Memory (recall and retrograde)
 - ✓ Executive
 - ✓ Praxis (wave, salute)
 - ✓ Visuospatial (clock drawing)

Neurological Examination

- Cranial nerve examination (olfactory, optic nerve, Oculomotor, trochlear, trigeminal, abducen, facial, vetibulcholear, glossopharyngeal, vagal, accessory, and hypoglossal)
- Motor examination
- Sensory examination
- Coordination (finger to nose and heel to chin)
- Tone and deep tendon reflexes)
- Gait

NIHSS

Figure 2. National Institutes of Health Stroke Scale

Category	Score	Time	Score
1a. Level of Consciousness (LOC) (Alert, drowsy, etc.)	0 = 1 = 2 = 3 =	Alert Drowsy Stuporous Coma	
1b. LOC Questions (Month, age)	0 = 1 = 2 =	Answers both correctly Answers one correctly Incorrect	
1c. LOC Commands (Open/close eyes, make fist & let go)	0 = 1 = 2 =	Obeys both correctly Obeys one correctly Incorrect	
2. Best Gaze (Eyes open - pt follows examiner's fingers or face)	0 = 1 = 2 =	Normal Partial gaze palsy Forced deviation	
3. Visual (Introduce visual stimulus/threat to pt's visual field quadrants. Cover 1 eye and hold up fingers in all 4 quadrants.)	0 = 1 = 2 = 3 =	No visual loss Partial hemianopsia Complete hemianopsia Bilateral hemianopsia	
4. Facial Palsy (Show teeth, raise eyebrows and squeeze eyes tightly shut.)	0 = 1 = 2 = 3 =	Normal Minor Partial Complete	
5a. Motor Arm - Left (Elevate extremity to 90 degrees and score drift/movement. Count to 10 out loud and use fingers for visual cue.)	0 = 1 = 2 = 3 = 4 = NT =	No drift Drift Can't resist gravity No effort against gravity No movement Amputation, joint fusion (Explain)	
5b. Motor Arm - Right (Elevate extremity to 90 degrees and score drift/movement. Count to 10 out loud and use fingers for visual cue.)	0 = 1 = 2 = 3 = 4 = NT =	No drift Drift Can't resist gravity No effort against gravity No movement Amputation, joint fusion (Explain)	
6a. Motor Leg - Left (Elevate extremity to 30 degrees and score drift/movement. Count to 5 out loud and use fingers for visual cue.)	0 = 1 = 2 = 3 = 4 = NT =	No drift Drift Can't resist gravity No effort against gravity No movement Amputation, joint fusion	
6b. Motor Leg - Right (Elevate extremity to 30 degrees and score drift/movement. Count to 5 out loud and use fingers for visual cue.)	0 = 1 = 2 = 3 = 4 = NT =	No drift Drift Can't resist gravity No effort against gravity No movement Amputation, joint fusion (Explain)	
7. Limb ataxia (Finger to nose, heel down shin)	0 = 1 = 2 =	Absent Present in one limb Present in two limbs	
8. Sensory (Pin prick to face, arms, trunk, and legs -compare sharpness side to side, or no feeling at all.)	0 = 1 = 2 =	Normal Partial loss Severe loss	
9. Best Language (Name items, describe picture, and read sentences. Don't forget glasses if they normally wear them.)	0 = 1 = 2 = 3 =	No aphasia Mild to moderate aphasia Severe aphasia Mute	
10. Dysarthria (Evaluate speech clarity by pt reading or repeating words on list.)	0 = 1 = 2 = NT	Normal articulation Mild to moderate dysarthria Near to unintelligible or worse Intubated or other physical barrier	
11. Extinction and Inattention (Use information from prior testing or double simultaneous stimuli testing to identify neglect. Face, arms, legs and visual fields.)	0 = 1 = 2 =	No neglect Partial neglect Complete neglect	
NT= Not Testable acceptable as noted above			
TOTAL SCORE:			

Four Major Stroke Syndromes for Rapid Recognition in the ED

All Occur Suddenly in Stroke Patients

- Left (dominant) cerebral hemisphere
- Right (non dominant) cerebral hemisphere
- Brainstem
- Cerebellum

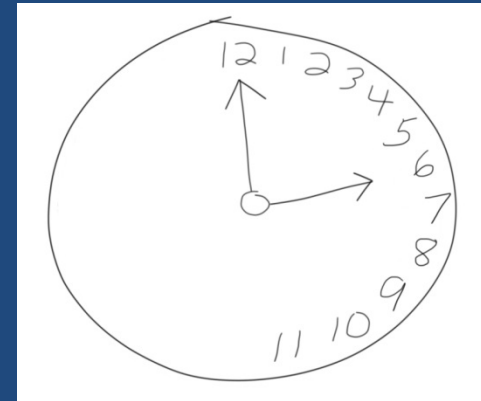
Note: The dominant cerebral hemisphere is the side that controls language function.

Left (Dominant) Cerebral Hemisphere

- Aphasia
- L gaze preference
- R visual field deficit
- R hemiparesis
- R hemisensory loss

Right (Nondominant) Cerebral Hemisphere

- Neglect (Lt hemi-inattention)
- R gaze preference
- L visual field deficit
- L hemiparesis
- L hemi-sensory loss



Brainstem

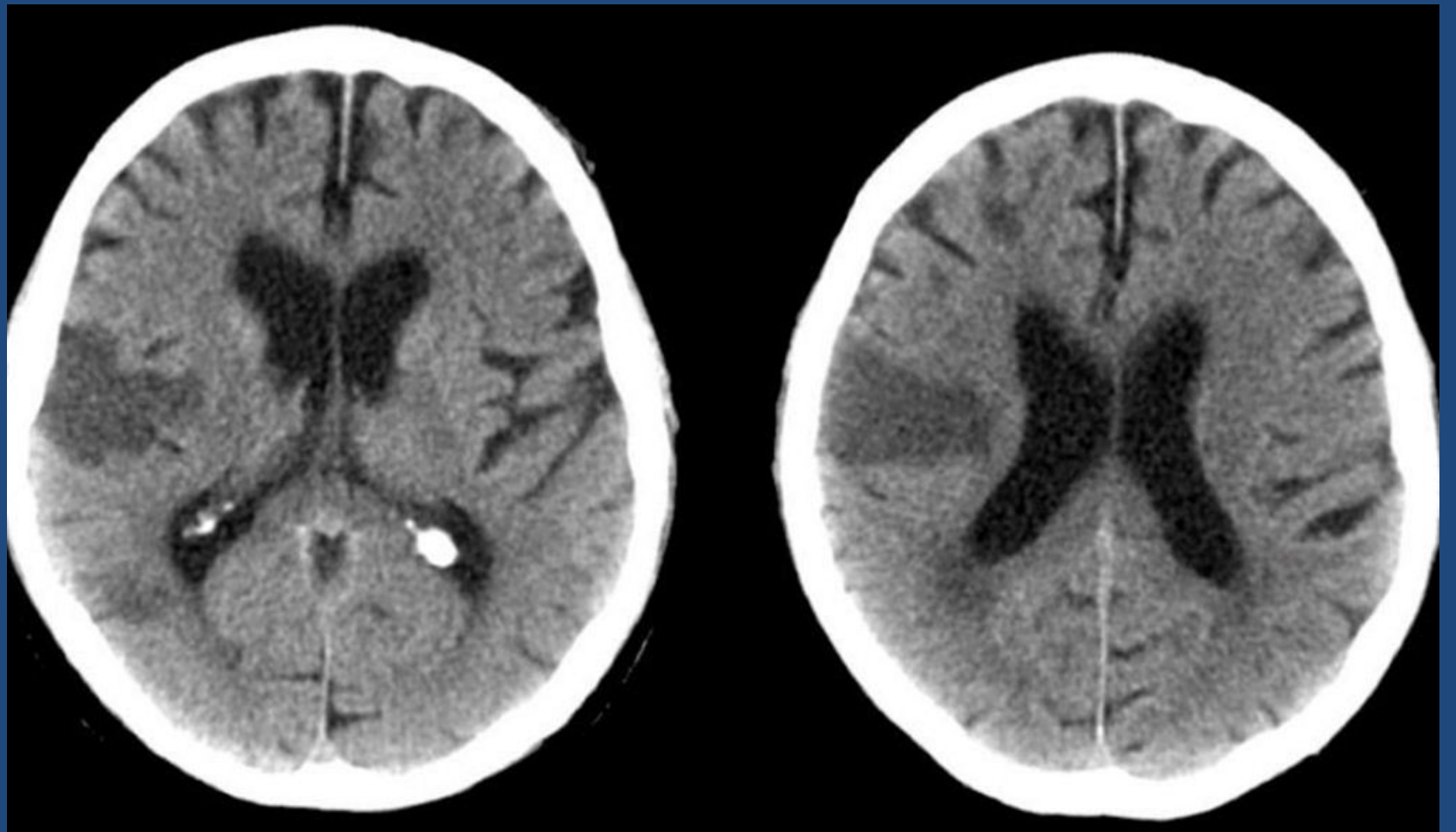
- Hemi- or quadriparesis
- Sensory loss in hemibody or all 4 limbs
- Crossed signs (face 1 side, body other side)
- Diplopia, dysconjugate gaze, gaze palsy
- Vertigo, tinnitus
- Nausea, vomiting
- Hiccups, abnormal respirations
- Decreased consciousness

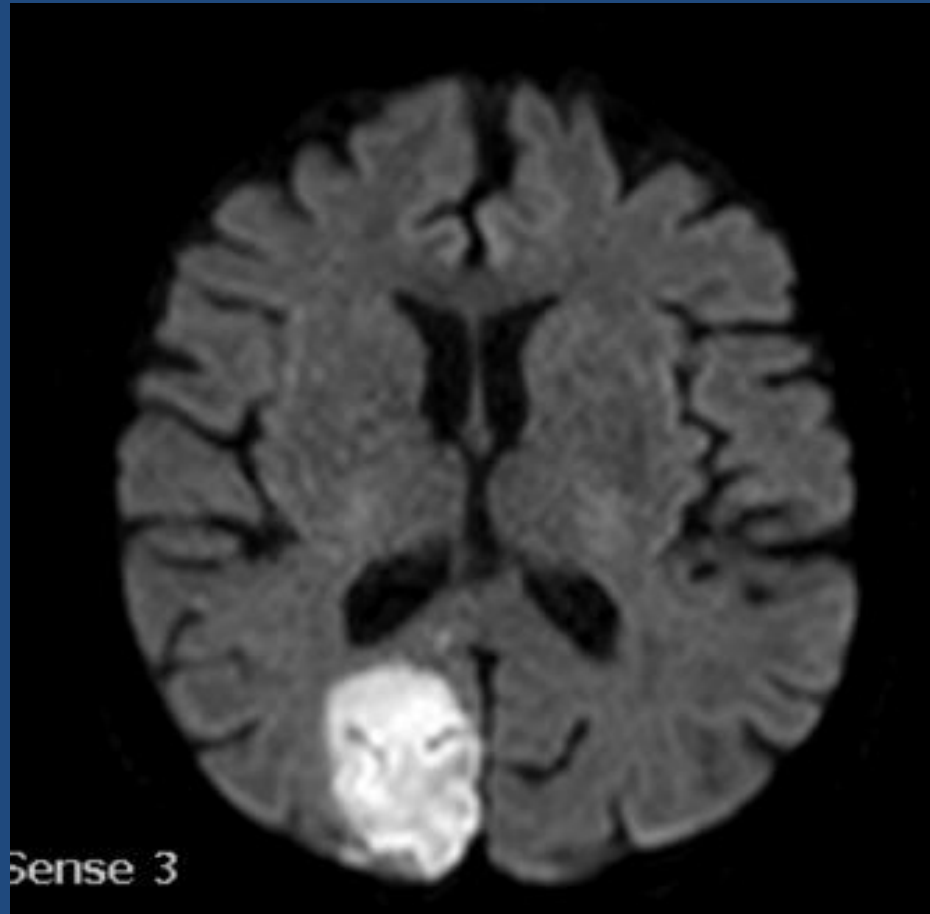
Cerebellum

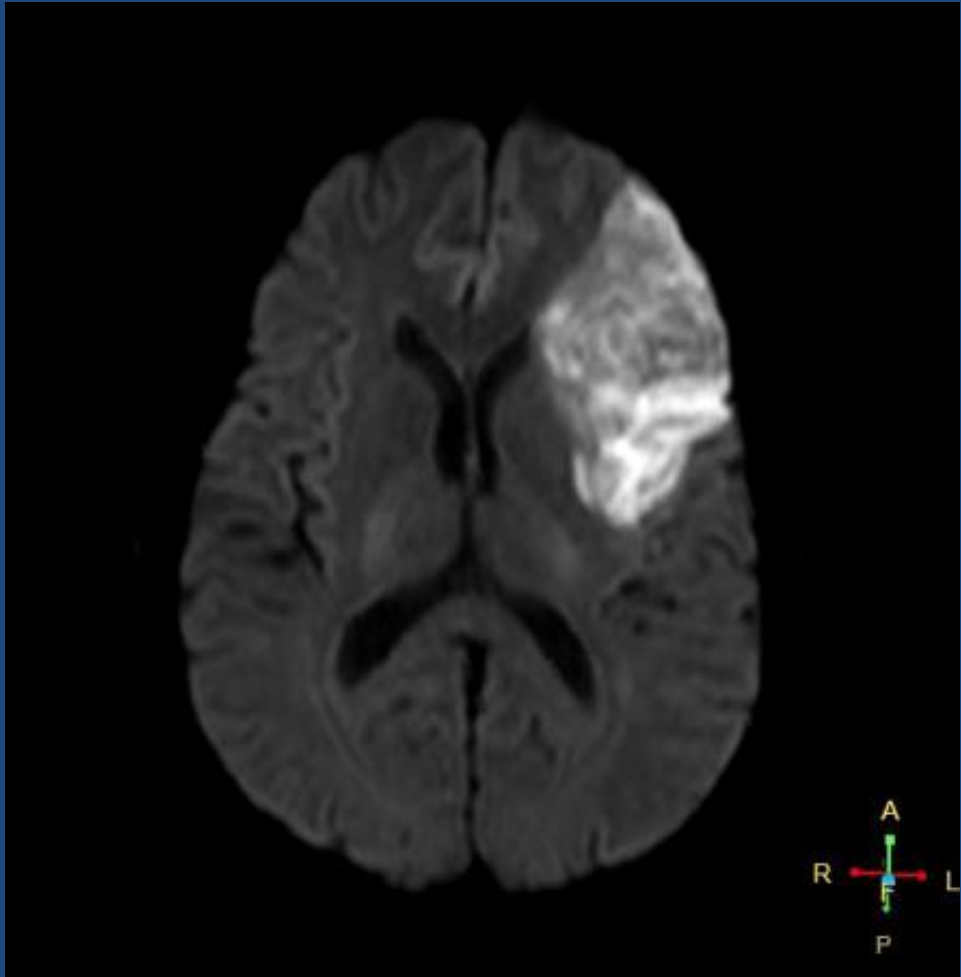
- Truncal = gait ataxia
- Limb ataxia

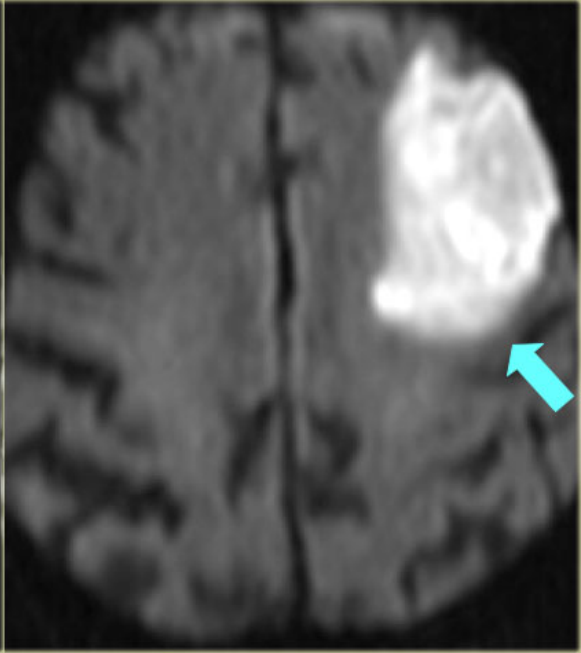
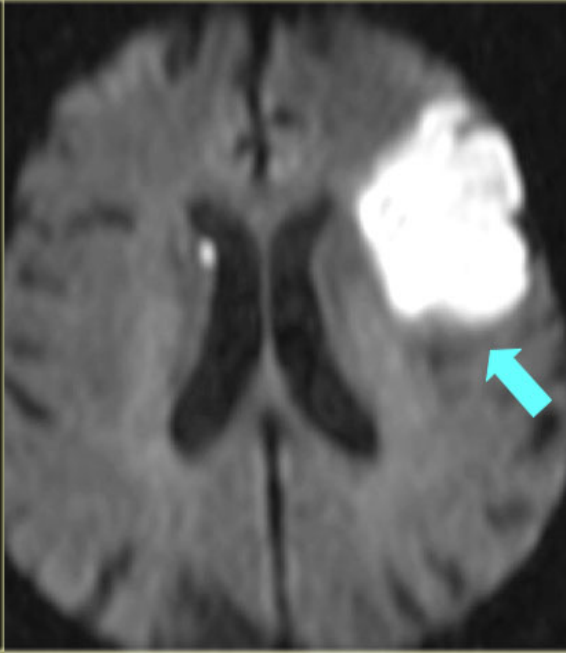
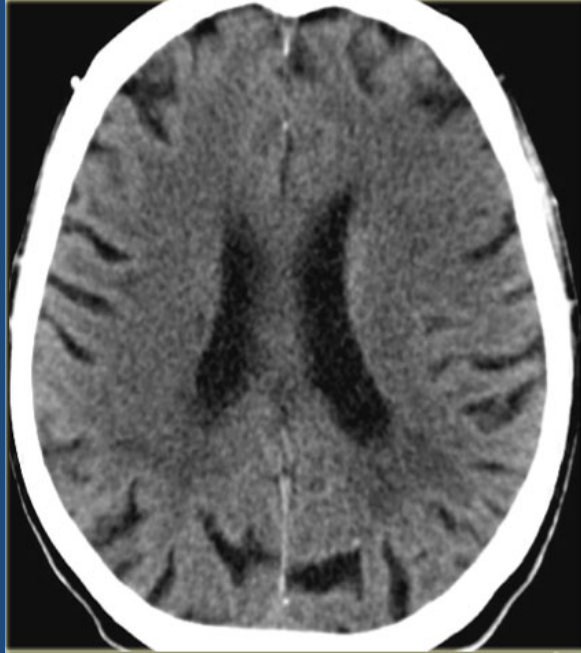












Stroke Treatment:

Primary Stroke Prevention

Acute Stroke Treatment

Secondary Stroke Prevention

Stroke Rehabilitation

Stroke Treatment:

Primary Stroke Prevention

Acute Stroke Treatment

Secondary Stroke Prevention

Stroke Rehabilitation

Acute Stroke Treatment

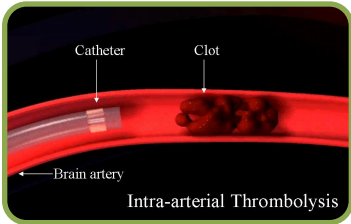


Ischemic

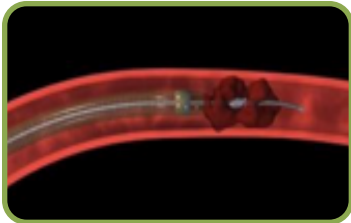
Modalities of Acute Stroke Treatment:



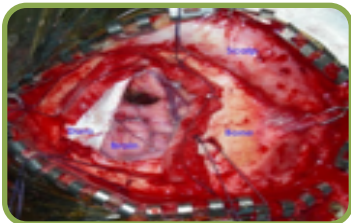
IV t-PA (standard)



IA t-PA



Mechanical Disruption



Surgical Rx (old)

NINDS+ ECASS III (IV t-PA)

Inclusion criteria:

- Clinical Dx of stroke
- Stroke onset < 270 minutes
- Age is > or = 18

Exclusion criteria:

- Intracranial Hge in imaging or clinical presentation suggests SAH
- Active/ recent internal bleeding or on warfarin with INR > 1.7 or platelets < 100K
- Serum Glucose <50 or > 400
- Systolic BP > 185 or diastolic >110
- Recent MI (3/52)
- Recent (2/52) major surgery or trauma
- Recent arterial puncture at non-compressible site
- *Others (see NINDS protocol)*

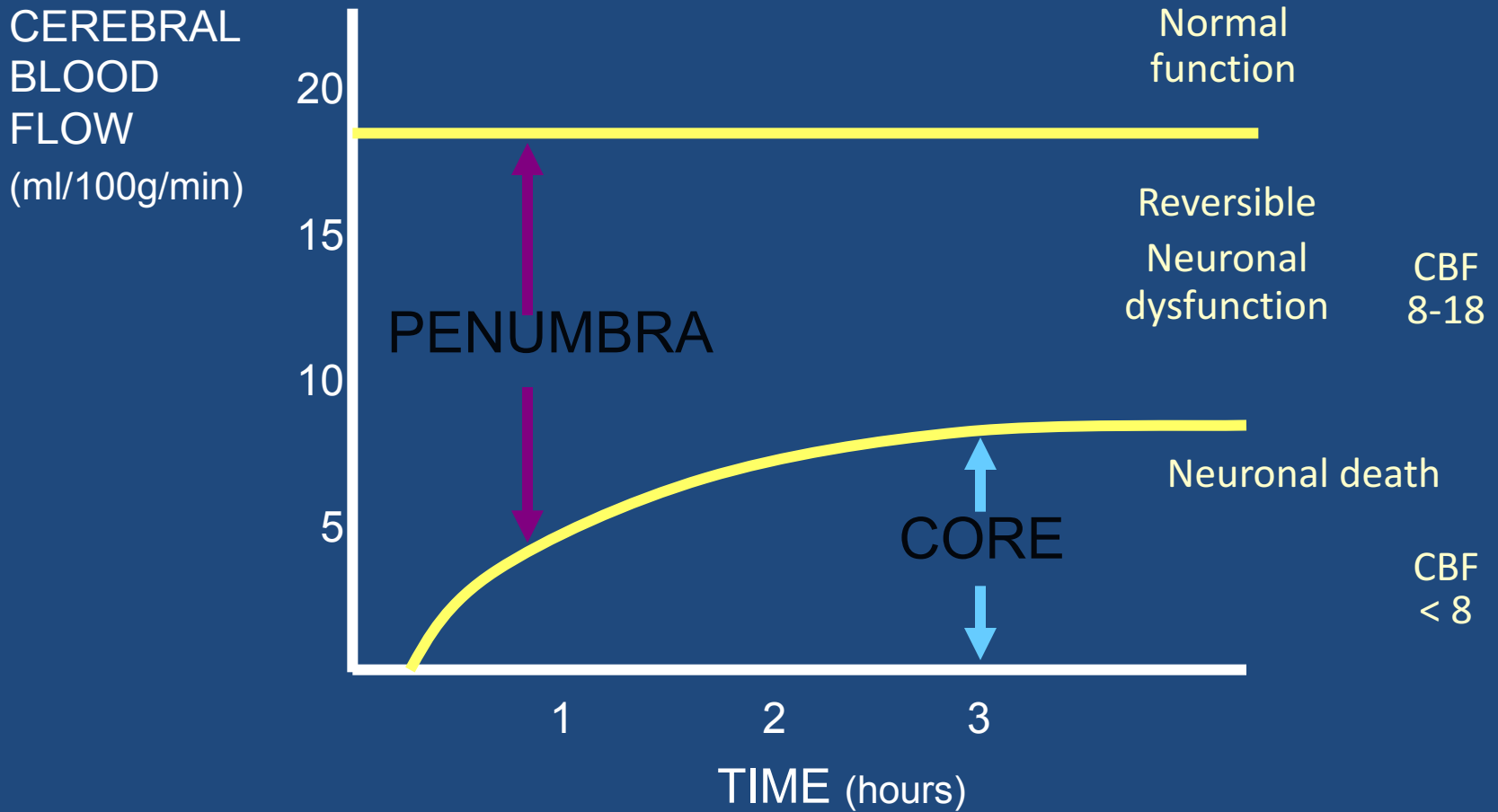
NINDS+ ECASS III) (IV t-PA

- Stroke onset: timing of first neurological deficit OR last time pt was seen well
- TIA: has to end with complete neurological recovery

IV t-PA (alteplase)

- 0.9 mg / kg to a maximum of 90 mg
- 10% bolus over 1 minute then infuse rest over 60 minutes
- Hold infusion and re-evaluate the pt in case of HTN (S>185,D>110), sudden headache, or sudden reduction in LOC

Stroke Penumbra



Stroke Penumbra:

The target of acute stroke Rx!!

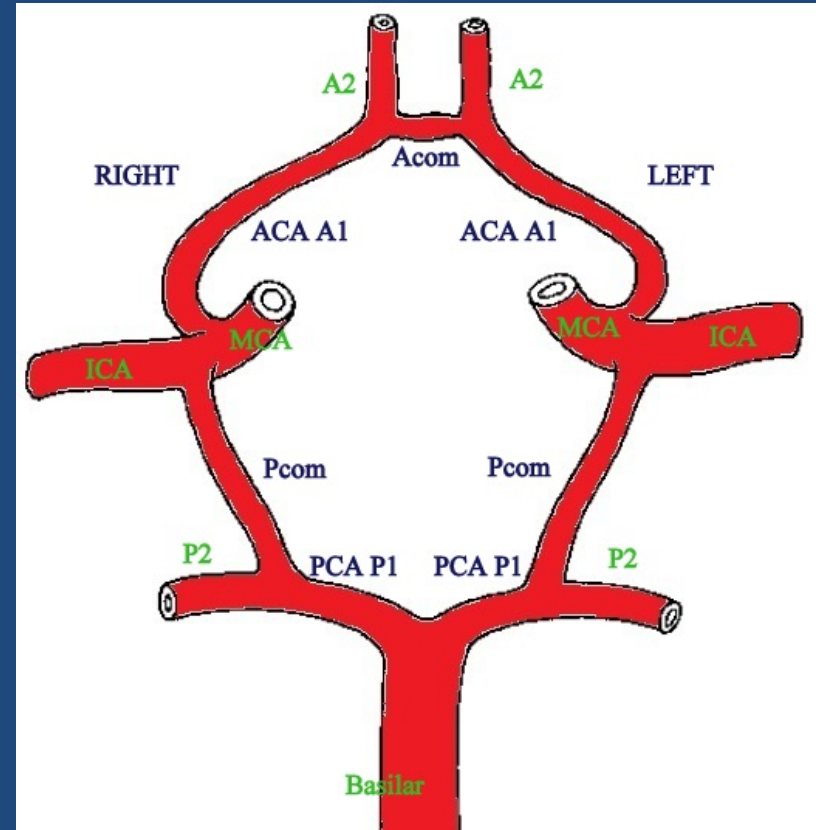


Cranial Collateral Arteries: Penumbra suppliers

External:



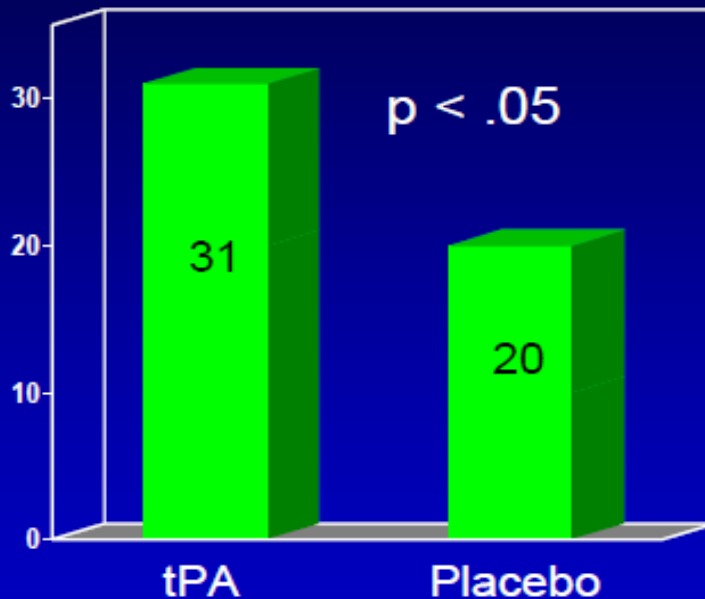
Internal:



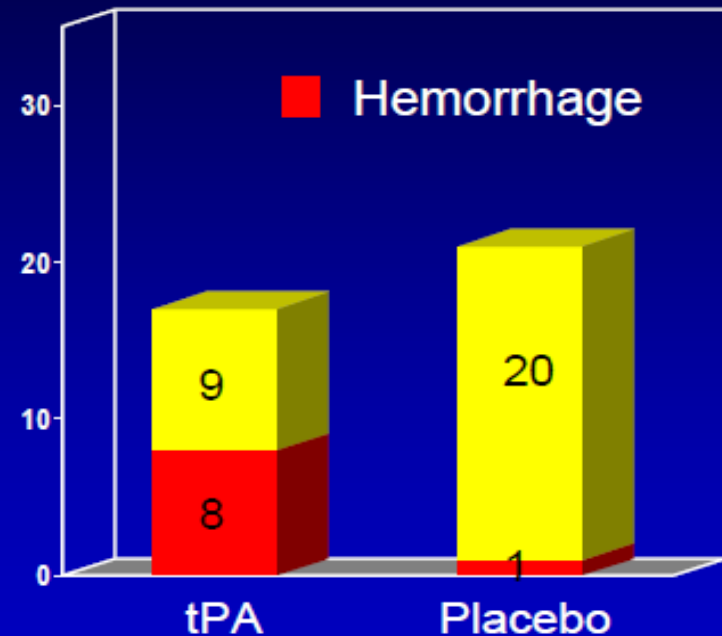
Outcome with: IV t-PA (NINDS)

New England Journal, 1995

NINDS tPA Stroke Trial



**NIHSS Excellent
Recovery (%)**

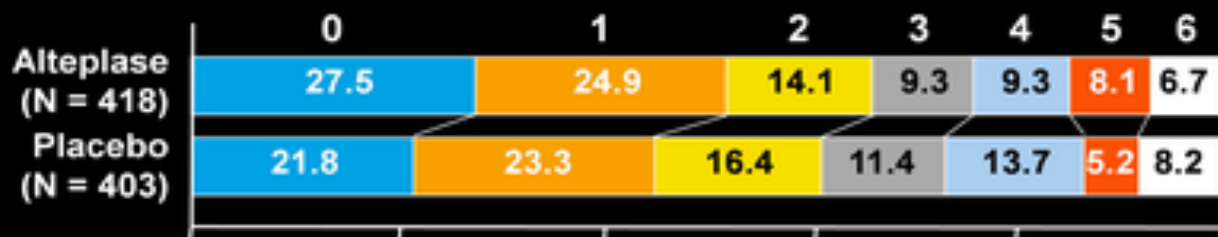


**Total Death
Rate (%)**

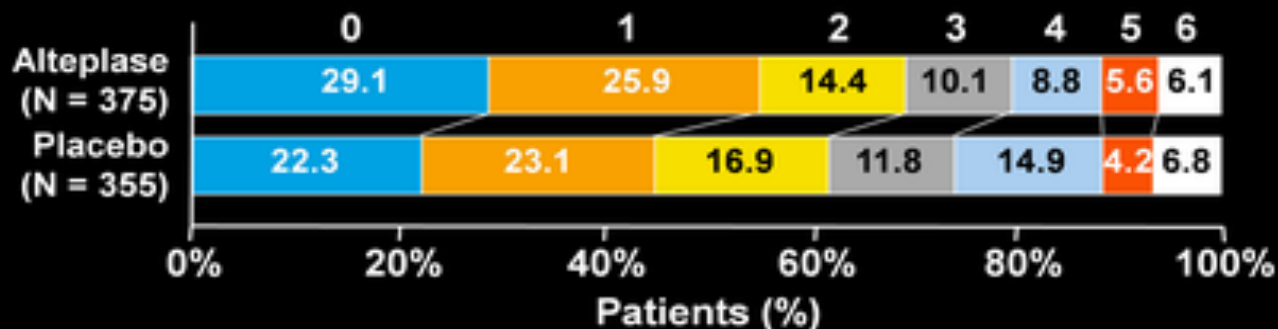
Outcome with: IV t-PA (ECASS III)

ECASS 3

A. Intention-to-Treat Population



B. Per-Protocol Population



3-month visit

$P = 0.02$ for both groups

Adjusted for baseline NIHSS and onset to time of treatment (OTT)

Hacke W, et al. *N Engl J Med.* 2008;359(13):1317-1329. Copyright © 2008 Massachusetts Medical Society.

IA t-PA

PROACT II trial (published 1998):

- A small study with 40 pts actively included
- Safety and recanalization rate with IA rpro-urokinase for proximal MCA stroke within 6 hrs compared to placebo → significant increase in recanalization ($p < 0.01$) but ↑ hemorrhagic transformation (15.4% vs. 7.1%)

→ *Suggested superiority of IA thrombolytics delivery*

IA t-PA

Interventional Management of Stroke (IMS-III) trial:

- Intervention:
 - 0.6 mg IV t-PA over 40 minutes
 - + Endo-arterial intervention → < 22 mg IA t-PA over 2 hrs
 - OR thrombus removal device
 - OR IA t-PA with US energy
- Control:
 - active with IV t-PA (standard protocol)
- **Trial is still ongoing**

Endoarterial Mechanical Disruption

Merci Retriever:

first FDA approved device



Increased recanalization rate and secondary clinical outcome when used for large cerebral arteries

	mRS 0-2	mRS 3	mRS 4-5	Dead
Recanalized	39%	12%	18%	30%
Non-recanalized	3%	10%	13%	73%

Endoarterial Mechanical Disruption

**Penumbra system:
FDA approved**

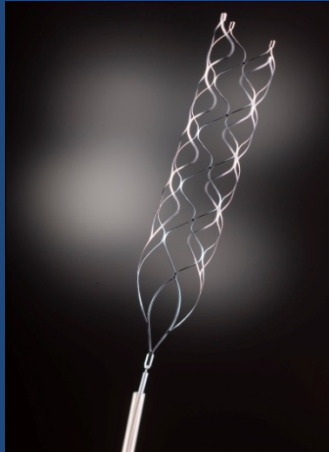


- It does: clot suctioning
- Similar rates of recanalization and clinical outcomes to Merci retriever

Endoarterial Mechanical Disruption

3rd Generation of devices

Solitaire Device:



Solitaire was superior to Merci in Swift trial

Trevo retriever:



Trevo was superior to Merci in Trevo II trial

Endoarterial thrombolysis: Combined IA and Mechanical disruption

General recommendation:

- For M1 (MCA) clot
- For Basilar artery clot
- In certain cases where IV t-PA can not be given
e.g. patient is on warfarin or recent MI

Limitations:

- Time (*should not delay IV t-PA initiation*)
- Expertise
- ? Costs

KEY TIME INTERVALS

- Perform an initial patient evaluation within 10 minutes of arrival in the ER
- Notify the stroke team within 15 minutes of arrival
- Initiate a CT scan within 25 minutes of arrival
- Interpret the CT scan within 45 minutes of arrival
- Ensure a door-to-needle time for IV rt-PA within 60 minutes from arrival

Recommended strategies:

- Advance hospital notification by EMS
- Rapid triage and stroke team notification
- Single call activation system
- Rapid access to CT and rapid interpretation
- Rapid laboratory testing (point of care)
- Mix t-PA a head of time
- Team-based approach

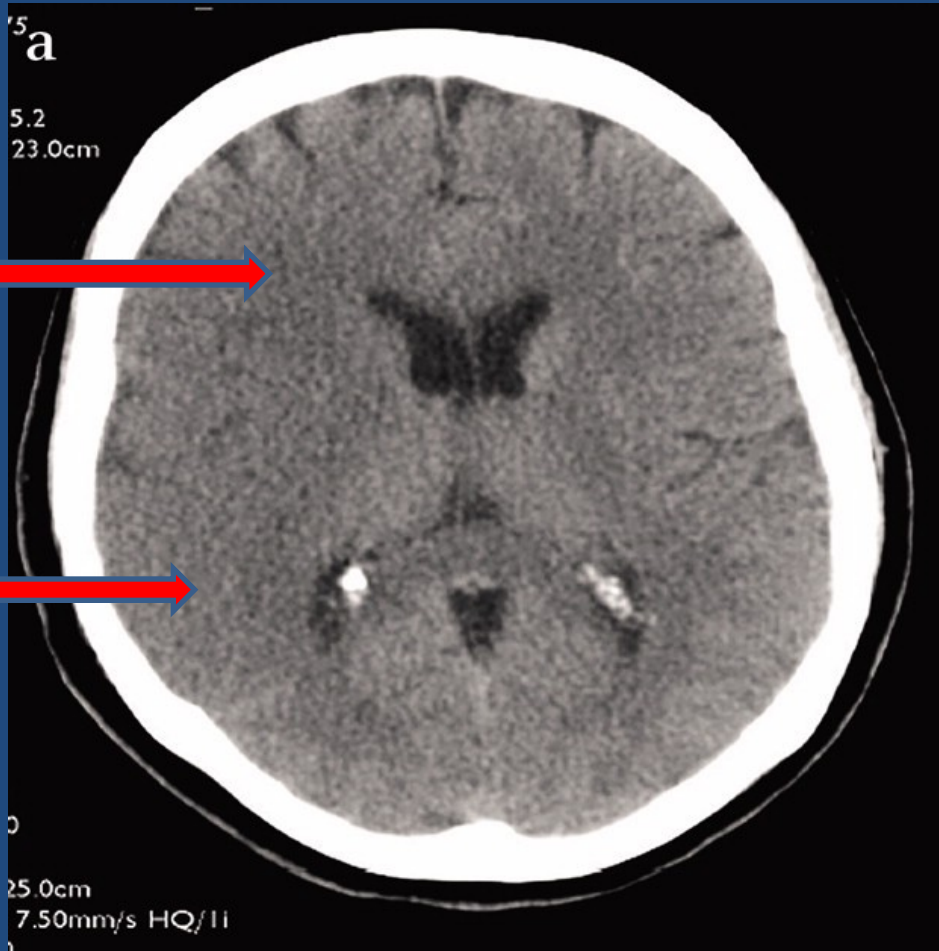
Barriers for Acute Stroke Therapy

- Late patient presentation to ER (In USA; only 30% present within t-PA window)
- **Poor stroke recognition and delayed triage at ER (mainly for un-usual stroke presentations)**
- Lack of appropriate infrastructure
- Lack of acute stroke expertise
- Presence of a contra-indication
- Difficulty in getting patient's or family's verbal consent

Acute Ischemic Changes in CT

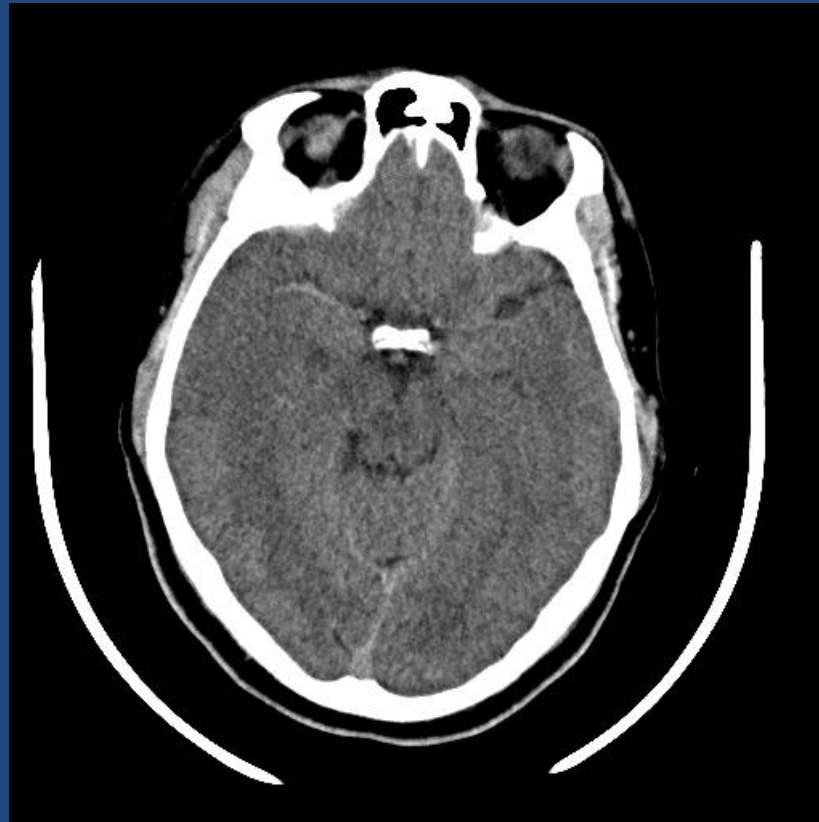


Acute Ischemic Changes in CT



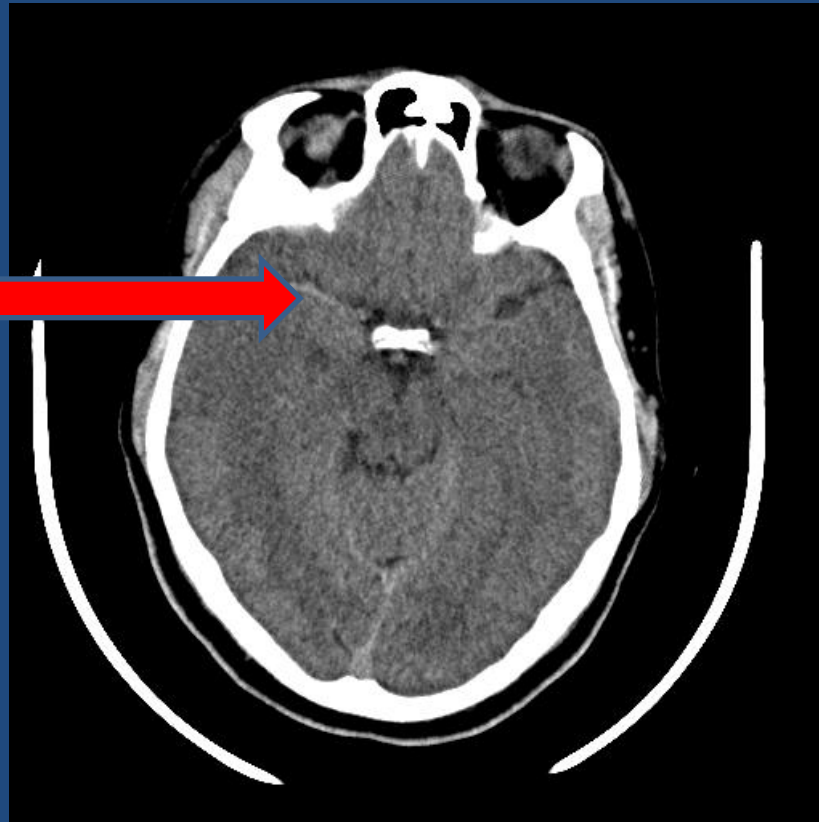
Loss of gray-white
matter
differentiation and
sulcal effacement

Acute Ischemic Changes in CT



Acute Ischemic Changes in CT

Hyper dense MCA



Acute Ischemic Changes in CT

A 45 yr old male with weakness in Lt side for 2 hrs



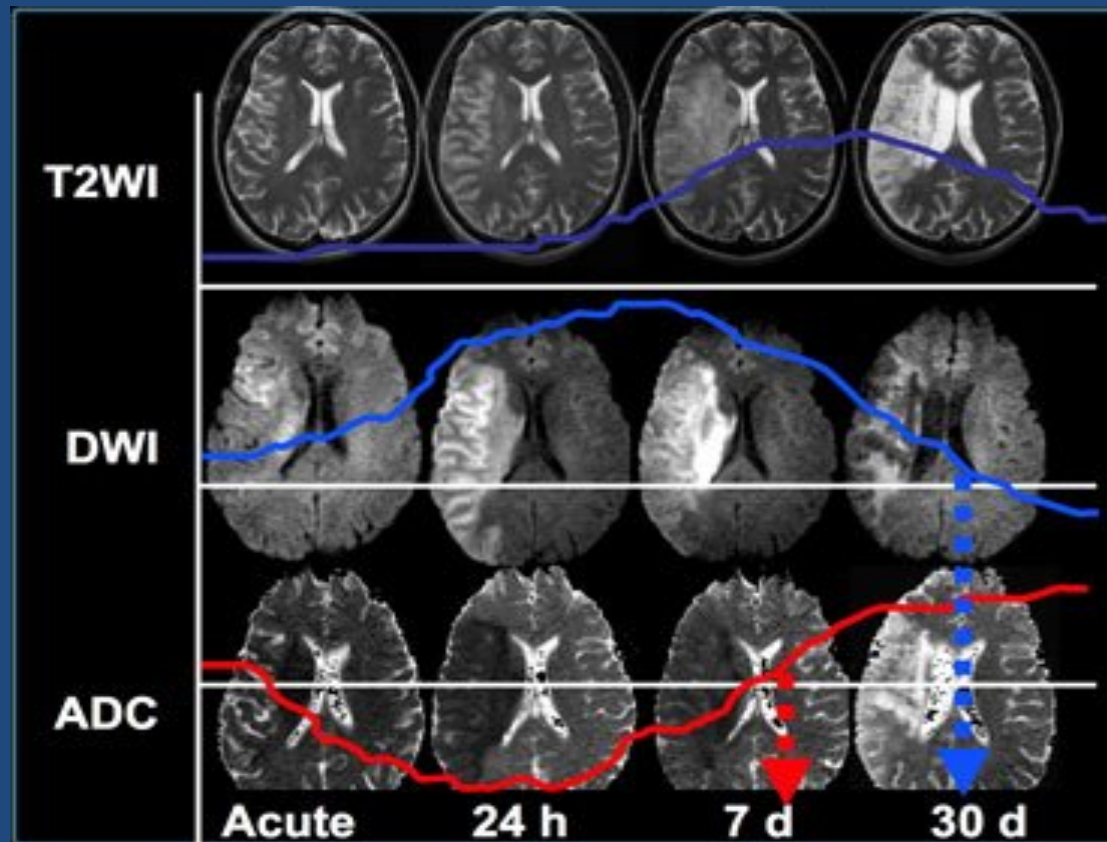
Acute Ischemic Changes in CT

A 45 yr old male with weakness in Lt side for 2 hrs

Obscuration of
lentiform nucleus



Acute Ischemic Changes in MRI



Case (1):



A 60 y.o lady with acute stroke few hrs post IV t-PA .

She is known with HTN and controlled DM-2

Case (1):



A 60 y.o lady with acute stroke
few hrs post IV t-PA .

She is known with HTN and
controlled DM-2

Oro-lingual angioedema

Case (2):

- 21 y. o man, a university student presented to ER with Left sided throbbing headache and mild expressive aphasia.
- Nothing else.
- NIHSS: 2
- PMHx: Migraine



Case (2):

- 21 y. o man, a university student presented to ER with Left sided throbbing headache and mild expressive aphasia.
- Nothing else.
- NIHSS: 2
- PMHx: Migraine



Acute Left MCA (upper division) ischemic stroke with (N) CT brain

Case (3):

A 53 y/o male with sudden reduction in LOC, jerking in 4 limbs, and difficulty in breathing.

→ Got intubated in ER then CT brain was done

PMHx: smoker, HTN



Case (3):

A 53 y/o male with sudden reduction in LOC, jerking in 4 limbs, and difficulty in breathing.

→ Got intubated in ER then CT brain was done

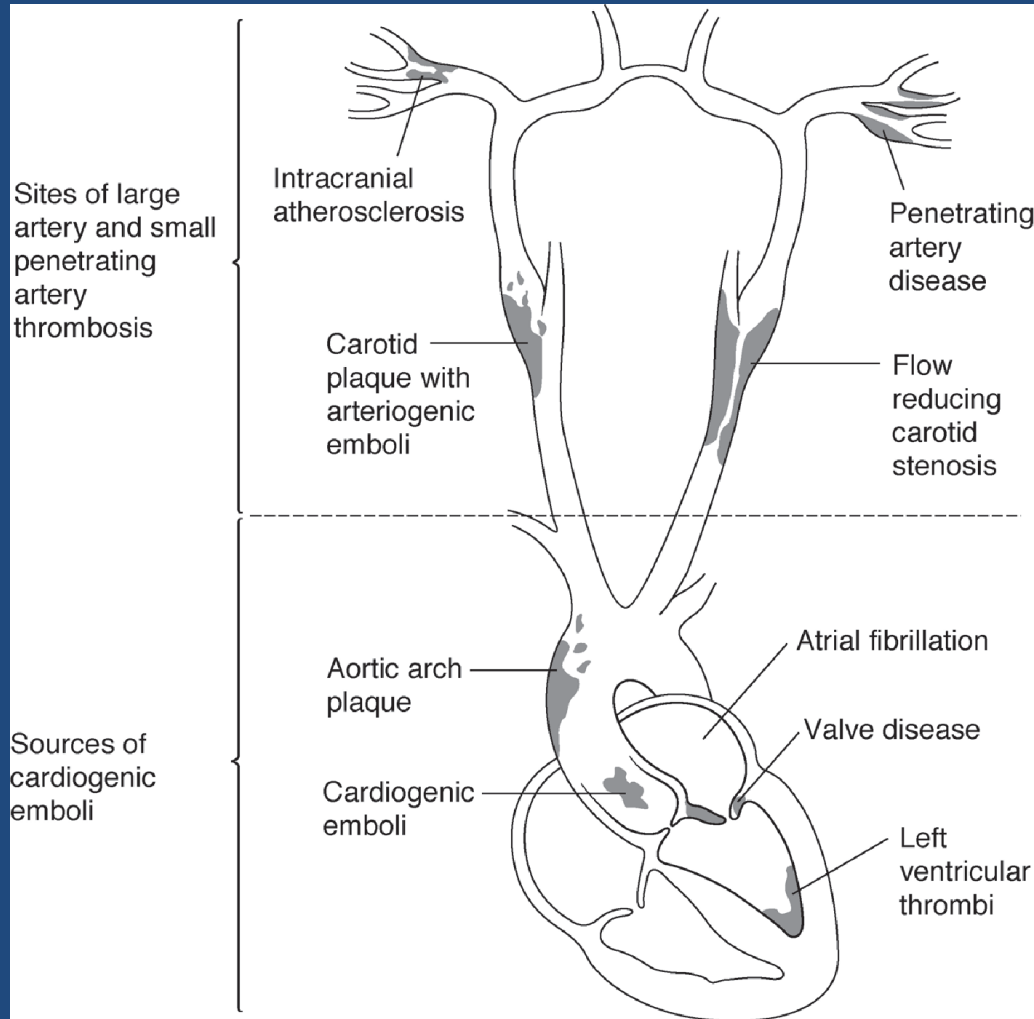
PMHx: smoker, HTN



Acute Basilar artery stroke

Look for the source:

Major sites and sources of ischemic stroke



Investigation

- 24/72 hour holter
- Carotid Doppler
- CT angiogram/ MRA brain and neck
- TEE
- Conventional angiogram