The 36th Annual
Virginia EMS Symposium

UPDATES IN STROKE
Strengthening the Stroke Chain of Survival

November 12, 2015

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Sentara Save The Brain Campaign

Because every moment counts

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Disclosures

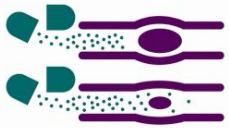
Nothing to disclose

Sentara Save The Brain Campaign

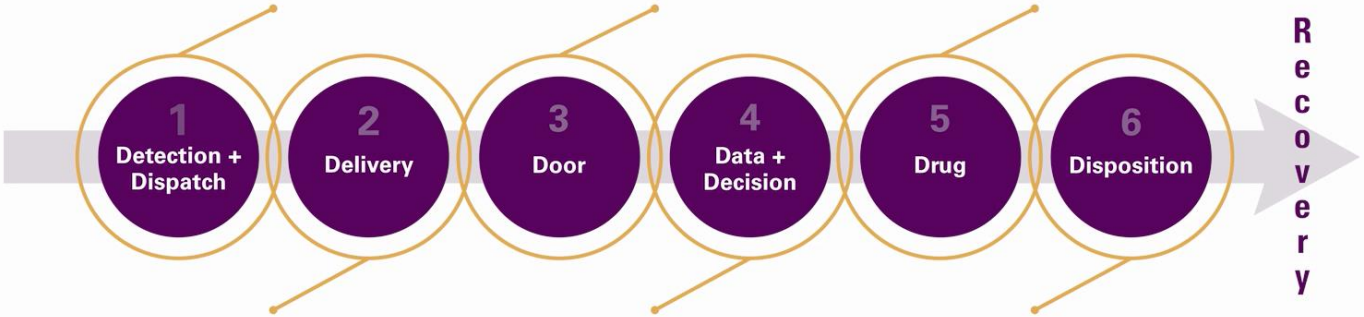
Because every moment counts

- **Identify first sign** of stroke symptoms
- **Call 9-1-1 immediately** for emergency medical services (EMS)

- **Primary stroke center experts** triage stroke patient

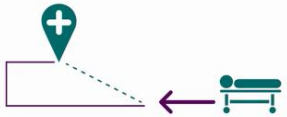


- **Safe and timely administration** of "clot busting" drugs for ischemic stroke



- **Rapid EMS stroke assessment and treatment** while en route to closest primary stroke center

- **Stroke experts evaluate treatment options** based on type of stroke in the emergency department (ED)



- **Fast access to catheter based treatment** to remove clot and/or admission to the appropriate hospital units with ongoing stroke care

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EMS

Hospital

Home

ED

Rehab

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Prehospital to the ED

Arrival: EMS vs. Walk-in

- 1 in 3 – Walk-in

- Arrival within 3 hours: OR 2.00
- Head CT within 25 min of arrival: OR 1.89
- tPA within 2 hours of symptoms: OR 1.47

Circ Cardiovasc Qual Outcomes. 2013;6(3):262-9

Original Investigation

Prehospital Triage to Primary Stroke Centers and Rate of Stroke Thrombolysis

Shyam Prabhakaran, MD, MS; Kathleen O'Neill, MHA; Leslie Stein-Spencer, RN; James Walter, MD; Mark J. Alberts, MD

Double tPA rate from prehospital stroke notification

JAMA Neurol. 2013;70(9):1126-32.

Can Mass Media Influence Emergency Department Visits for Stroke?

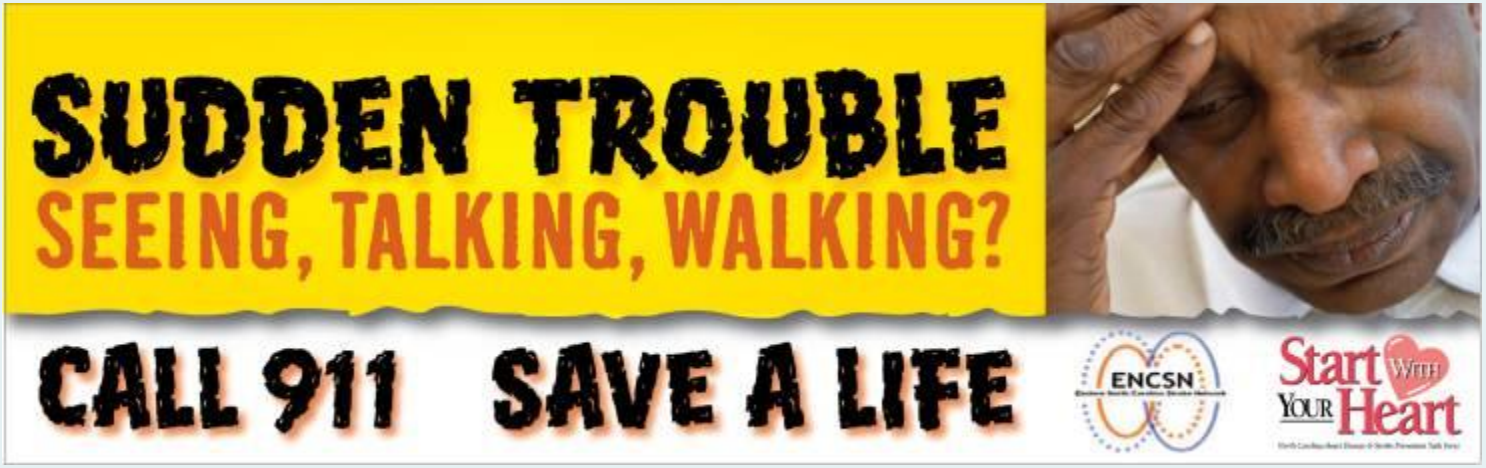
Corinne Hodgson, MA, MSc; Patrice Lindsay, RN, PhD Frank Rubini, BA

From CSH Associates (C.H.), Burlington, Ontario, Canada; Institute for Clinical Evaluative Sciences, Canadian Stroke Network (P.L.), Toronto, Ontario, Canada; Heart and Stroke Foundation of Ontario (F.R.), Toronto, Ontario, Canada.

Mass media campaigns

- Increased awareness

Increased visits for stroke


SUDDEN TROUBLE
SEEING, TALKING, WALKING?
CALL 911 SAVE A LIFE
ENCSN
Start With Your Heart

Factors Related to Decision Delay in Acute Stroke

Kashif Waqar Faiz, MD, Antje Sundseth, MD, Bente Thommessen, MD, PhD, Ole Morten Rønning, MD, PhD

DOI: http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2013.05.007

62% of delays related to calling EMS

J Stroke Cerebrovasc Dis. 2014;23(3):534-9

EMS

Stroke Screen

Time of onset

Medications

Contact of family members

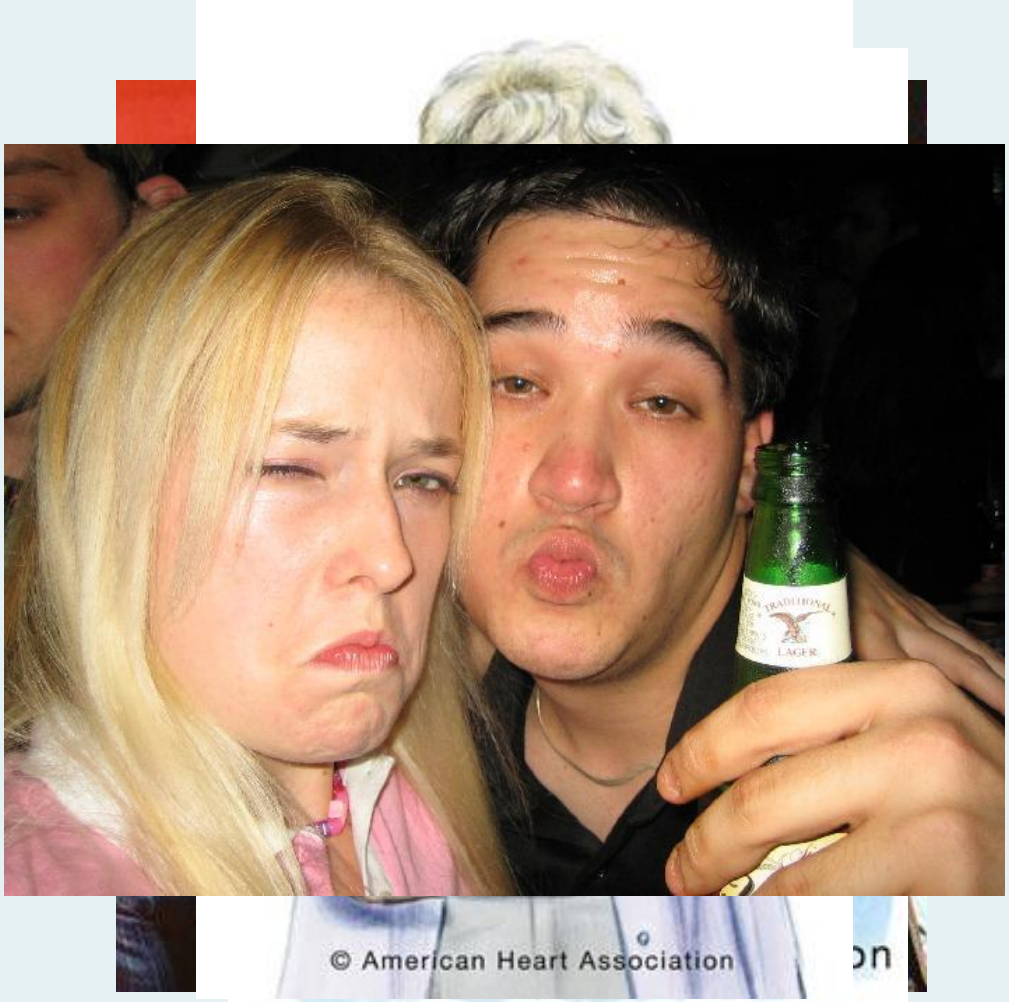
Nearest appropriate hospital

- Stroke center/capable
- Ground vs. Aeromedical

Cincinnati Stroke Scale

3 components:

- **F**acial Droop
- **A**rm Drift
- **S**lurred Speech
- **T**ime (onset)



EMS Accuracy for Stroke

Utilize CPSS or LAPSS

- Sensitivity 80% vs 74%

EMS LKN very close to Neurologist

- Not as accurate for wake-up stroke

Ann Emerg Med. 2014;64(5):509-15.
Stroke. 2014;45:1275-1279

Time to Onset

When did occur?

Witnessed?

Last seen “normal”?

- Wake-up Stroke

Their Medications

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Other Important Medications

Coumadin

Lovenox/Arixtra

Pradax (Dabigatran)

Xaralto/Eliquis/Savaysa

Family Contact

Phone contact information

Family/friend – last witness patient

Prehospital Interventions

Classic Teaching

Blood glucose

IV, O_2, Monitor (ACLS)

Hypoxia is BAD

But is more O_2 the better?

Physiological Effects of O_2

Vasoconstriction to carotid

20-33% decrease cerebral blood flow

– (100% O_2 for 10-15 min)

Critical Care 2013, 17 :313

Evidence for (Against) O_2

HBOT – no benefit in acute ischemic stroke

No improvement in functional outcomes

Mortality OR 0.45 (Against O_2)

AHA/ASA guidelines rec AGAINST routine O_2

Cochrane Database Syst Rev. 2005;(3):CD004954.
Ann Indian Acad Neurol 2010, 13:284-288.
Stroke. 2013;44(3):870-947

WHERE TO TRANSPORT?

Hub and Spoke

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Emergency Department

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ED (Stroke Ready)

TJC/DNV Standards

Set protocols

Time	Target
Door to MD	10
Door to CT	25
Door to CT read	45
Door to Needle	60
Door to Admit	180

ED SUSPECTED STROKE/TIA ORDERSET [594]

3/9/10 added SCH lab
12/15/09 IV Therapy changes
11/3/09 added labs for Port Warwick
8/18/09 added POC labs
2/3/09 all sections opened. Added ASA links. prechecked mult orders in mult sections

ED orders for symptoms of stroke or TIA.

ASA ICH Guidelines Stroke 2007	**URL:** Q:\Micromedex\PDF\ASA ICH Guidelines Stroke 2007.pdf
ASA Ischemic Stroke Guidelines Stroke 2007	**URL:** Q:\Micromedex\PDF\ASA Ischemic Stroke Guidelines Stroke 2007.pdf
ASA SAH Guidelines 2009	**URL:** Q:\Micromedex\PDF\ASA SAH Guidelines 2009.pdf

ED – Stroke Alert Process

Nurse

- Triage – Walk-ins
- Charge – EMS

ED Physician Eval

- Neurologist notified
- Radiology and Interventionalist notified

Time	Target
Door to MD	10
Door to CT	25
Door to CT read	45
Door to Needle	60
Door to Admit	180

ED – Stroke Alert Process

Team Approach

- Blood drawn
  - Lab notified
- IV placed

To CT

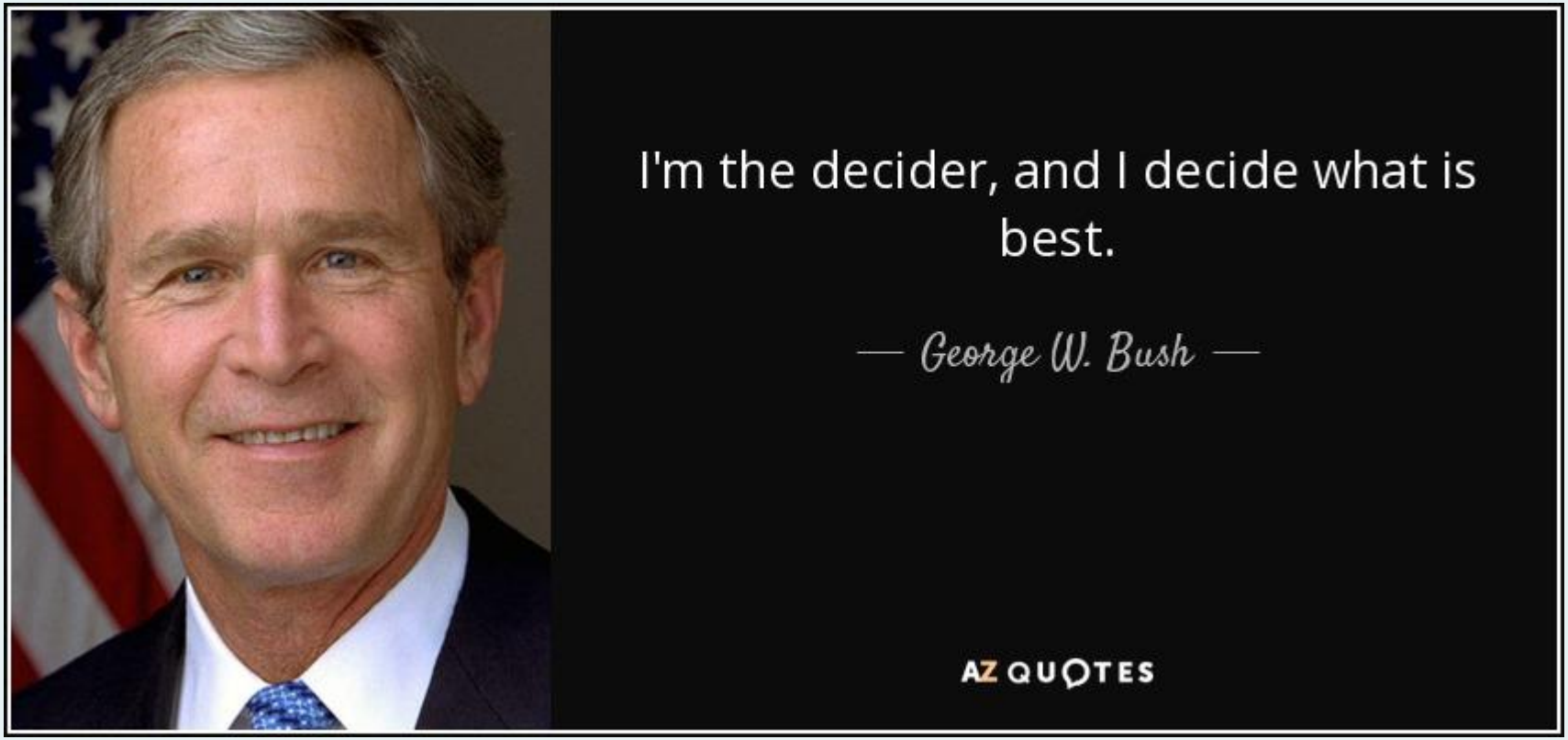
- CT tech notified

Time	Target
Door to MD	10
Door to CT	25
Door to CT read	45
Door to Needle	60
Door to Admit	180

IS THIS A STROKE?

WHERE IS THE STROKE?

IS THIS A BLEED?



WHEN DID THE SYMPTOMS BEGIN?

ARE THERE CONTRAINDICATIONS TO IV TPA?

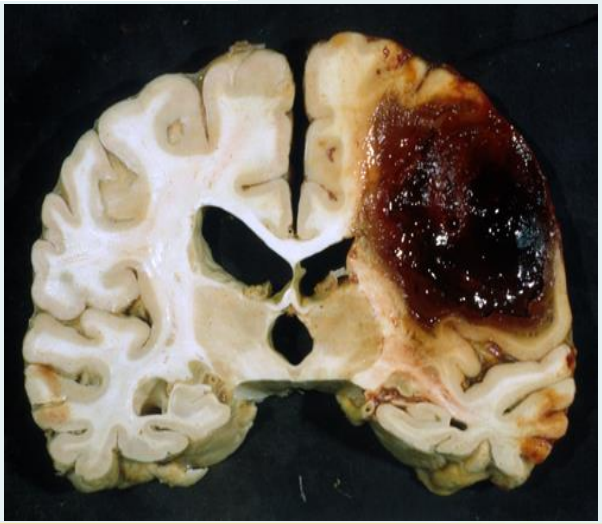
Types of Stroke

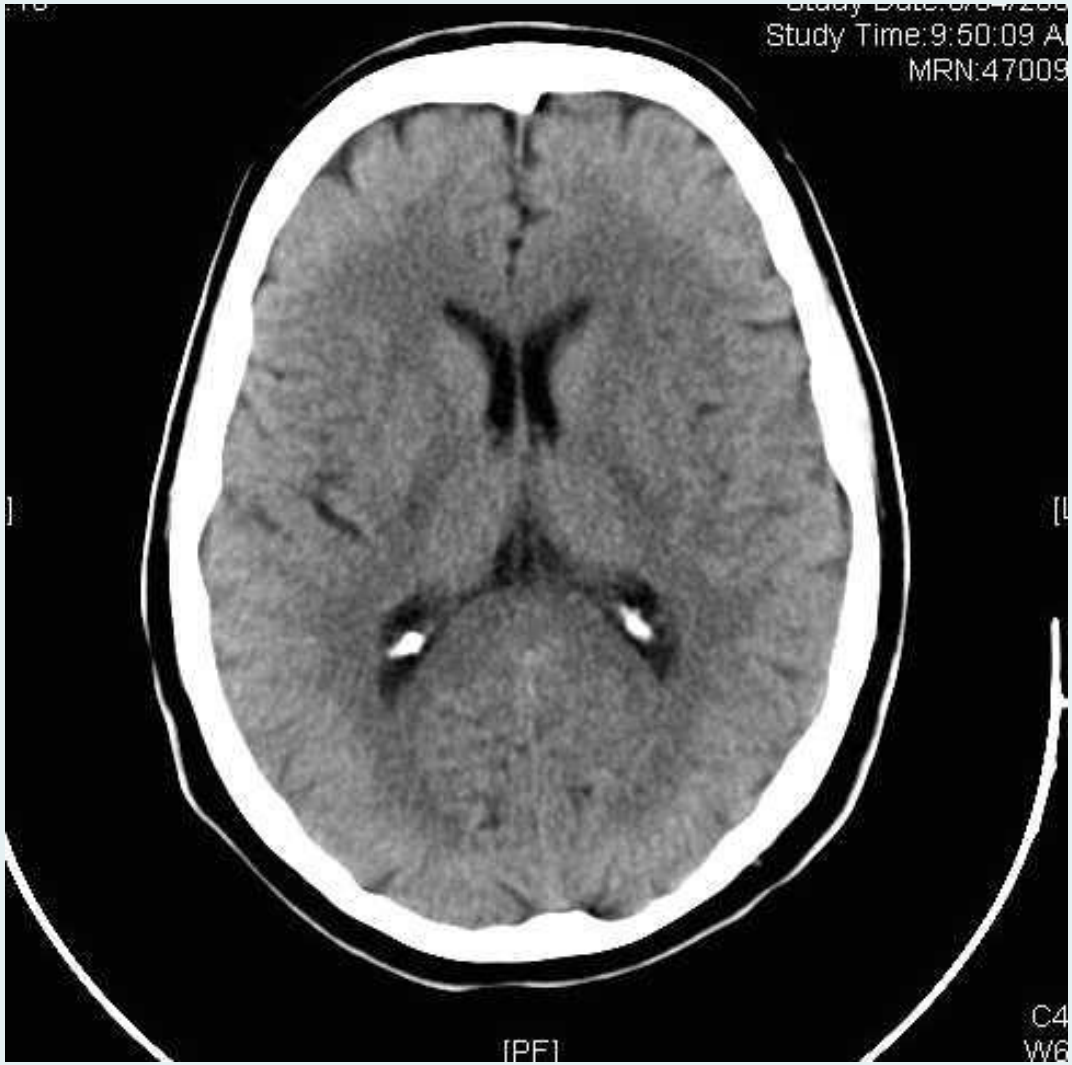
Ischemic

- Arterial (80%)
- Venous (2%)

Hemorrhagic

- Intracerebral (9%)
- Subarachnoid (9%)




Study Time:9:50:09 A
MRN:47009
[PF]

Characteristics of an Ischemic Arterial Stroke

Symptoms	Differential Diagnosis
Sudden onset	Hypoglycemia
Focal neurological	SDH/EDH
Negative symptoms	Post Ictal
Vascular origin	Complicated migraine
	Brain tumor
	Psychiatric/malingering

THE 53rd
GRAMMY AWARDS
11:32 54°
2 HD

WISC-TV STUDIO
Gazette
NEWS
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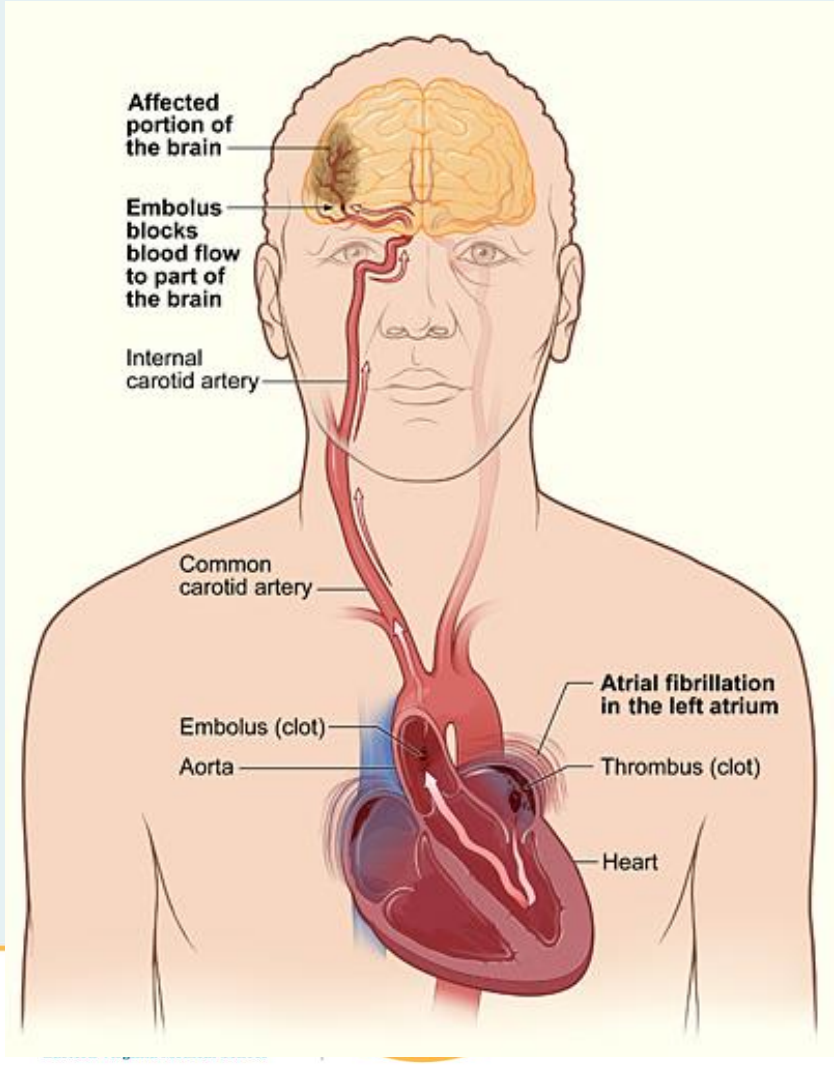
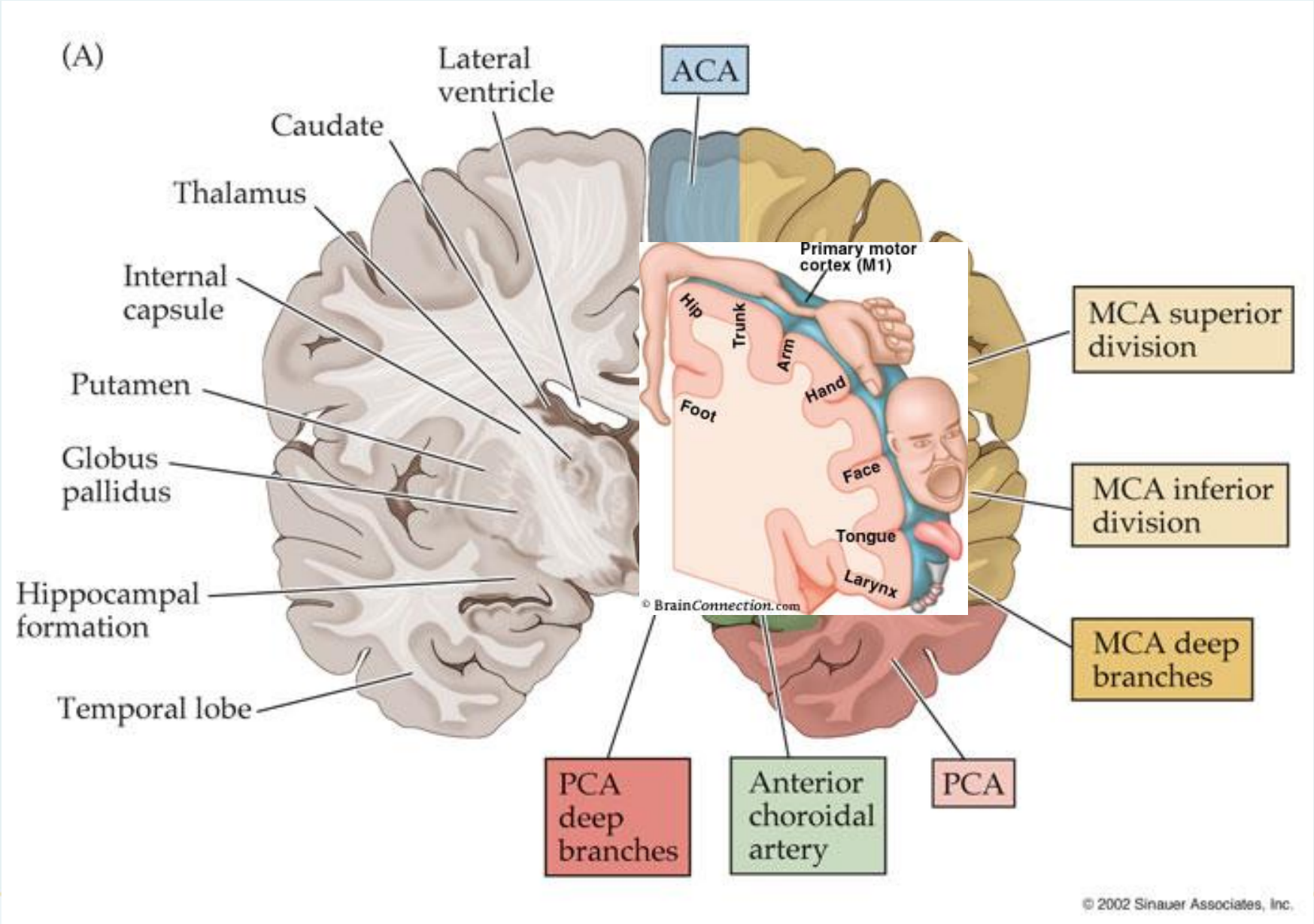
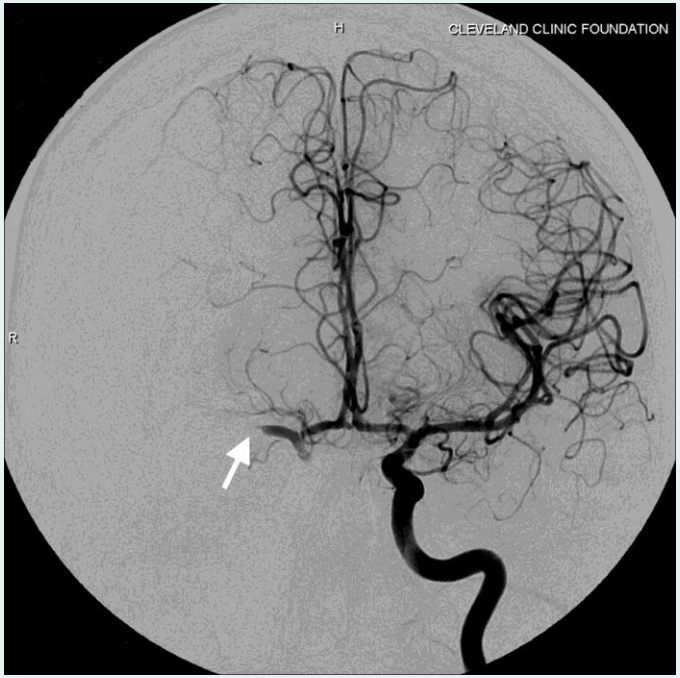
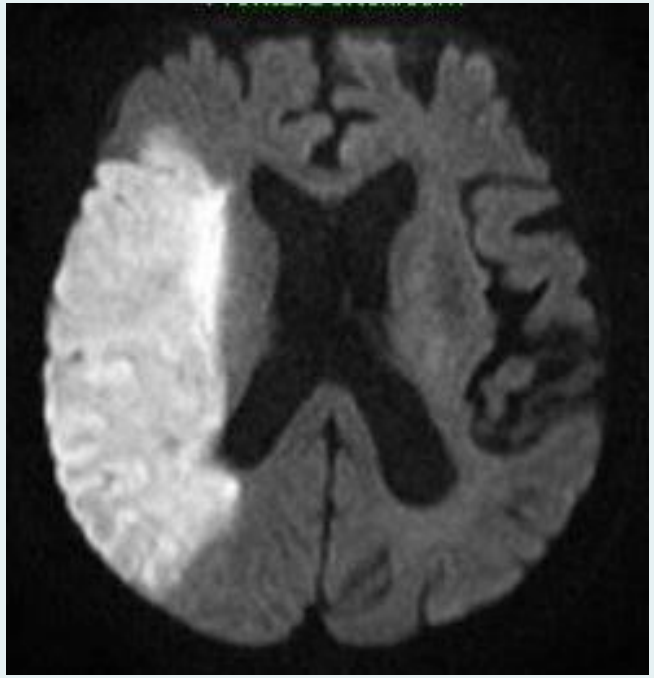
Ischemic Stroke Mechanism




(A)
Lateral ventricle
ACA
Caudate
Thalamus
Internal capsule
Putamen
Globus pallidus
Hippocampal formation
Temporal lobe
Primary motor cortex (M1)
Hip
Trunk
Arm
Hand
Foot
Face
Tongue
Larynx
© BrainConnection.com
MCA superior division
MCA inferior division
MCA deep branches
PCA deep branches
Anterior choroidal artery
PCA
© 2002 Sinauer Associates, Inc.

Middle cerebral artery





Dominant (Left) MCA

Right hemiparesis: face, arm > leg
Gaze preference to left
Right hemianesthesia
Aphasia
Right homonomous hemianopsia

Non-dominant (Right) MCA

Left hemiparesis: face, arm > leg

Gaze preference to right

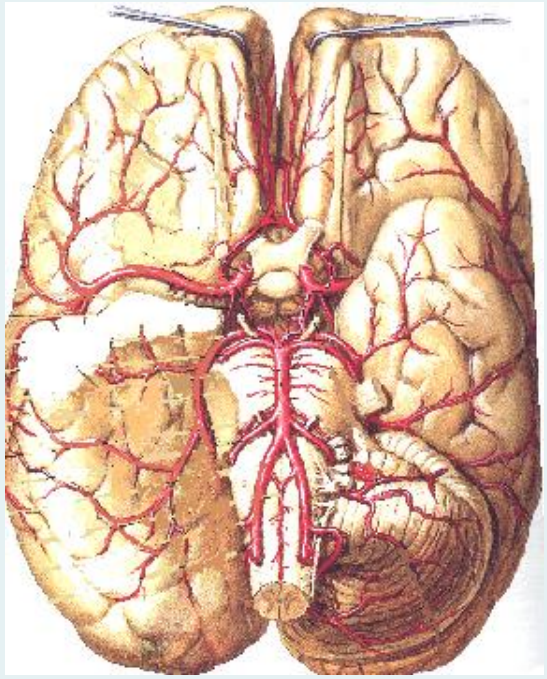
Left hemianesthesia

Left hemineglect

Anosagnosia

Left homonomous hemianopsia

Anterior Cerebral Artery



Anterior Cerebral Artery

Hemiparesis: Leg >>Arm/ Face

Hemianesthesia

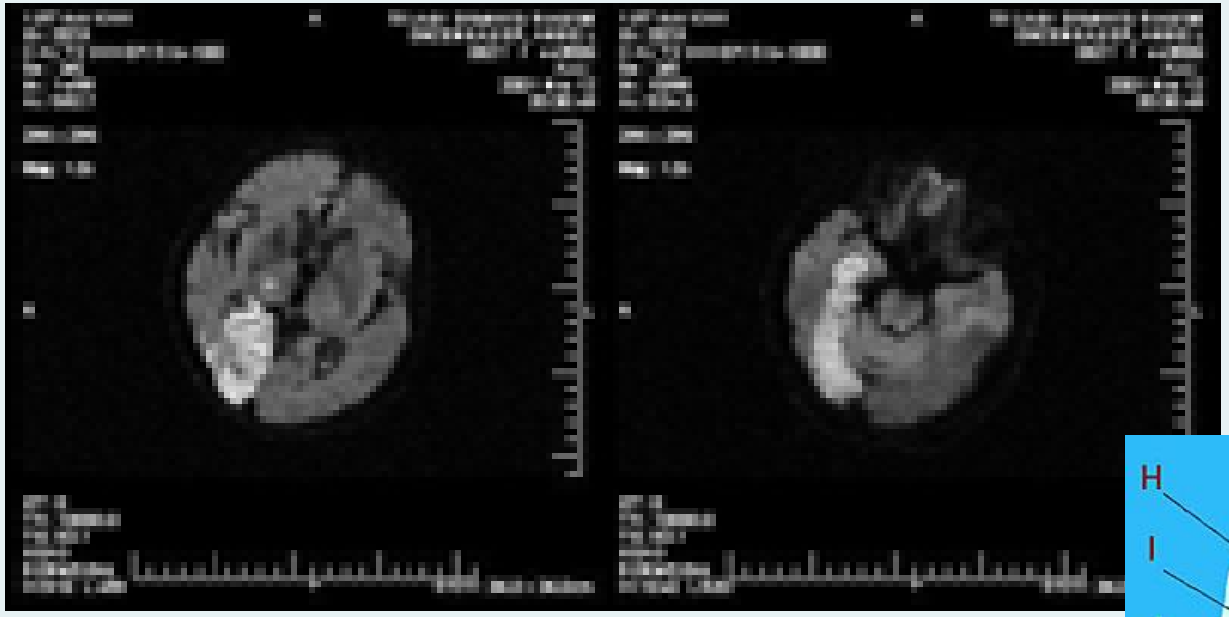
Contralateral Grasp

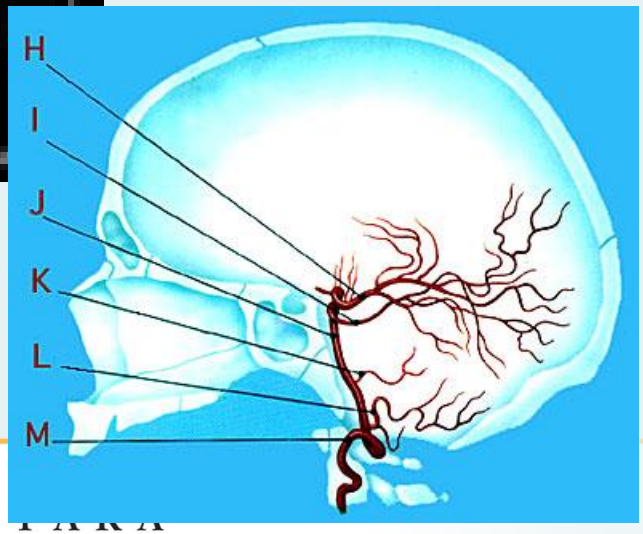
Mutism

Abulia

Disinhibition

Posterior Cerebral Artery





Posterior Cerebral Artery

Homonomous hemianopsia

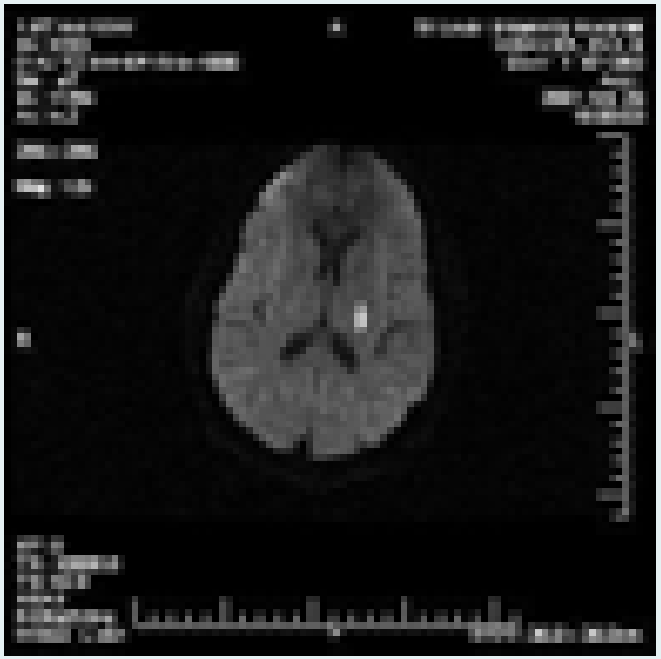
Anton's Syndrome

Alexia without agraphia

Visual and/or color anomia

Small Vessel (Lacunar) Syndromes

- Pure Motor Stroke
- Pure Sensory Stroke
- Sensorimotor
- Ataxic-hemiparesis
- Dysarthria Clumsy-hand
- Hemichorea/hemiballism



Exclusionary Criteria for Alteplase

Exclusionary Criteria for alteplase in acute ischemic stroke

Absolute Contraindications

	Yes	No
Time from onset would be more than 4.5 hours by the time treatment would begin.	☐	☐
There is evidence of intracranial hemorrhage on CT scan	☐	☐
Symptoms suggest subarachnoid hemorrhage even if the initial CT scan is normal	☐	☐
The patient has had arterial puncture at a non-compressible site or a lumbar puncture in the previous 7 days	☐	☐
Presence of intracranial conditions that may increase the risk of bleeding (e.g. some neoplasms, arteriovenous malformation, or ruptured aneurysms).	☐	☐
Significant head trauma or prior stroke in previous 3 months	☐	☐
Recent intracranial or intraspinal surgery within 3 months	☐	☐
Elevated blood pressure (systolic >185 mmHg or diastolic >110 mmHg)	☐	☐
Active internal bleeding	☐	☐
Acute bleeding diathesis, including but not limited to:		
Platelet count < 100,000/mm^3	☐	☐
Heparin received within 48 hours, resulting in abnormally elevated aPTT greater than the upper limit of normal	☐	☐
Current use of anticoagulant or INR >1.7 or PT > 15 sec	☐	☐
Current use of direct thrombin inhibitors or direct factor Xa inhibitors within the past 48 hours. (If CrCl < 50 ml/min, then a longer time period may be needed)	☐	☐
The patient has received enoxaparin within the past 24 hours	☐	☐
The patient has an abnormal blood glucose (< 50 mg/dl)	☐	☐
CT shows a multi-lobar infarction (hypodensity >1/3 cerebral hemisphere)	☐	☐

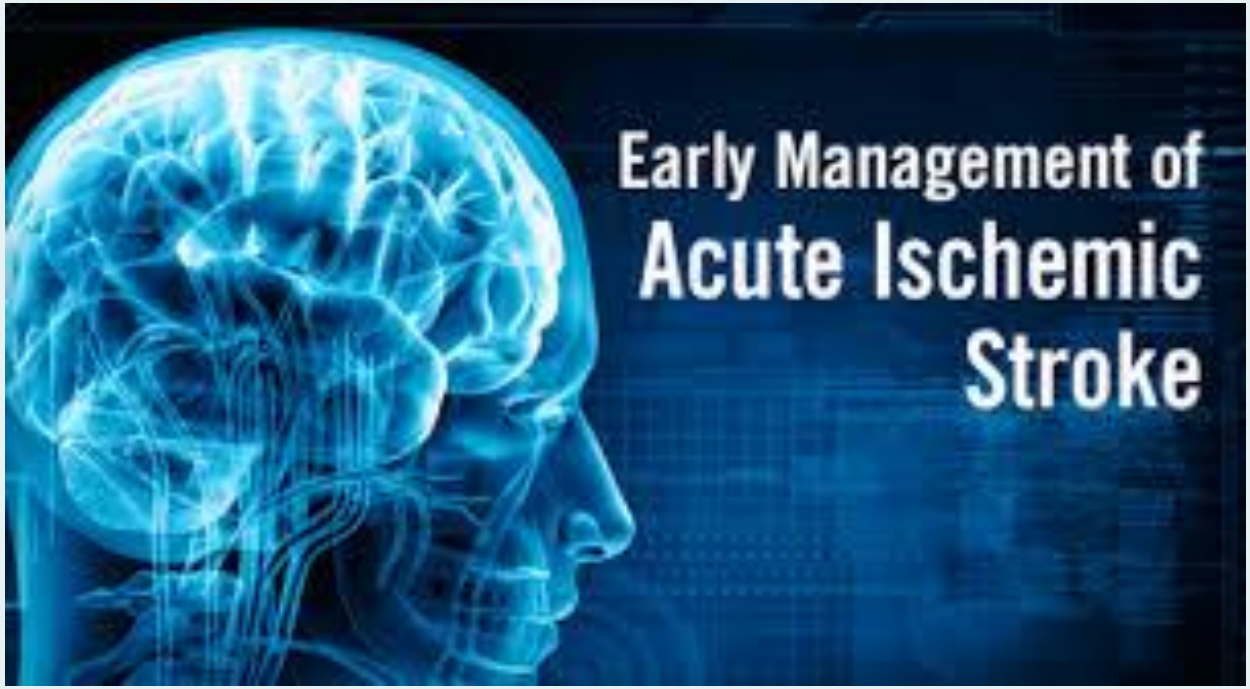
Relative Contraindications

	Yes	No
Age younger than 18	☐	☐
Only minor or rapidly improving stroke symptoms (clearing spontaneously)	☐	☐
Pregnancy	☐	☐
Seizure at onset with postictal residual neurological impairments	☐	☐
Major surgery or serious trauma within previous 14 days	☐	☐
Gastrointestinal or urinary tract hemorrhage within the previous 21 days.	☐	☐
Acute myocardial infarction within previous 3 months	☐	☐
History of previous intracranial hemorrhage	☐	☐
Unruptured Aneurysm	☐	☐

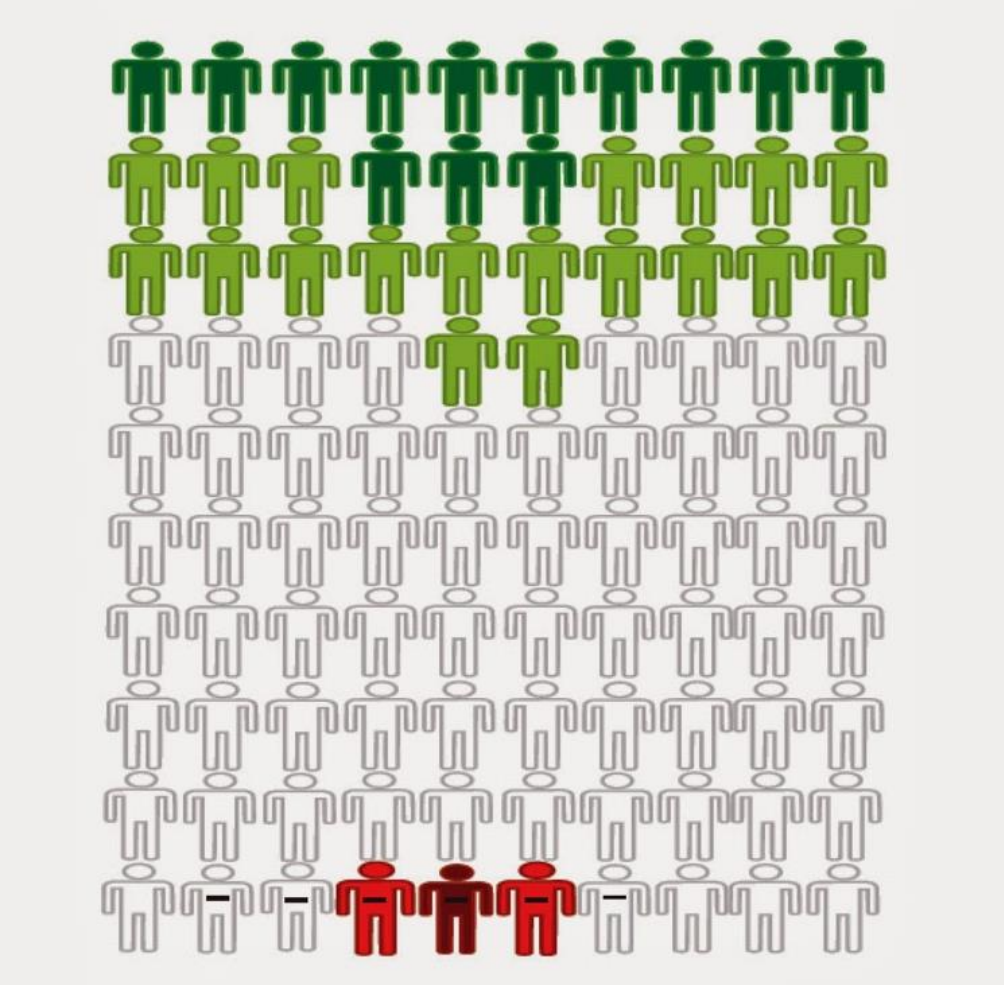
Additional Relative Contraindications between 3-4.5 hours

Patient older than 80 years	☐	☐
Patient is taking oral anticoagulant (no matter what the INR is)	☐	☐
Patients has a baseline National Institutes of Health Stroke Scale score of 25 or more	☐	☐
Patients has a history of prior stroke and diabetes	☐	☐

For all the above exclusionary criteria, intra-arterial alteplase or mechanical thrombectomy may be an option if a clot can be identified.

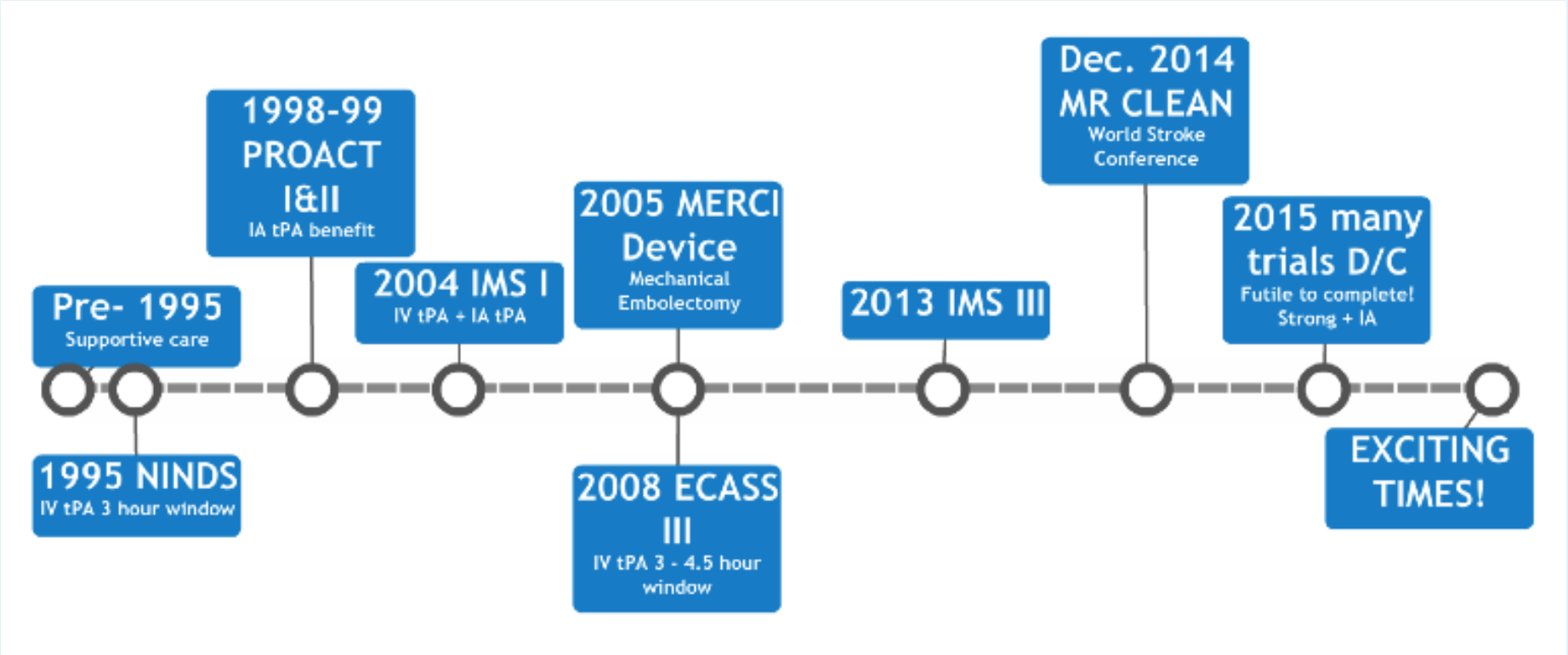

Early Management of
Acute Ischemic
Stroke

Benefits of TPA



How About Endovascular Thrombectomy?

Evolution of Acute Stroke Management

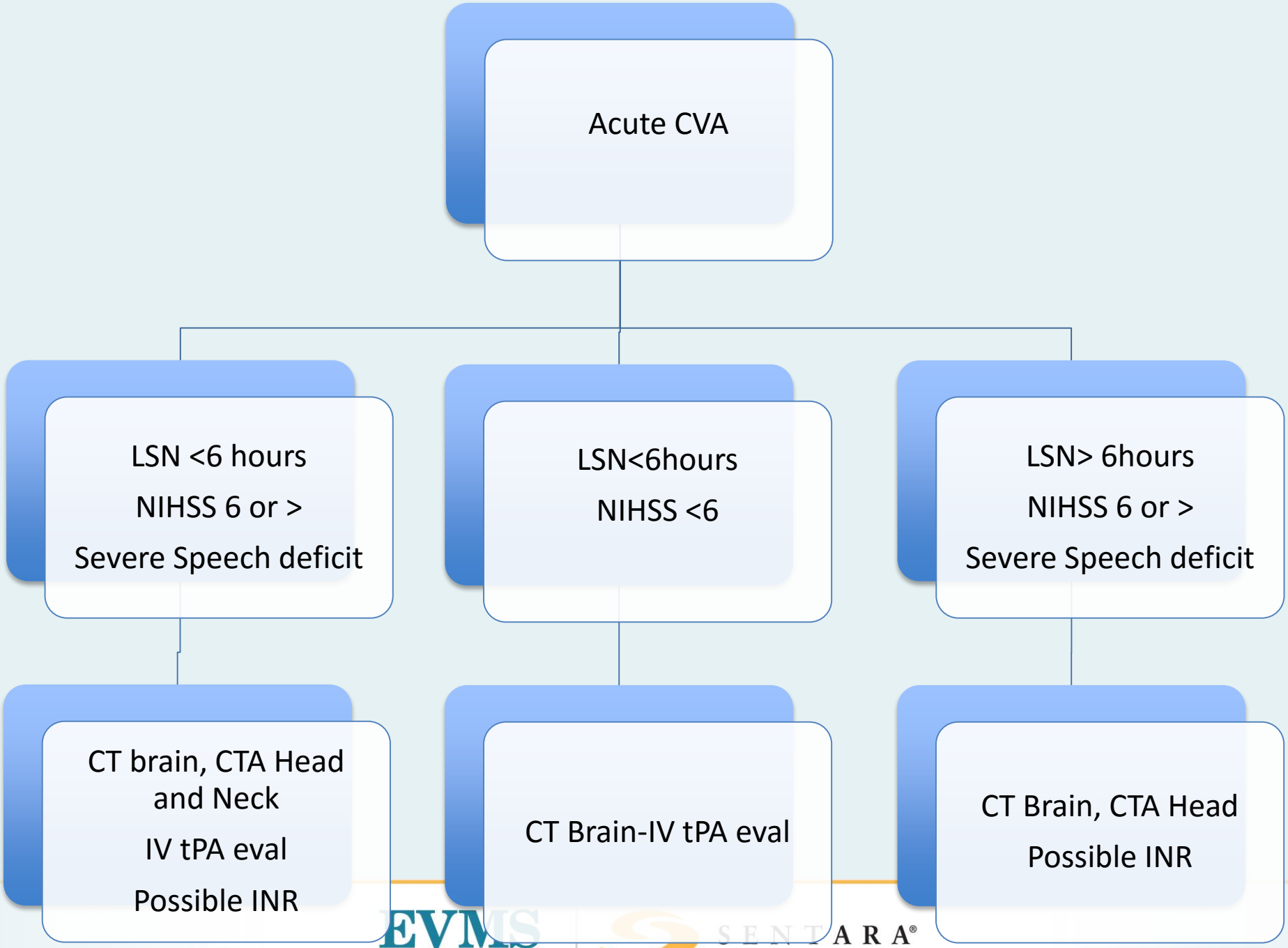


Meta-Analysis

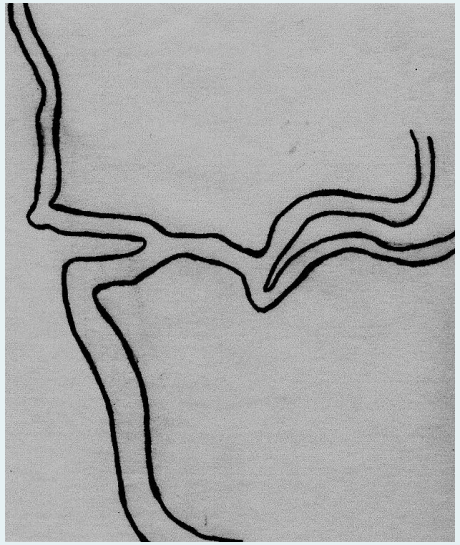
Across all 6 of the prospective randomized controlled trials (IMS-3, MR RESCUE, SYNTHESIS, MR CLEAN, EXTEND-IA and ESCAPE)

- With LVO confirmation pre-randomization, pts who were randomized to IAT had 1.67 times greater odds of better outcome compared to medical therapy (p=0.0001)
- With LVO confirmation regardless of pre-randomization, the superiority of IAT persisted: OR 1.27, p=0.018)

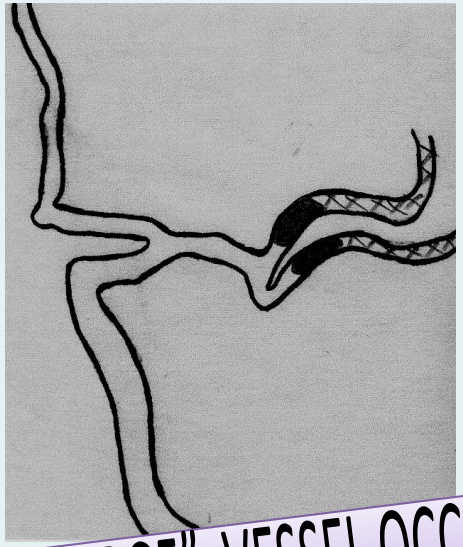
*Journal of NeuroInterventional Surgery February 2015 Volume 7 Issue 2


Acute CVA
LSN <6 hours
NIHSS 6 or >
Severe Speech deficit
LSN<6hours
NIHSS <6
LSN> 6hours
NIHSS 6 or >
Severe Speech deficit
CT brain, CTA Head and Neck
IV tPA eval
Possible INR
CT Brain-IV tPA eval
CT Brain, CTA Head
Possible INR

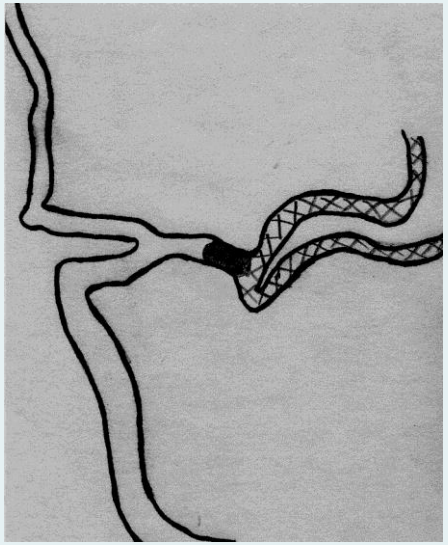
ICA



M2 Emboli

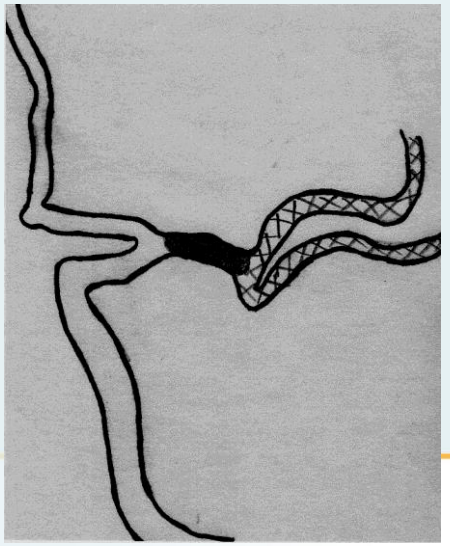


Distal M1

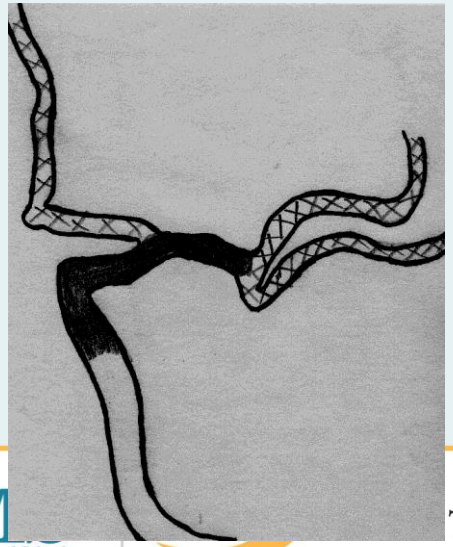


How large is "LARGE" VESSEL OCCLUSION?

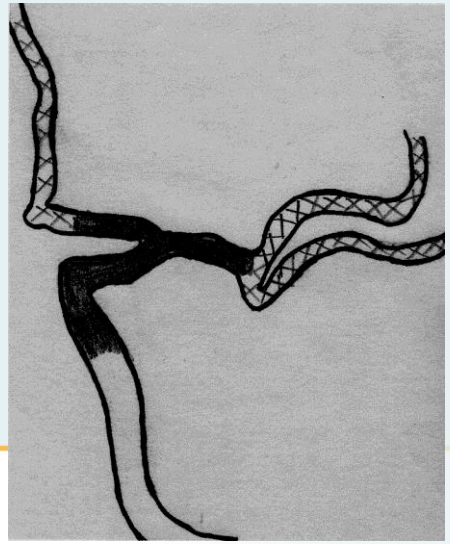
Proximal M1



Carotid "L"

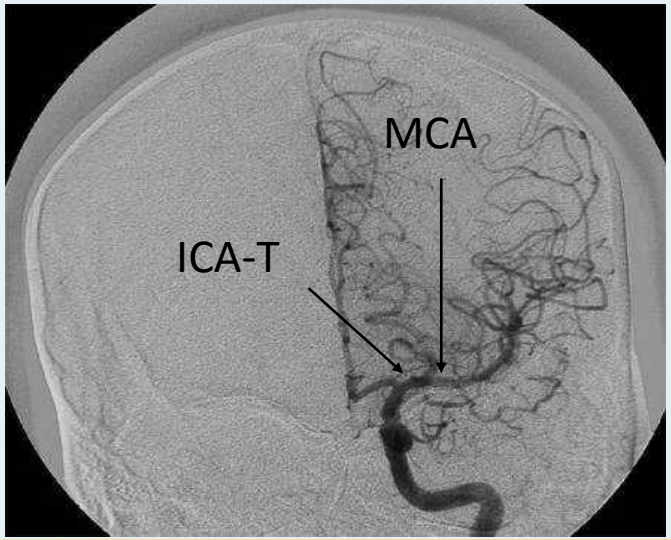


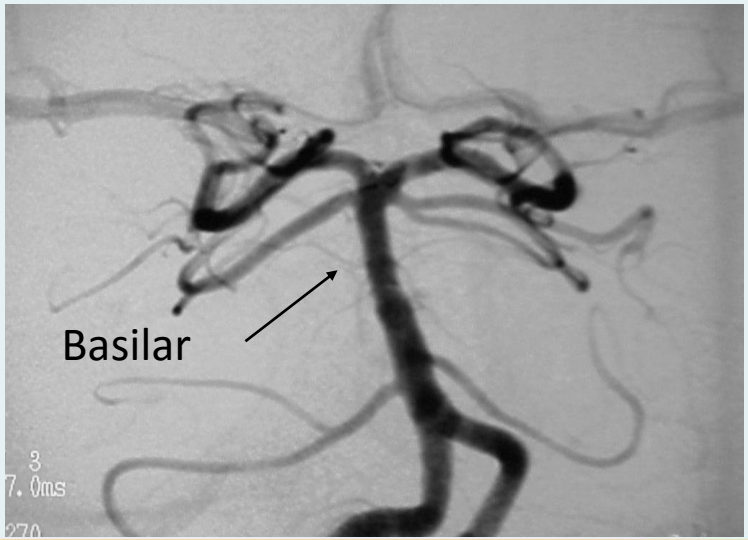
Carotid "T"



Large Vessel Strokes

- Poor natural history of large vessel stroke
- High mortality associated with LVO
  - Carotid-T: 53% Jansen, 1995
  - MCA: 30-35% Chambers, 1987
  - Basilar: 89-92% Bruckman H, 1986 & Brandt, 1996





Patient Selection Endovascular Stroke Therapy

NIHSS stroke scale ≥6
Or severe speech deficit

CTA/MRA/Angio defined target
i.e.; a clot to retrieve or stenosis to relieve

Viable brain
<70 cc acutely infarcted brain

Considerations for INR Exclusion

Acute Endovascular Exclusion Criteria:

- Advanced dementia
- Metastatic disease with life expectancy < 1 yr
- Low level baseline functional status (e.g., does not independently meet ADLs pre-stroke)
- Advanced systemic disease with Life expectancy < 1 yr (advanced COPD, Cirrhosis, end-stage cardiac disease)

Please note:

- Past history of ICH is NOT an exclusion
- Recent surgery is NOT an exclusion
- Anticoagulation is NOT an exclusion
- Pediatric patients ARE candidates

IV tPA Contraindications

B. Contraindications

- Age < 18
- CT scan findings (intracranial hemorrhage, or major acute infarct signs)
- Suspicion of subarachnoid hemorrhage (even if head CT is negative for hemorrhage)
- Recent (within 3 months) major surgery or trauma (discuss with Attending)
- History of intracranial hemorrhage or brain aneurysm or vascular malformation or brain tumor (May consider IV tPA in patients with CNS lesions that have a very low likelihood of hemorrhage, such as small unruptured aneurysms or benign tumors with low vascularity)
- Known bleeding diathesis **OR**
  - I. Current use of oral anticoagulants with INR > 1.7 or PT > 15 seconds
  - II. Use of heparin within 48 hours preceding onset of stroke AND prolonged aPTT at time of presentation
  - III. Platelets <100,000
  - IV. Internal hemorrhage (GI hemorrhage, urinary tract hemorrhage) < 3 weeks
  - V. Dabigatran use in the past 48 hours (if last dose >48 hours, confirm normal renal function [creatinine clearance >50 mL/min] and normal coagulation [aPTT, INR, platelet count] before tPA administration).
  - VI. Low molecular weight heparin use (i.e.- Lovenox) in the past 24 hours.
- Persistent systolic BP >185 mm Hg or diastolic BP >110 mm Hg despite treatment.

IV tPA Warnings

C. Warnings (risks must be weighted against anticipated benefits)

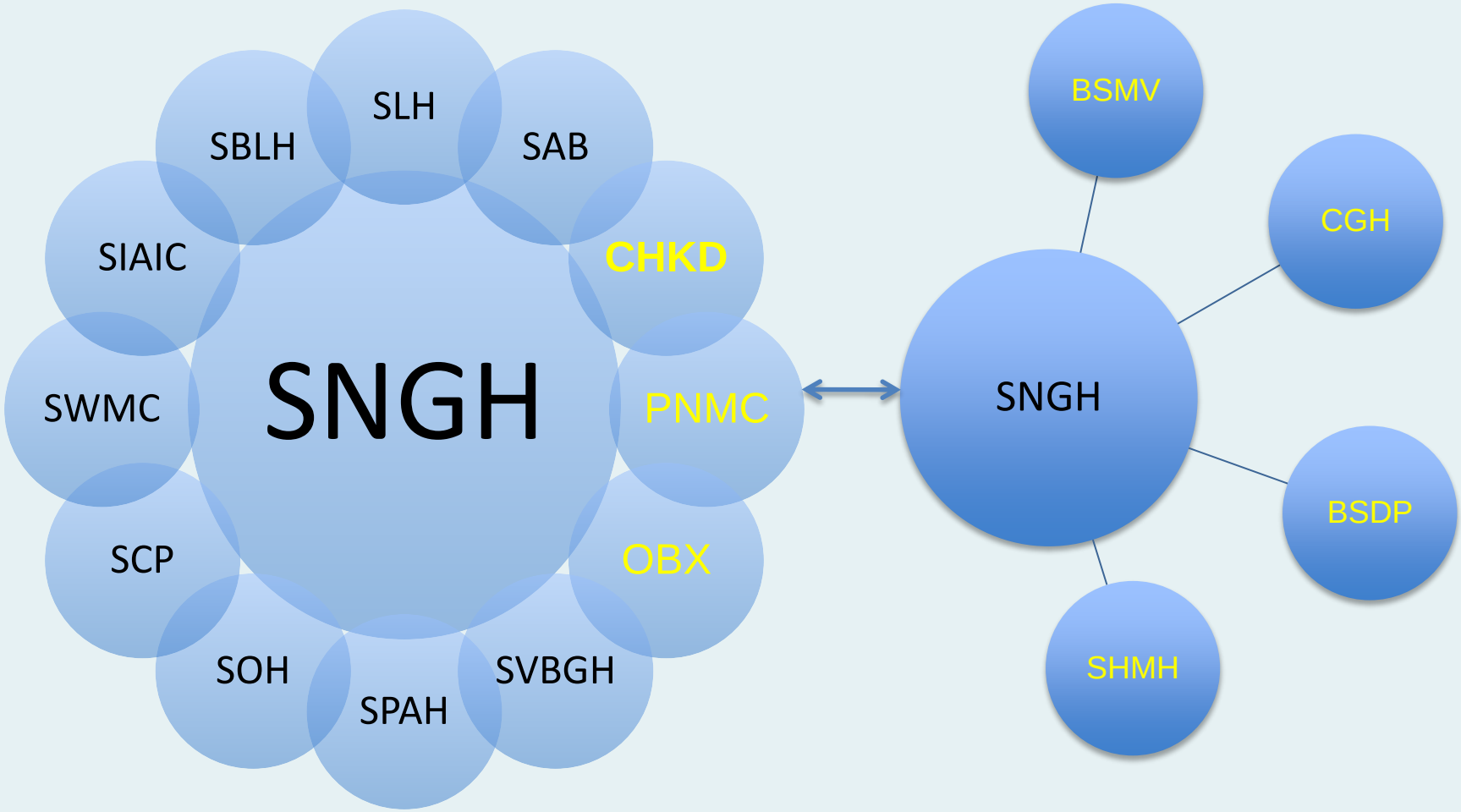
Additional warnings for tPA use from 3 to 4.5 hours

- **Age > 80 years**
- **Any anticoagulant use (even if INR<1.7)**
- **NIHSS>25**
- **History of stroke AND diabetes**

- MI within last 2 months (with normal TTE)
- Current use of oral anticoagulants with INR > 1.5 or PT > 15 seconds
- Recent stroke (within one month & depending on type & size)
- Minor neurological deficit or rapidly improving symptoms
- High likelihood of left heart thrombus
- Aortic dissection
- Evidence of infarction of > 1/3 of the MCA territory on CT
- Severe neurological deficit (NIH stroke scale score >22)
- Seizure at stroke-onset
- History of IVDA and/or suspicion for endocarditis
- Tox-screen positive for ETOH, cocaine, opiates, or amphetamines (if available, but should not delay tPA protocol)
- Subacute bacterial endocarditis
- Acute pericarditis
- History of hemorrhagic diabetic retinopathy
- Significant hepatic dysfunction with abnormal INR
- Pregnancy
- Sickle cell disease
- Arterial puncture at non-compressible site < 1 week
- Blood sugar < 50 or > 400 mg/dL

Endovascular Stroke Rescue Tools and Techniques

Sentara INR Stroke Universe



Radiographic Triage of Possible Candidates

CT Head

- Blood or dead brain

CTA brain and neck

- Large vessel occlusion

+/- CT/MR Perfusion

- Area at risk versus dead brain

MRI/ MRA

- Most accurate assessment of infarct volume

Time is Brain Quantified

	Neurons Lost	Synapses Lost	Demyelinated Fibers Lost	Accelerated Aging
Per Stroke	1.2 **Billion**	8.3 Trillion	4470 miles	36 Years
Per Hour	120 Million	830 Billion	447 Miles	3.6 Years
Per Minute	1.9 Million	14 Billion	7.5 Miles	3.1 Weeks
Per Second	32,0000	230 Million	.125 Miles	oo

What Next?

MAC/ General anesthesia

- Airway protection
- Paralytics
- Blood pressure control

Rapid assembly of INR team to prepare room, equipment and patient

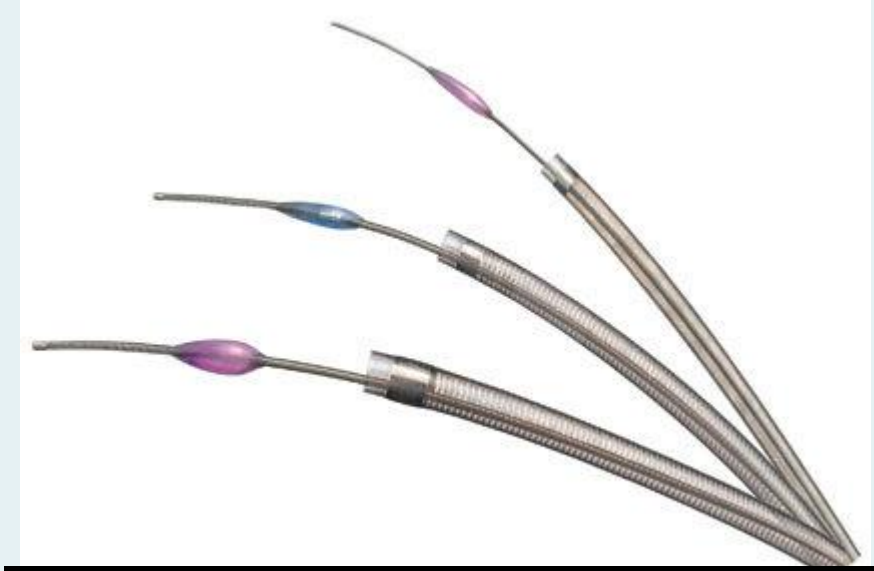
- Angio techs
- Angio RN

GOAL:
Table to clot access = 30 minutes!

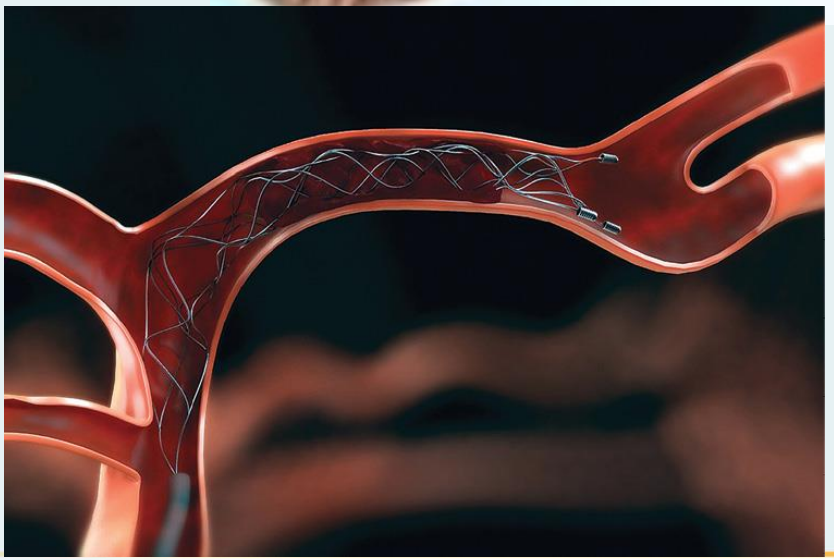
Tools of the trade….

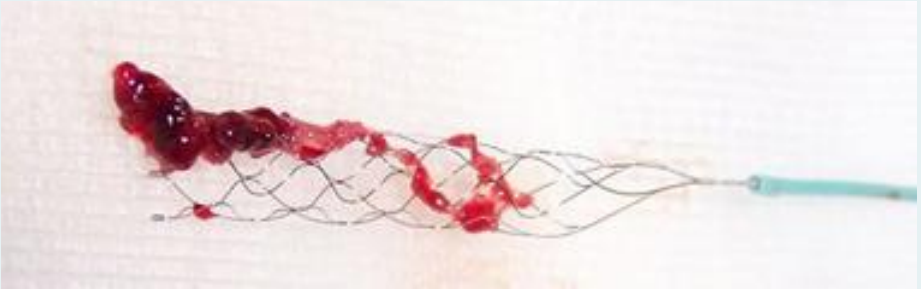
THROMBOLYTICS=CLOTBUSTERS

Penumbra Suction Thrombectomy = Wet Vac



Stent Retriever
= “Chinese finger trap”





Putting the tools to use….

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Trevo ProVue TICI 3 Revascularization of M1 segment of RMCA and RICA

Norfolk General Hospital

PATIENT OVERVIEW

- 75 y/o with DM and HTN with left hemiparesis, left neglect and left facial droop, awakened with symptoms, last seen normal, previous night 11PM.
- CT head: hyperdense M1 segment, early changes infarct right basal ganglia
- CTA: Pseudoocclusion post bulbar RICA with embolic occlusion M1 segment RMCA
- NIHSS 14
- 135 minutes from presentation to SCP ER to SNG interventional neuroangio suite and intubation
- Not a candidate for IV-tPA

CASE CONCLUSION

- Day one: NIHSS 6

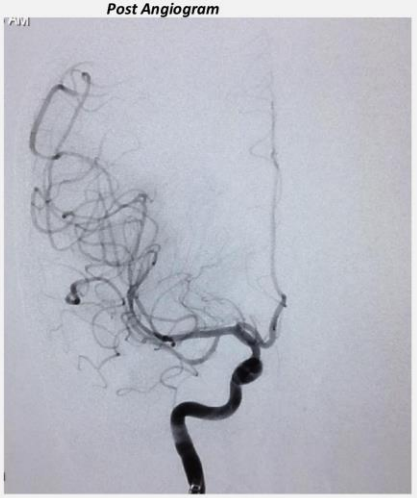
PROCEDURAL DESCRIPTION

- Single deployment and retrieval of TREVO ProVue Stent Retriever during flow arrest and manual suction
- 9 cm of fragmented clot in stent and in the aspirate
- Full revascularization TICI 3 RMCA distribution
- Total Procedural time from arterial puncture to revascularization ***33 Minutes!***

Pre Angiogram

Trevo ProVue Deployed in Clot

Post Angiogram



- Neurointerventionalists: - Dr. Karah Lanier and Dr. John Agola
- Neurologist SCP Dr. Maria Guina
- ED SCP Dr. Jason Garrison
- ED SNG Dr.Moss Mendelson
- Air transfer to SNG: Life Evac of VA (Contact Beverly Harris)

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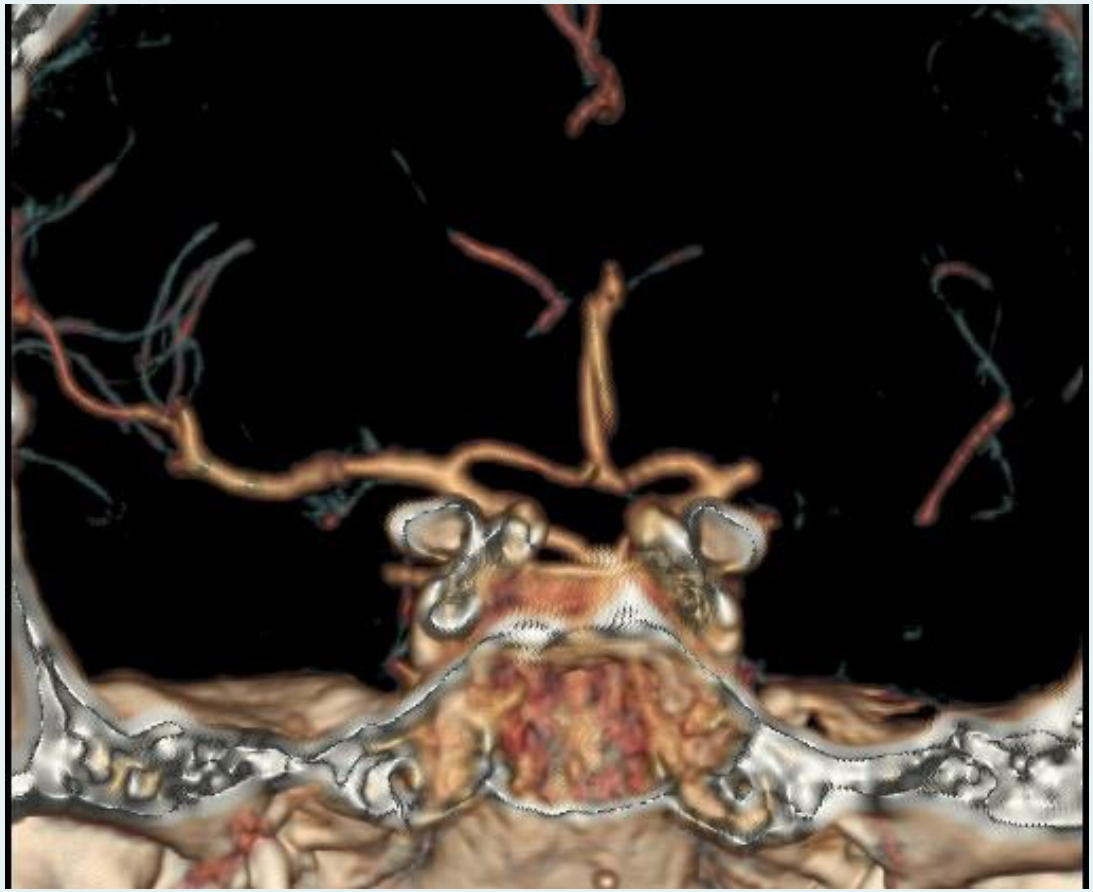
Solitaire FR Revascularization

78 y/o with right hemiparesis, right facial droop and aphasia

Stuttering course in ER, recurred 3 hours later after admission to ICU at OSH

NIHSS 14

No change s/p IV tPA



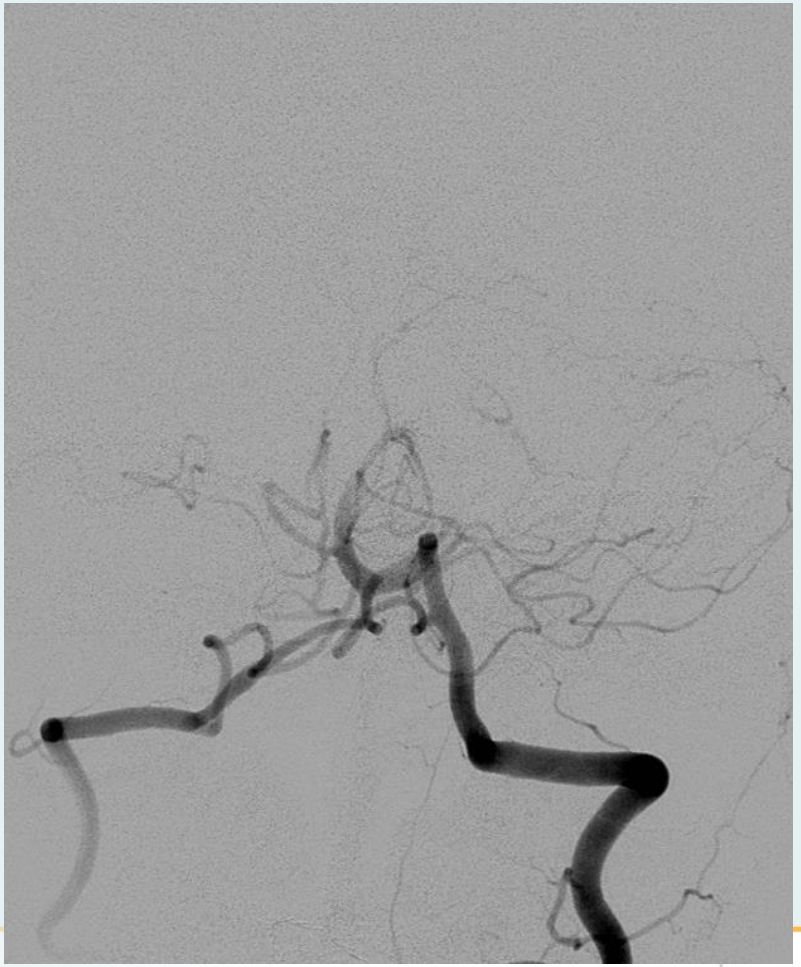
3.5 hours from symptom onset to complete revascularization

30 minutes from arterial access to TICI 3 Solitaire revascularization

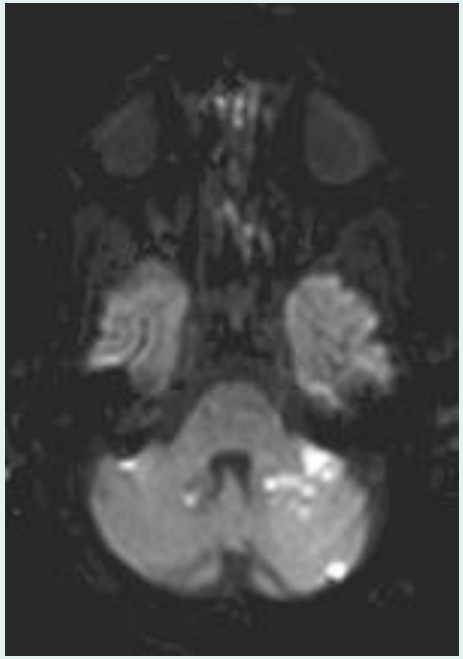
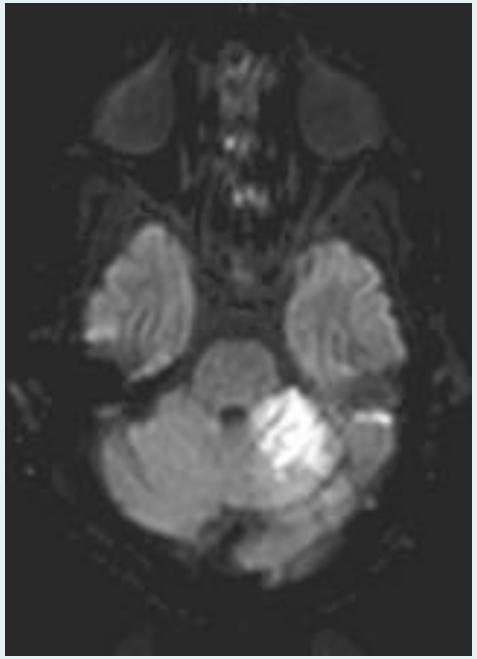
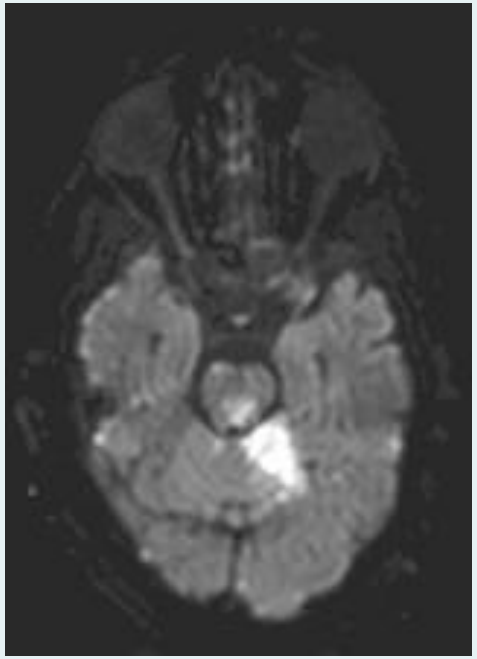
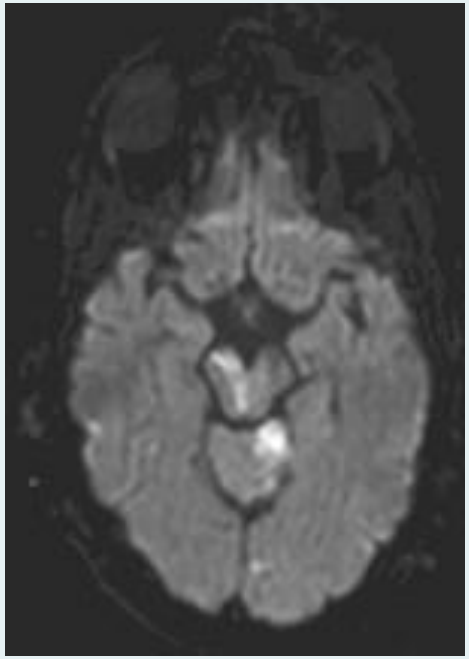
NIHSS 5 on D/C with OP rehab (mostly speech deficit)

65 y/o with progressive motor deficit, vision changes and nausea, Required emergent intubation for airway protection

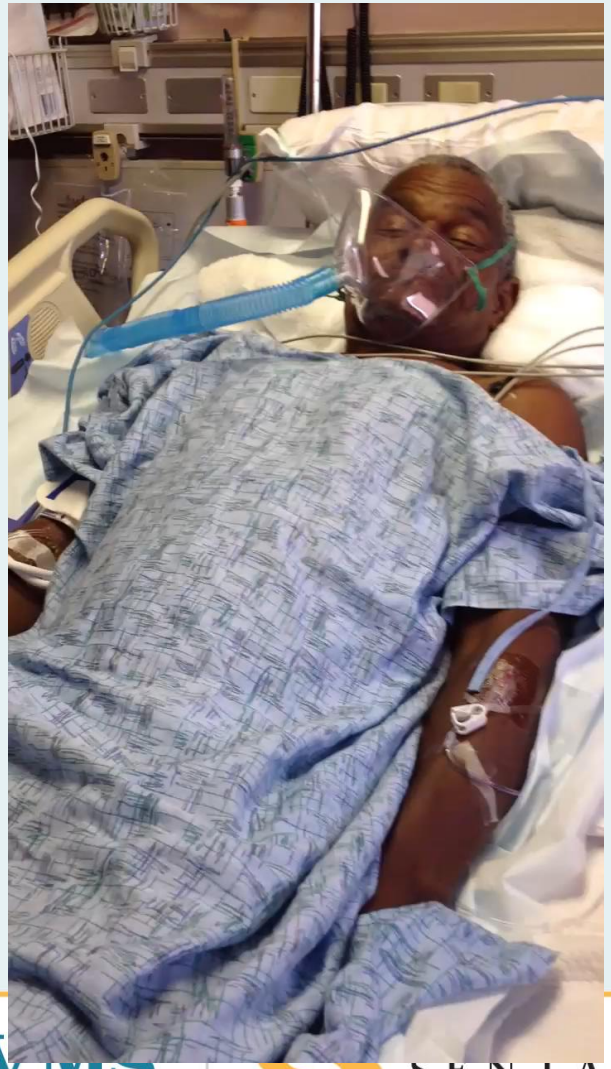
Time of onset = 20 hours earlier!



48 Hours Post Intervention

Immediate post embolectomy, on arrival to NICU



SENTARA®

Full Revascularization and clot removal of MCA Stroke in Afib Patient

Norfolk General Hospital

PATIENT OVERVIEW

- Patient underwent Afib Ablation at Sentara Heart hospital 48 hours prior
- Alert of stroke occurred at 7:45 am
- Patient was sent to Interventional Lab at 8:30 am
- Groin puncture at 8:41am
- Full clot retrieval and TICI 3 revascularization at 9:15

CASE CONCLUSION

- NIHSS 1

PROCEDURAL DESCRIPTION

- Merci Balloon Guide Catheter was used for flow arrest and aspiration
- Trevo ProVue was deployed in MCA
- Full Clot retrieval and full revascularization
- **Total procedure time to revasc: 34 minutes**...Time to complete revasc from symptom alert: 1 hr 30 min
- TICI 3 revascularization was observed

Angiogram revealing MCA Clot

Trevo ProVue Deployed in clot

Full Revascularization

- Neuro Interventionalists: - Dr. John Agola and Dr. Karah Lanier
- Special thanks to Sentara Heart Hospital for quick response

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What can go wrong?

Anything and everything!

- Access complications femoral artery
- Vessel perforation
- Dissection
- Inability to remove clot
- Distal emboli
- ICH due to revascularization of infarcted brain
- Medical issues: Cardiac/respiratory

TIME IS BRAIN!

Average neuron loss during untreated large vessel ischemia is 1.9 million neurons/minute

That equals approx 3.6 years of accelerated brain age for every hour of sustained ischemia

For every 30 minute delay there is a 10% decrease in favorable outcome

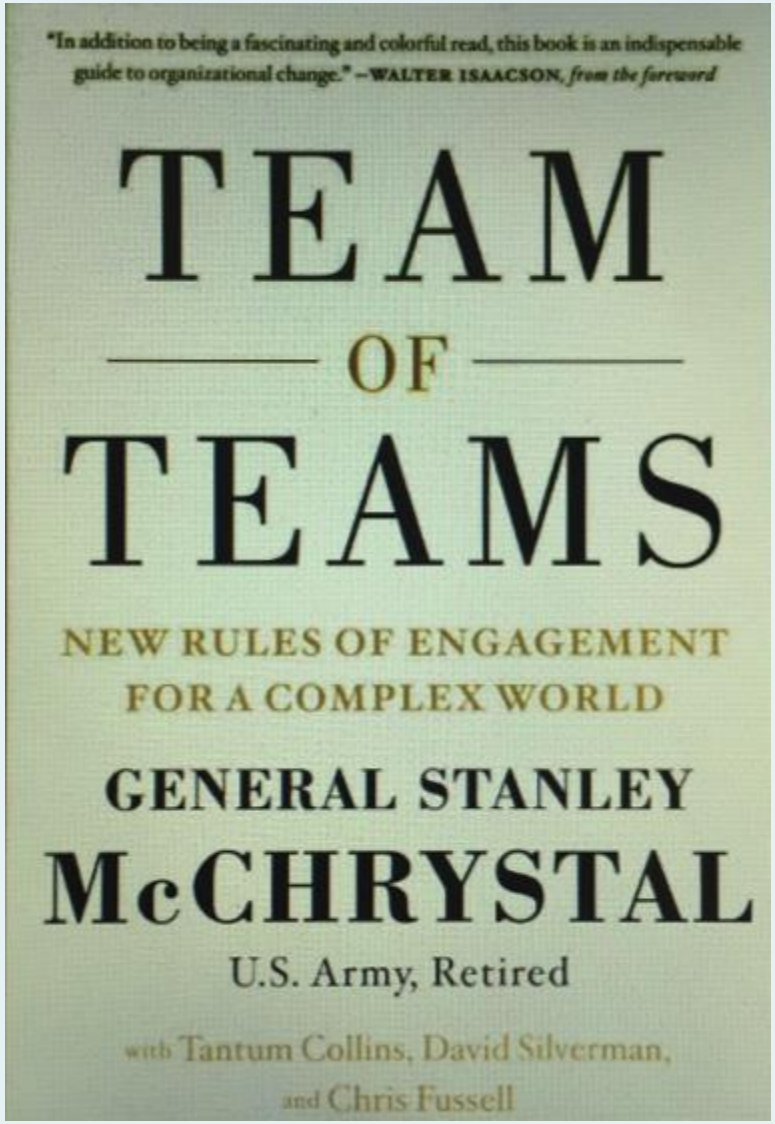
Conclusions

Early revascularization optimizes outcome

- Door to groin puncture goal 60 minutes
- Level 1, Class A evidence that rapid embolectomy is superior to IV tPA alone for patients with LVO

Our INR Protocol (Unchanged since 2009!)

- Immediate frontline INR consult for all stroke alerts
- NCCT head & CTA for appropriate pt with sufficient deficit
- Rapid transfer to SNGH ED for endovascular intervention when being considered for intervention



"Team of Teams" required for expedient and successful revascularization!

QUESTIONS?

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