Pediatric Acute Stroke

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UTHealth
The University of Texas Health Science Center at Houston
McGovern Medical School

Children's Memorial Hermann Hospital

Disclosures

No relevant financial disclosures

I will be discussing off label use of tissue plasminogen activator and endovascular thrombectomy in children

Objectives

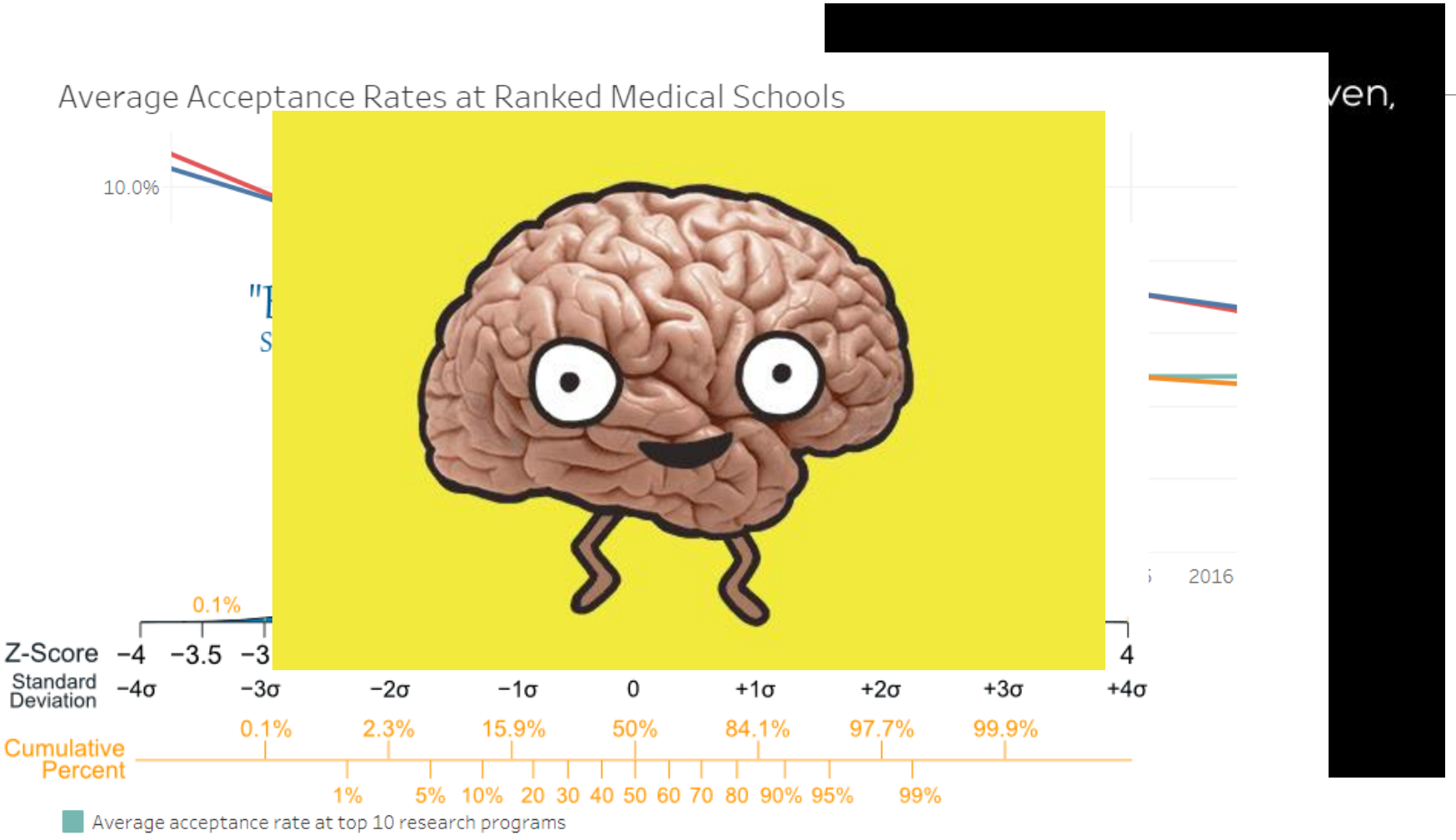
1. Discuss the epidemiology and etiology of pediatric stroke in non-neonates
2. Review the current best practice recommendations for suspected pediatric stroke
3. Review pediatric acute stroke guidelines for Children's Memorial Hermann hospital

Objectives…continued

1. To teach 11 things to the Pediatric Hospitalists

Objectives…continued

- Why 11?
- …why not
- The ‘must



The Elephant in the Room

The Elephant in the Room

Side By Side Comparison

IPHONE 14	ME
State of the Art Bionic Chip	3 lbs of jello floating in salt water
12MP wide-angle telephoto camera	No photographic memory options
Candy Crush	Crushes Candy
1hour Recharge *Fast Charge* Technology	7 hour recharge time nightly
4G Internet Connection	No native internet connection
256GB Hard Drive	No reliable memory storage
Three-axis Gyro	Semicircular canals
‘Space Gray’ Matte Finish	Button-up and khakis

Disclosures

No financial disclosures

I will be discussing off label use of thrombolysis and endovascular clot retrieval in children

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UTHealth Houston Department of Pediatrics, Division of Child Neurology

UTHealth Institute for Stroke and Cerebrovascular Disease

NIH Training Grants T32NS007412-23 (previous) and T32135118 (current)

Society of Vascular and Interventional Neurology Pilot Grant

Objectives

1. Define perinatal and childhood stroke
2. Discuss the most important initial steps in emergency diagnosis and of childhood and perinatal stroke
3. Review outcomes and long-term management of childhood and perinatal stroke survivors

Visit www.iapediatricstroke.org for information

A Bit About Adult Learners (That's You!)

Andragogy – The Art and Science of Helping Adults Learn by Malcolm Knowles (1980):

- Need to know WHY we should be learning
- Need internal motivation
- Want to know how learning will help SPECIFICALLY
- Bring prior knowledge and assumptions as their foundation
- They are self-directed and want to take charge
- They find relevance from task-oriented learning

To start

I will answer your two most burning questions:

- Q: Do kids have strokes?
  - A: THEY ABSOLUTELY HAVE STROKES
  - It is the 9th most common cause of death in pediatrics.
- Q: Dr. Fraser, are you old enough to be teaching us this?
  - A: Yes.
    - I'm older than I look.

Who’s this guy talking to us?

- **Past Training:**
  - General Pediatrics
  - Neurology with Special Qualifications in Child Neurology
  - Vascular Neurology (as in adults)
  - I see kids and adults with stroke in Houston, Texas.

Pediatric Stroke Program

Pediatric Stroke Program Quick Links:

- What Is A Pediatric Stroke and What Are Potential Causes?
- Research and Clinical Trials
- Publications
- Pediatric Stroke Clinic
- UTHealth Houston Pediatrics
- In The News

Who Are We?

At UTHealth's Pediatric Stroke Program, we provide clinical care and conduct research related to pediatric stroke and cerebrovascular diseases. Pediatric stroke is an underrecognized medical emergency, among the top 10 causes of morbidity and morality in the pediatric population. Currently, there is a shortage of pediatric neurologist specifically trained in diagnosis, acute management and long-term care of pediatric patients with cerebrovascular diseases. Our pediatric stroke program works closely with our partners at Children's Memorial Hermann Hospital to provide comprehensive medical care to children and families affected by pediatric stroke and cerebrovascular diseases.

Mission Statement

Our mission is to provide pediatric stroke patients with compassionate, comprehensive, and personalized care. We strive to support our patients by creating a nurturing and inclusive community for children with cerebrovascular disease. We are committed to performing innovative, cutting-edge research to continuously advance stroke care for young stroke survivors.

Meet Our Pediatric Stroke Team

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Director, Program for Pediatric Stroke and Cerebrovascular Disease at the Institute for Stroke and Cerebrovascular Disease at UTHealth Houston

Cases

Case #1

HPI:

A 12 hour old term infant (‘Layla’) develops seizures and encephalopathy at about 12 hours of life.

Differential Diagnosis?

Neonatal Seizures:

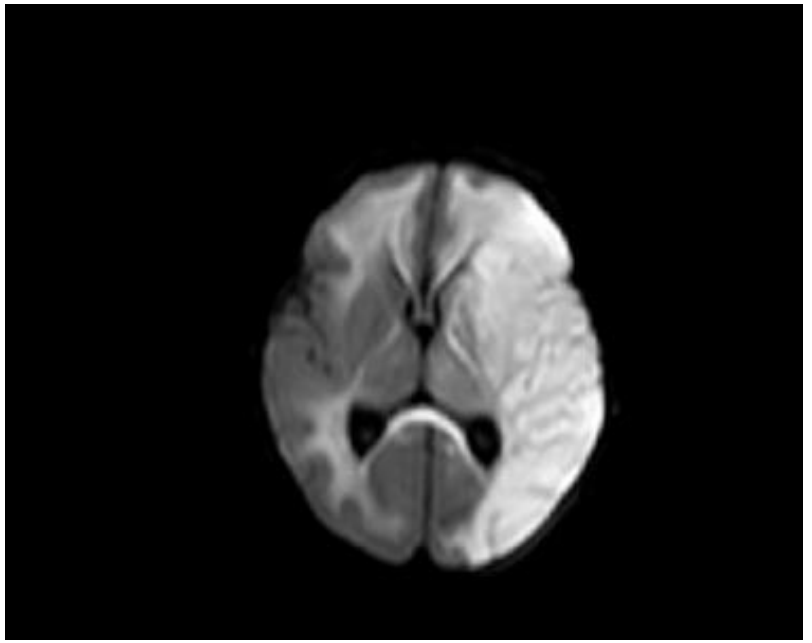
1. Hypoxic Ischemic Encephalopathy (60%)
2. Stroke (almost 20%!)
3. Some other neonatal brain injury
4. Hypoglycemia/electrolyte abnormalities
5. Something else (like genetic disorders, etc)

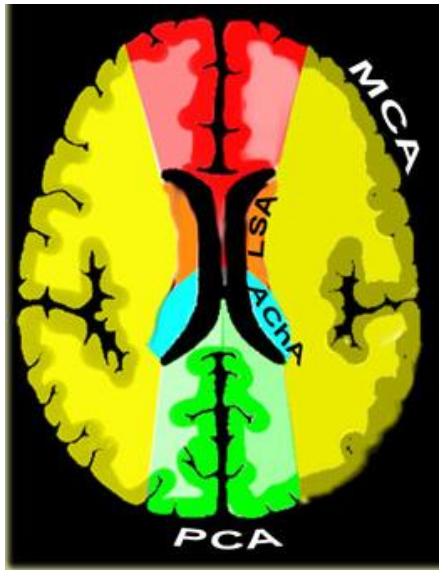
Case #1

HPI:

A 12 hour old term infant (‘Layla’) develops generalized seizures and encephalopathy at about 12 hours of life.

MRI is obtained demonstrating the findings on the right.





Diagnosis?

Let's Define 'Stroke'

Injury (across all groups)

- Arterial Ischemic Stroke (55%)
  - Blood can't get in
- Intracerebral Hemorrhage (40%)
  - Blood where it's not supposed to be
- Cerebral Venous Sinus Thrombosis (5%)
  - Blood can't get out

Age

- Perinatal
  - 28 weeks gestation to 28 days of extrauterine life
  - Incidence – take a guess
    - 1 in **1,100**
- Childhood
  - 29 days of life to 18 years of life
  - Incidence? Take a guess
    - 1 in 25,000 children **per year**

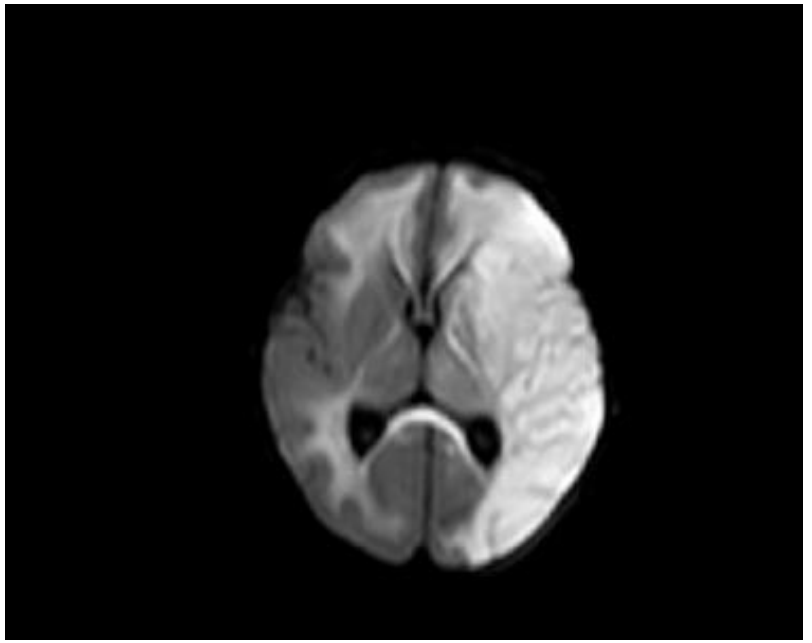
Case #1

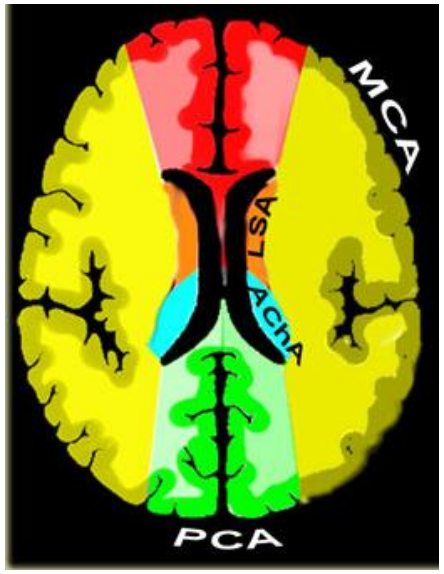
Back to ‘Layla’

Layla has strokes in her left Middle Cerebral Artery, Anterior Cerebral Artery, and Right Anterior Cerebral Artery territories

Perinatal Stroke can present in 2 ways:

1. Acute
   - Encephalopathy (for a few days)
   - Seizures (usually only for a few days – but 20% have long term epilepsy)
2. Presumed Perinatal
   - Child develops hemiparesis at about 6 months of life, and imaging will reveal an old stroke that must have happened antenatal or shortly after birth





Acute Perinatal Arterial Ischemic Stroke Management

ABCs (duh!)
Control Seizures!
- Give phenobarbital, transfer to a NICU with continuous EEG monitoring capability

Workup (per AHA scientific statement 2019)
- MR Angiogram of the brain and neck, MR Venogram of the brain and neck
- Echocardiogram
- DIC screen

Not routinely done (Per AHA and ASH)
- Thrombophilia workup
- 4 extremity ultrasound
- Invasive angiography

Acute Care?
- Supportive

tPA – no!
Heparin drips – no! (unless they have a clot in the heart)
Thrombectomy – no!
Aspirin – no!

In children with normal cardiac anatomy and perinatal stroke, incidence of childhood stroke is the same as children without perinatal stroke

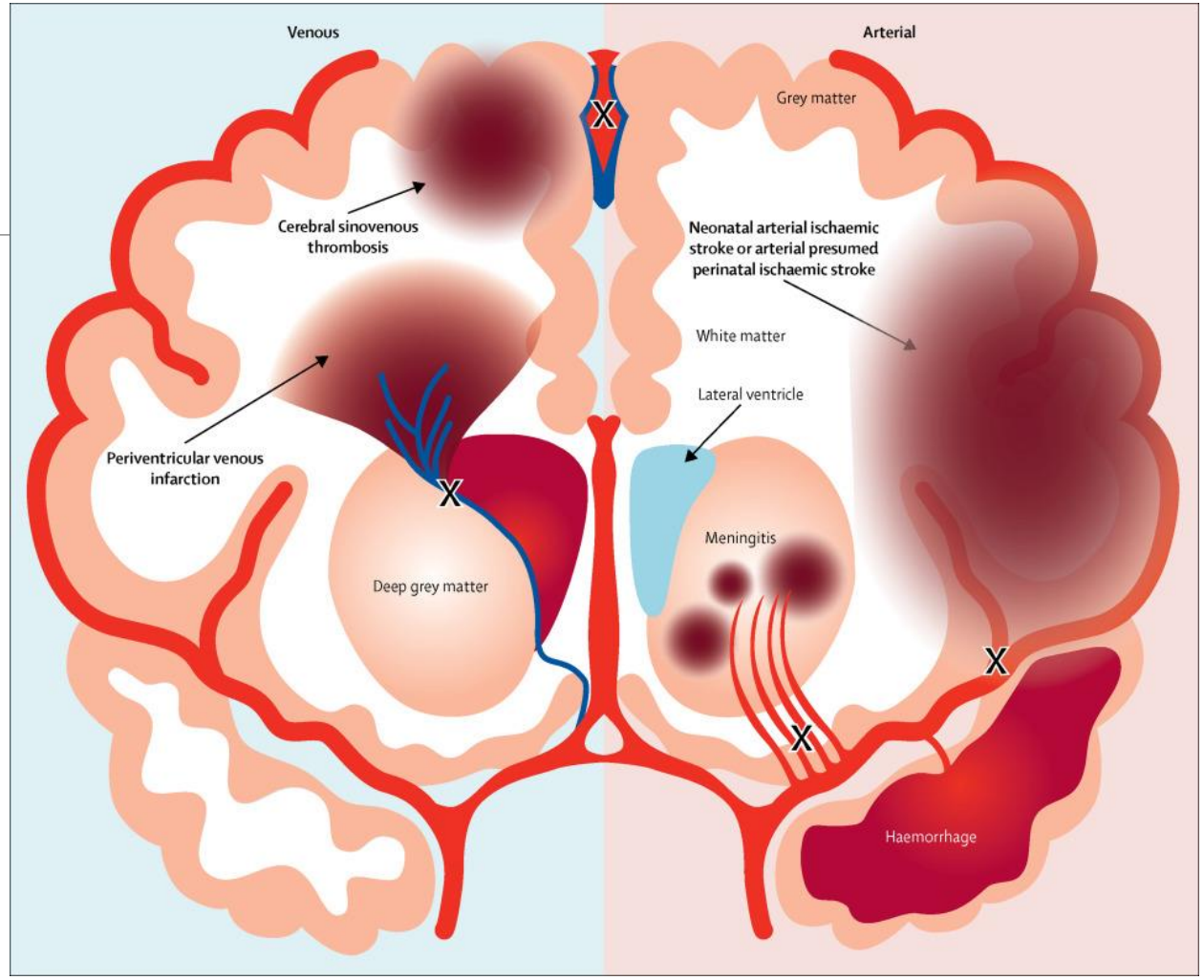
Pathophysiology

Arterial Ischemic Stroke
- Usually unknown
- Though to be related to placental factors
- Associated with ‘precipitous birth’
  - Low APGARS, Nuchal Cord, need for intubation, etc.

Periventricular Infarction
- Usually due to IVH causing impaired venous outflow

ICH
- Likely related to birth trauma

CSVT
- Can be precipitated by dehydration and infection, and often not treated with anticoagulation



Dunbar and Kirton, 2018.

Question: How commo
stroke?

UNIVERSITY OF CALGARY

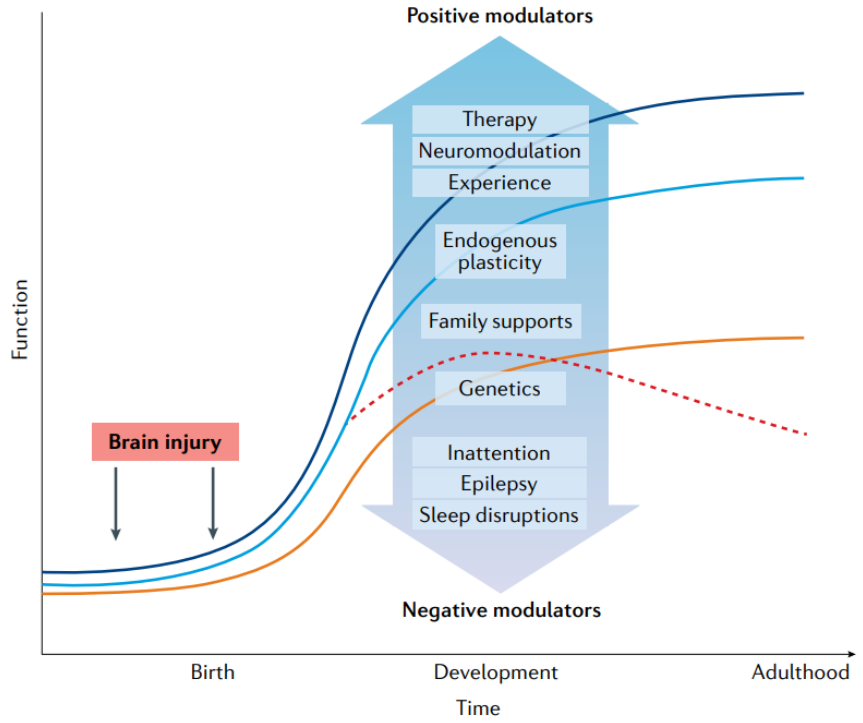
	Years	N	Births in Period	Birth Prevalence per 10 000 Births	95% CI	1/× Births	95% CI
Total	2008–2017	219	236 832	9.2	7.6–10.9	1081	1300–900
Neonatal Arterial Ischemic Stroke	NAIS	2008–2017	80	236 832	3.4	2.7–4.1	2960	3800–2400
Periventricular Venous Infarction	PVI	1990–2017	93	558 447	1.7	1.3–2.1	6005	8000–4800
Neonatal Hemorrhagic Stroke	NHS	2008–2017	35	236 832	1.5	0.7–2.3	6767	14 000–4400
Apparent Presumed Perinatal Ischemic Stroke	APPIS	1990–2017	71	558 447	1.3	0.9–1.6	7865	11 000–6200
Cerebral Sinus Venous Thrombosis	CSVT	2008–2017	26	236 832	1.1	0.6–1.6	9109	16 100–6400
Presumed Perinatal Hemorrhagic Stroke	PPHS	1992–2017	8	521 742	0.2	0.04–0.3	65 218	234 000–38 000

Neonatal Stroke Outcomes

Each child is different, and every patient has their own potential

In adults, recovery is defined by *regaining lost function*

In children, it is perhaps better to define recovery by *achieving developmental milestones*



Kirton, et al. 2021

Outcomes

MOST COMMON CAUSE OF HEMIPLEGIC CEREBRAL PALSY

Pathologic early handedness typically starts around 6 months

Some patients will have ‘normal’ development, some will have cerebral palsy

About half have some form of neurologic or neurodevelopmental disorders (ADHD, Dyslexia, hemiparesis)

Perinatal Arterial Stroke (PAS):
A Phase III Multi-site Trial of I-ACQUIRE

WE ARE ENROLLING

Contact: pedistroke@uth.tmc.edu

Case #2

CC: Right Sided Weakness

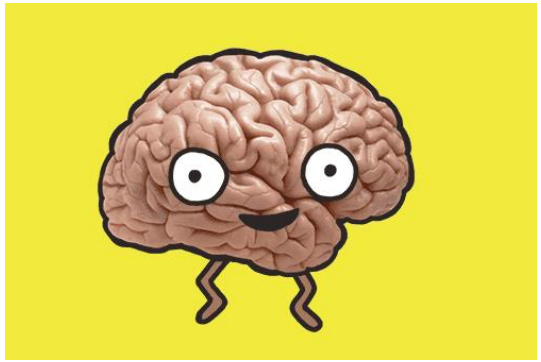
HPI: A 15 year old male is transferred to the CMHH floor. He had right sided weakness for about an hour and difficulty speaking but recovered in the outside ED. On arrival to the floor, he says he is feeling weak again for maybe the past twenty minutes.

You feel like his right side is weak and you call the page operator to page a pedi code stroke

Regardless: WHAT DO YOU DO NEXT?

CT Brain

The Stroke Paradigm



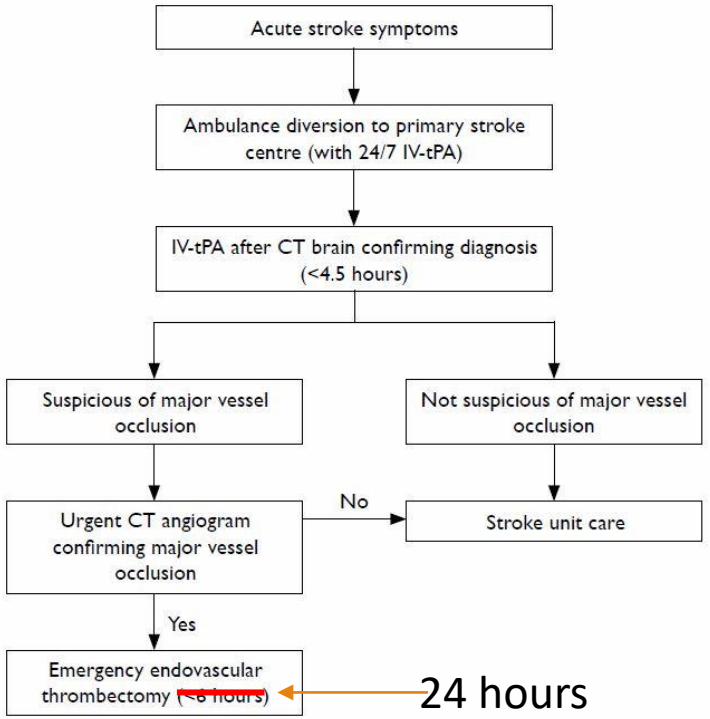


FIG 3. Treatment algorithm for patients with acute ischaemic stroke
Abbreviations: CT = computed tomography; IV-tPA = intravenous thrombolysis with tissue plasminogen activator

What should we do next?

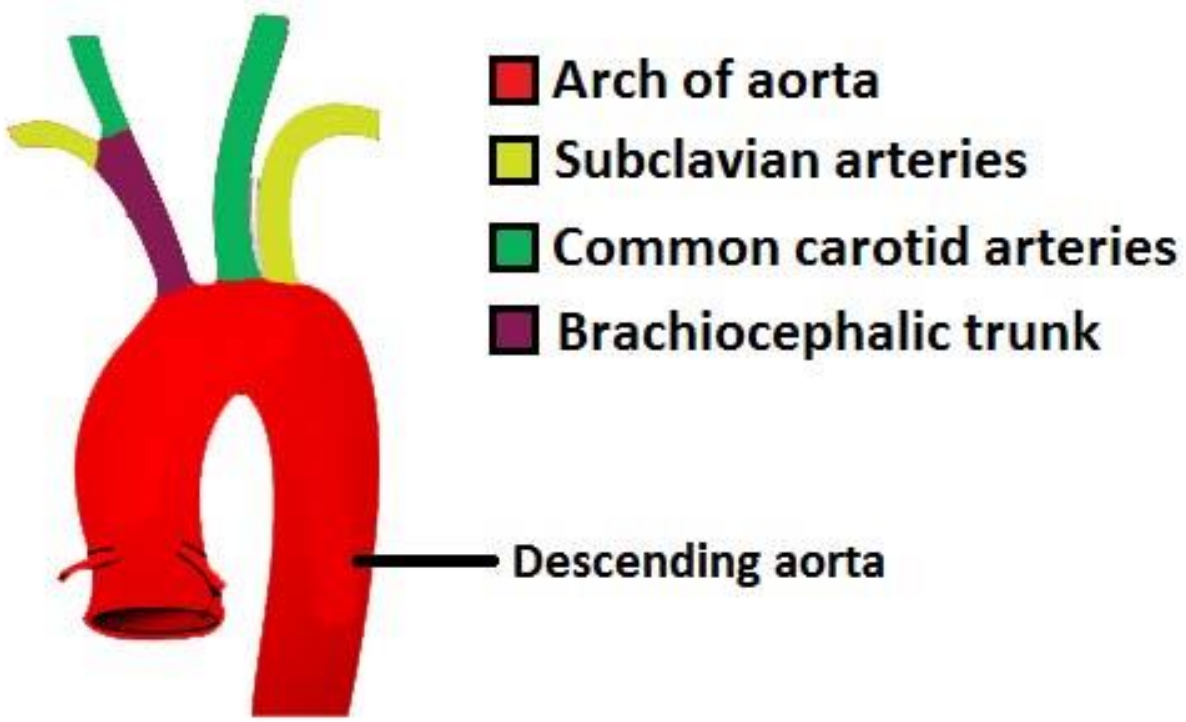
A. Give em the juice! TNK baby! (or tPA)

B. Perform a CT Angiogram

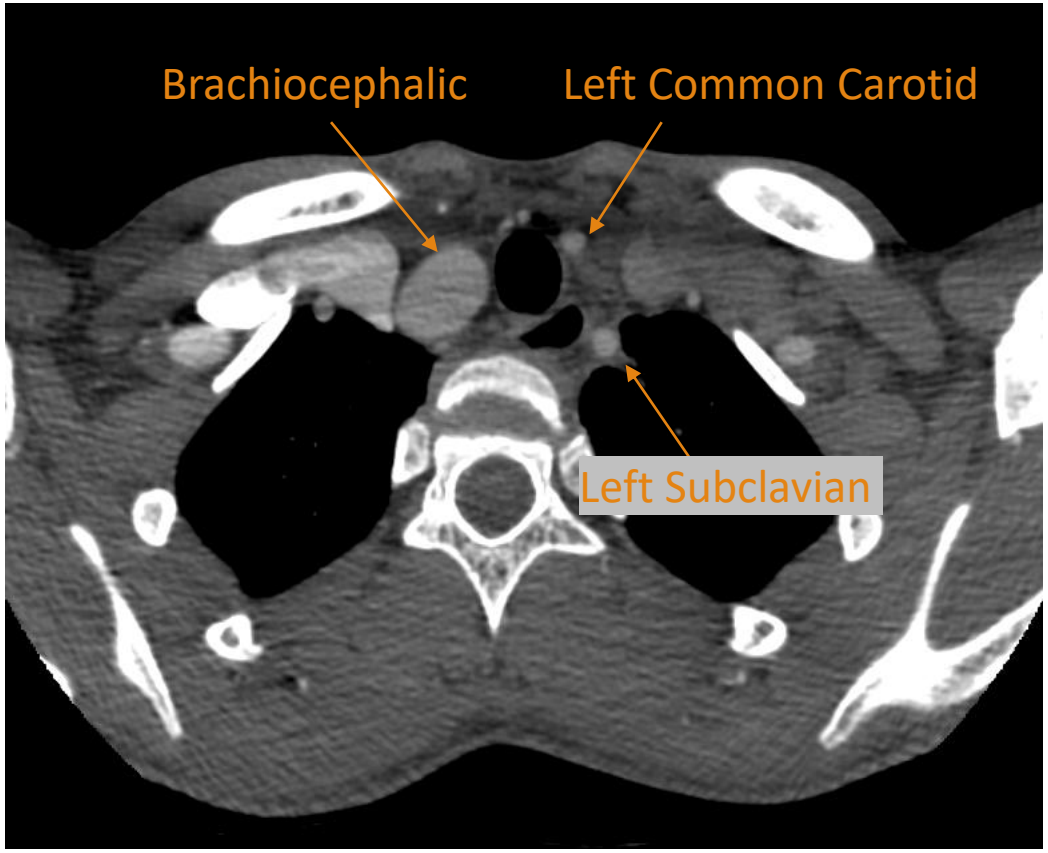
C. Obtain a stat MRI brain

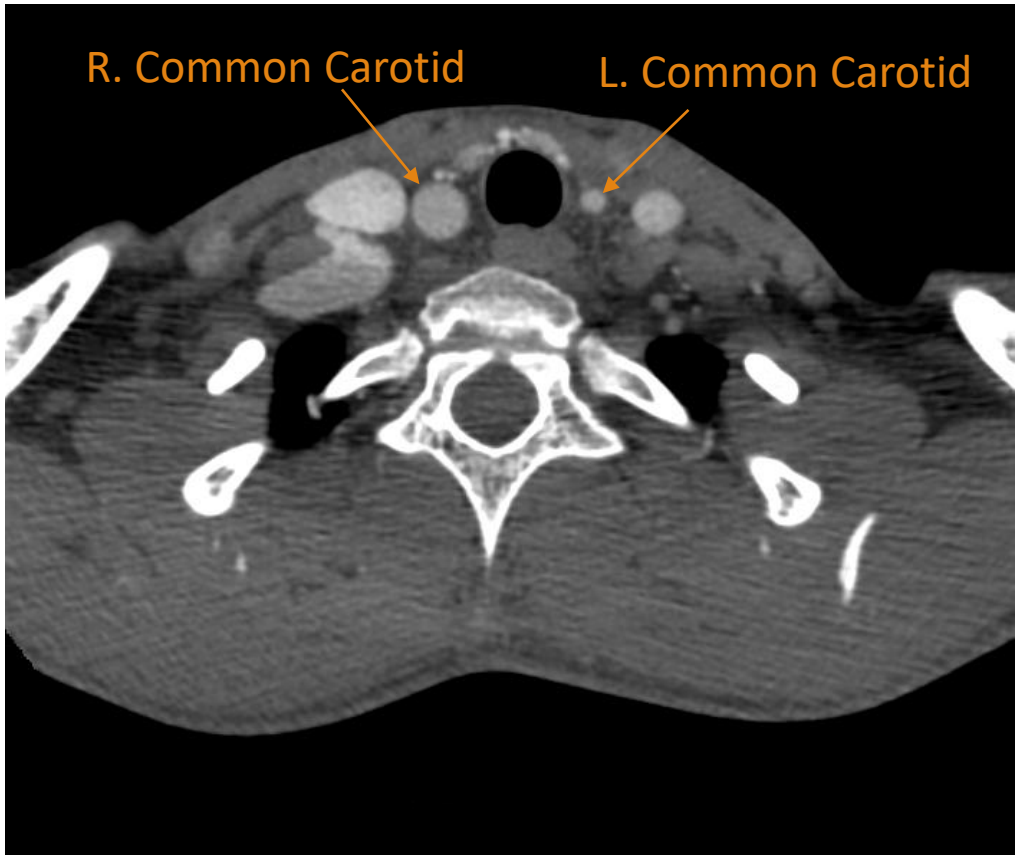
D. Panic!

Arch Anatomy

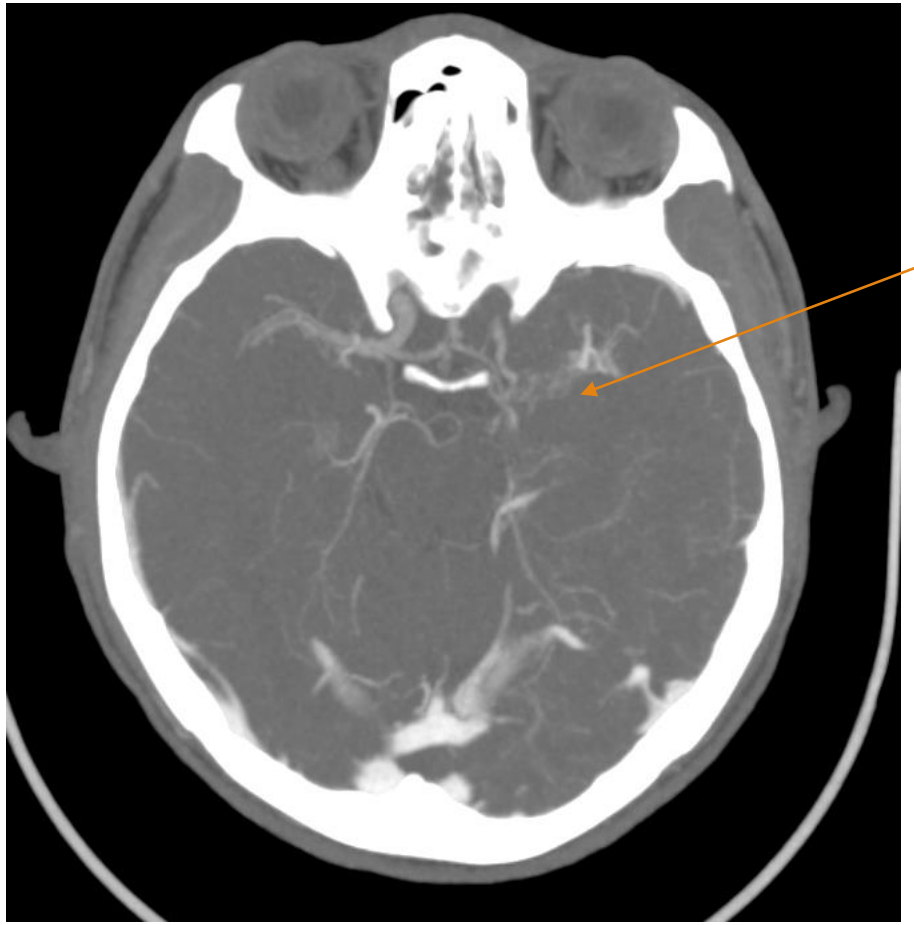


CTA Brain/Neck (still outside hospital)



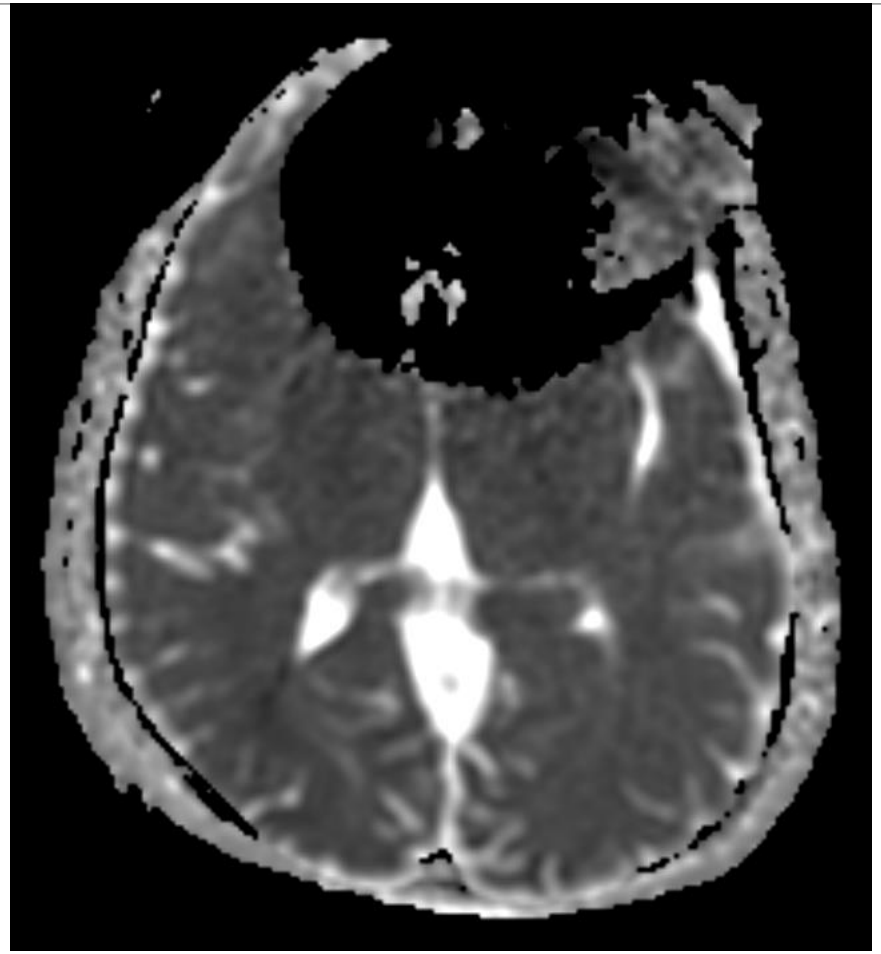


CTA Brain/Neck

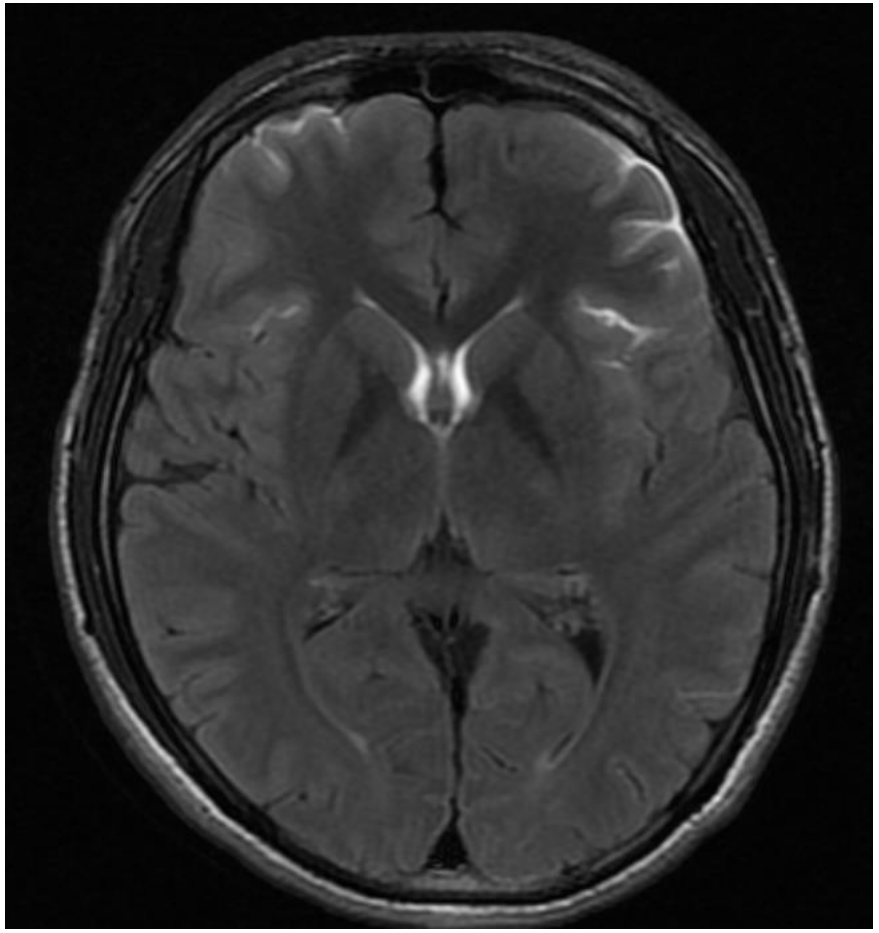


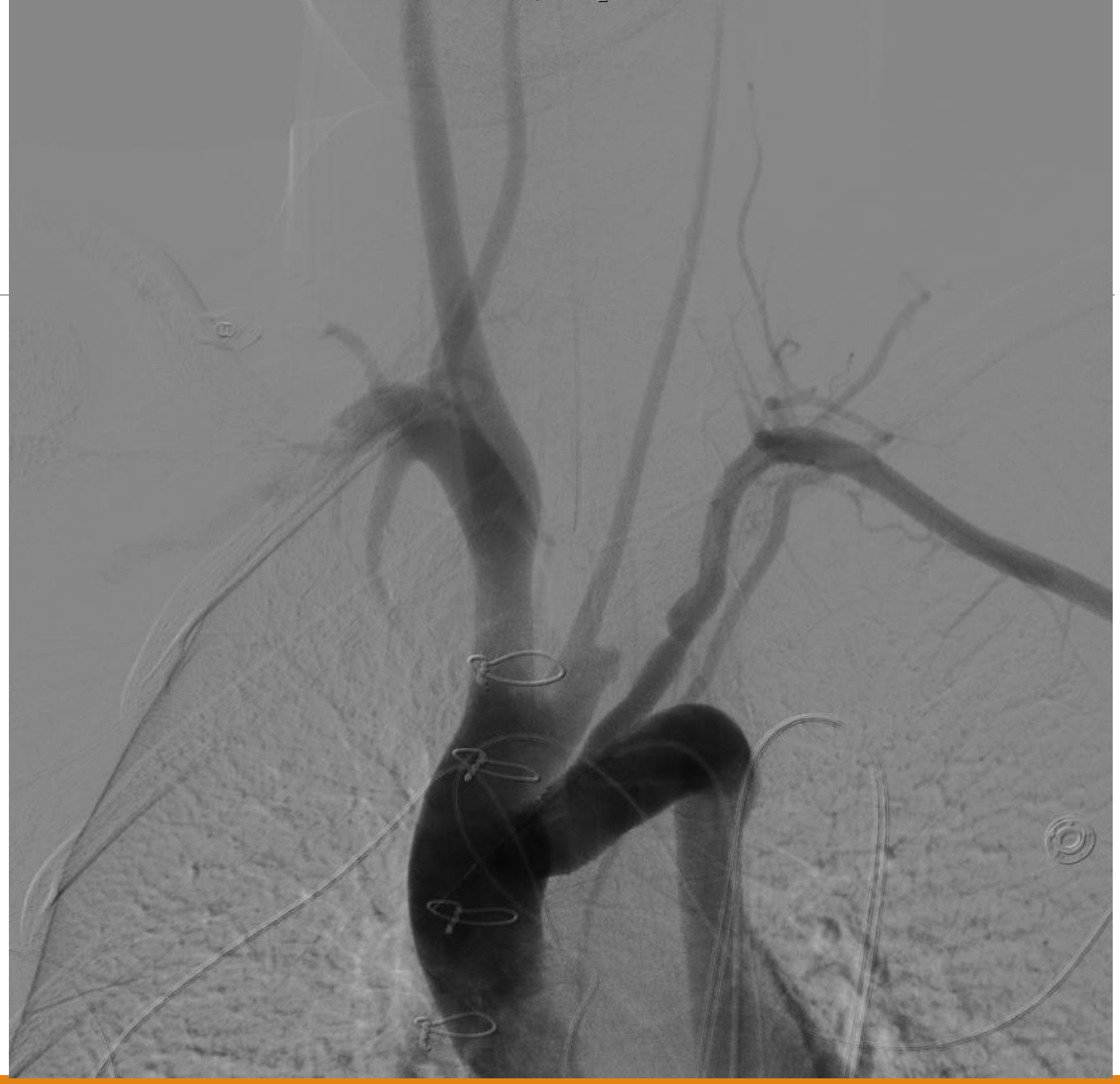
Read as “concerning for possible moyamoya vasculopathy”

MRI Brain (ADC)



MRI Brain (T2 FLAIR)



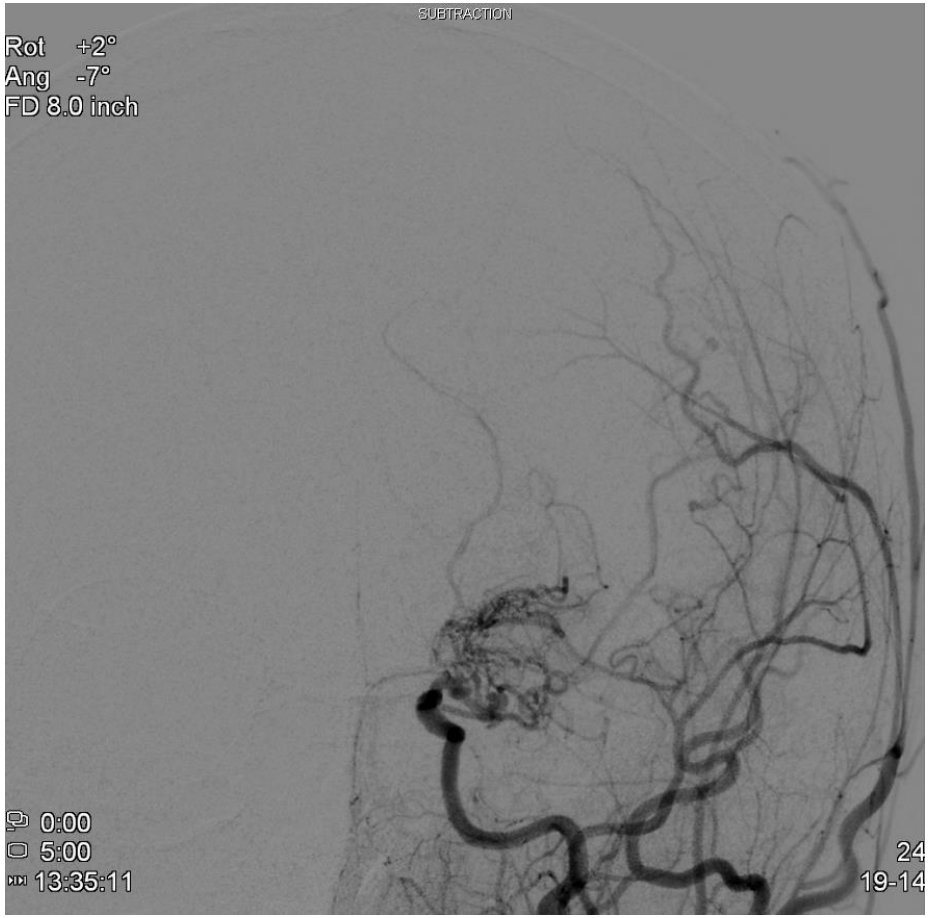


R. ICA


SUBTRACTION FRAME_SELECTION


SUBTRACTION FRAME_SELECTION

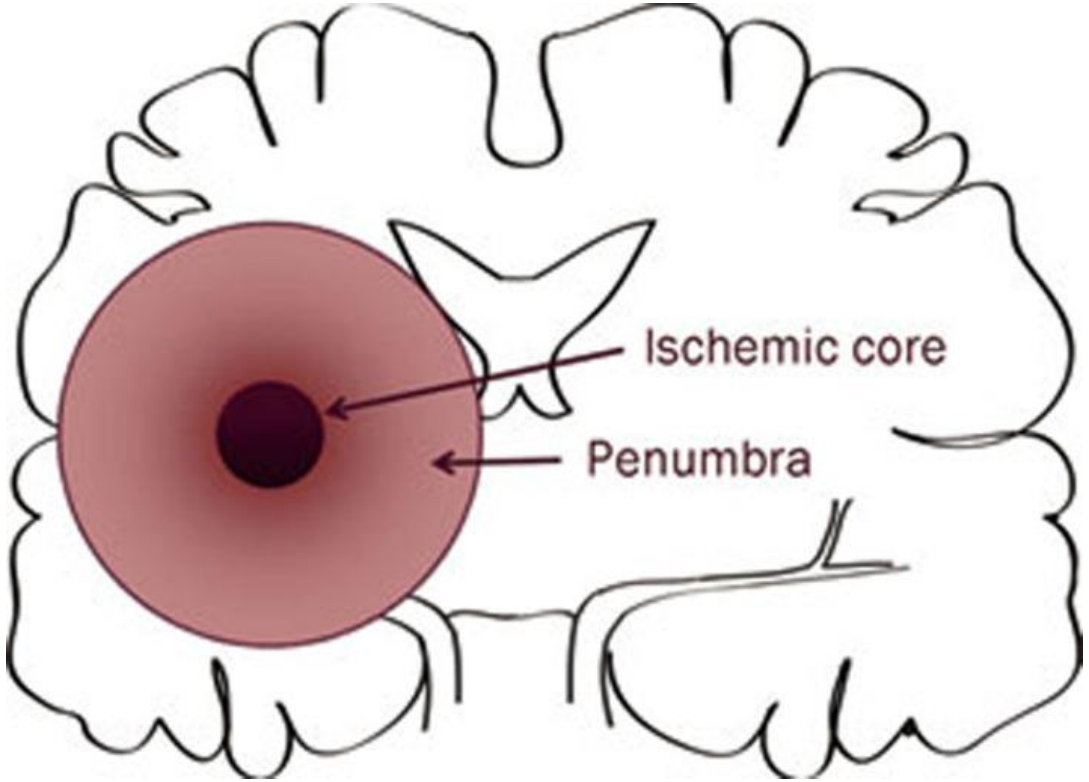
L. Common Carotid



Diagnosis: Moyamoya Syndrome

- Narrowing of the ICA, likely due to his history of coarctation causing developmental abnormalities
  - This is the most common arteriopathy causing stroke in children
    - It is a RELATIVE contraindication to TNK. It may be a good idea in some situations
      - It’s still pretty risky though

This is a Stroke



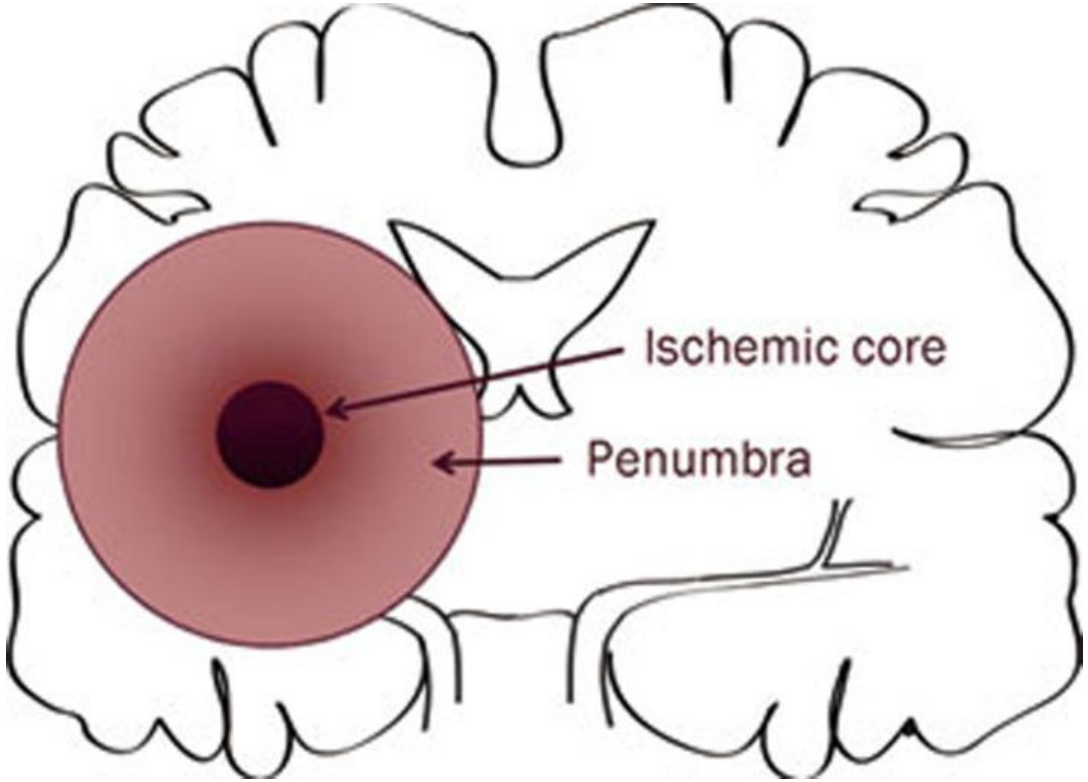
In an ischemic stroke, blood flow through an artery is cut off. Immediately around the occluded blood vessel brain cells die very rapidly (the **CORE** infarct)

Tissue further out can remain viable a bit longer via collateral flow from nearby vessels (the **PENUMBRA**)

You always want to stop the core infarct from spreading

Hemorrhagic strokes are caused by bleeding into brain parenchyma. Management is very different than ischemic strokes

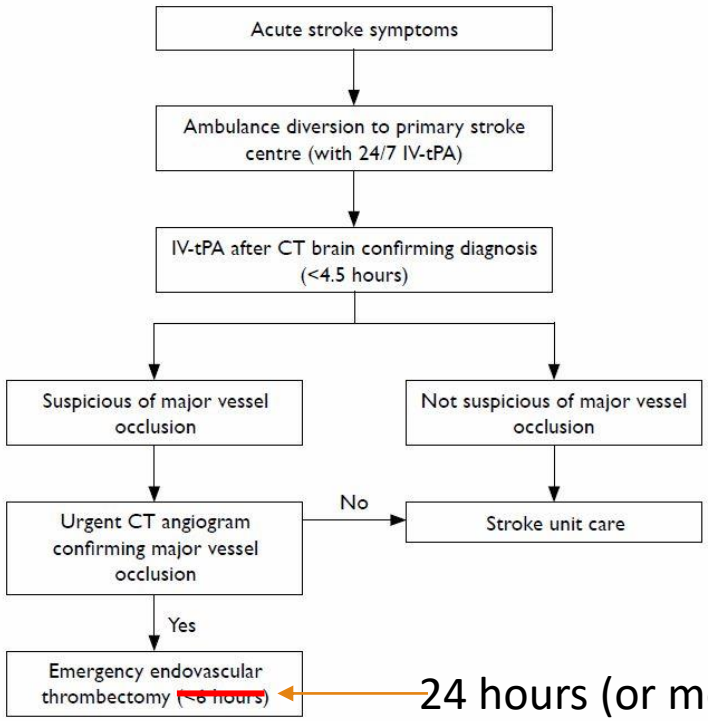
Stroke Care 101



In any stroke, there are three things you want to do:

1. **Stabilize** the patient. Salvage the penumbra and prevent further damage
    1. Ideally that includes opening up the vessel somehow (thrombectomy or tPA)
2. Figure out **Why** the stroke happened (echo, vessel imaging, hypercoag workup, etc.)
3. **Rehab, rehab, rehab**
    1. This starts IN the hospital

The Stroke Paradigm



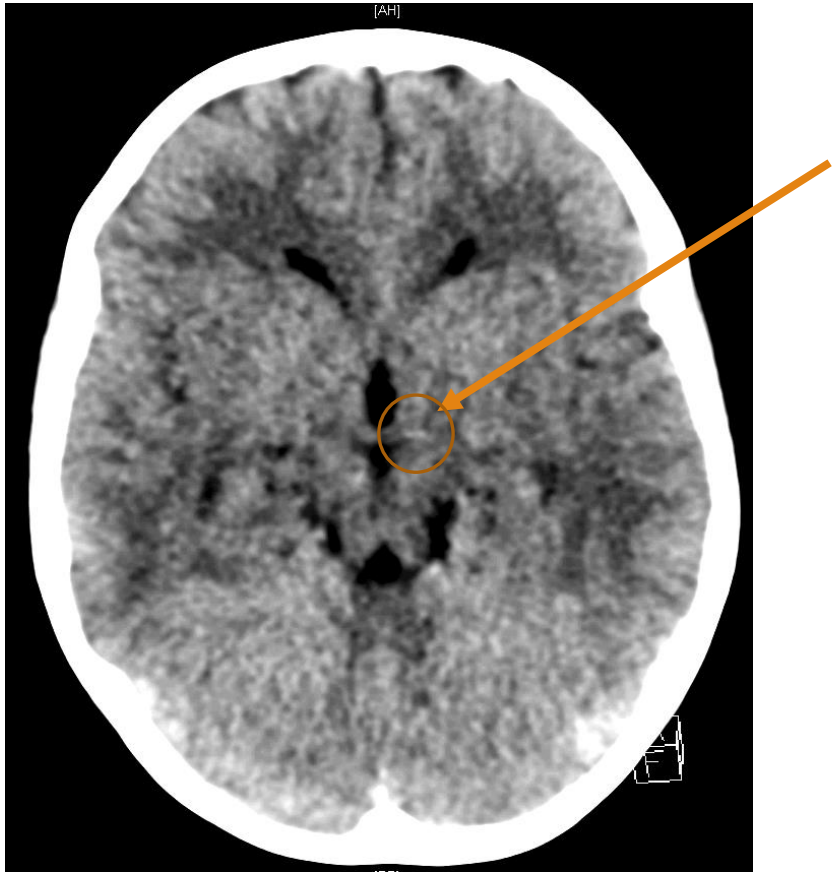
24 hours (or more sometimes)

FIG 3. Treatment algorithm for patients with acute ischaemic stroke
Abbreviations: CT = computed tomography; IV-tPA = intravenous thrombolysis with tissue plasminogen activator

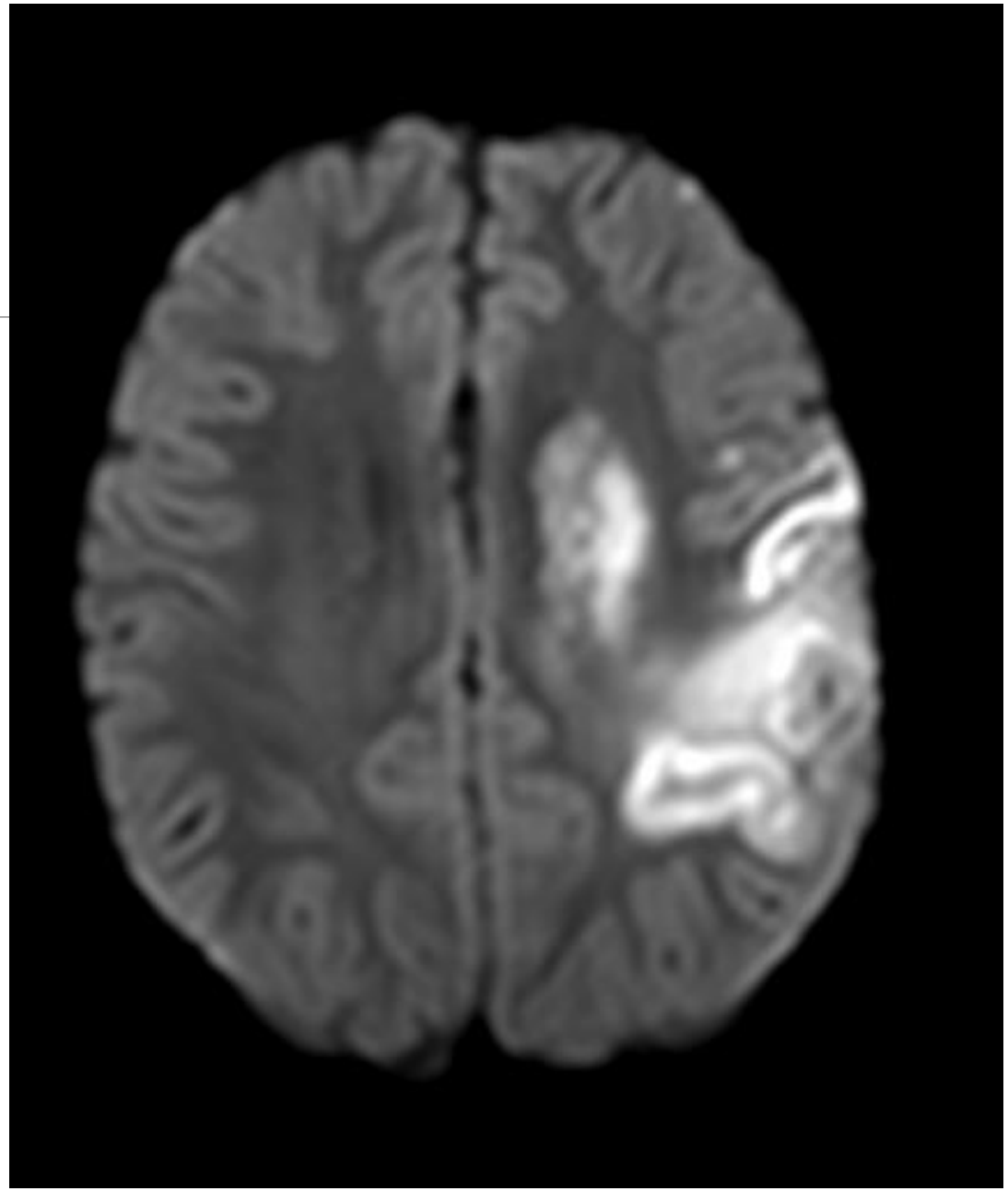
Case #3

A 5 year old girl with congenital heart disease presents to the ED at 6:00PM after having sudden difficulty walking at 5:30PM. A CT Brain at 9:00PM is normal. She is admitted for observation.

A routine consult to pediatric cardiology is called in the morning. The cardiology attending sees the patient at 10:00 AM and notices right facial droop and arm weakness. An emergent MRI is ordered at about 10:30 AM and pediatric neurology is consulted.



In AM cardiology attending notices weakness and calls a code stroke



Acute Ischemic Strokes Simplified

Left:

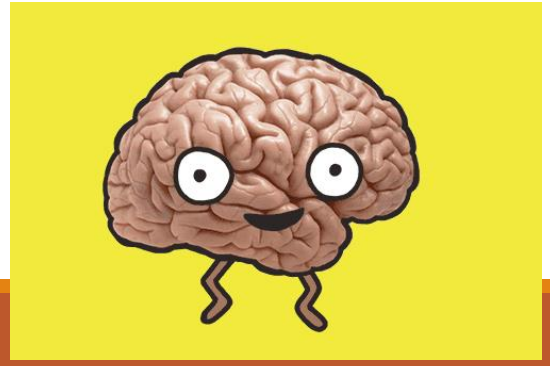
Right sided weakness, aphasia

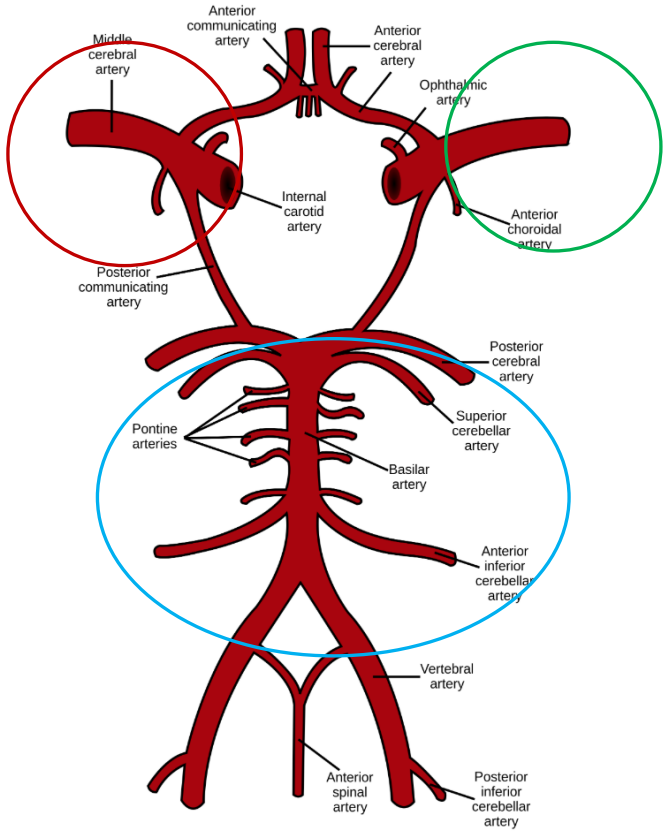
Right:

Left sided weakness, neglect

Back:

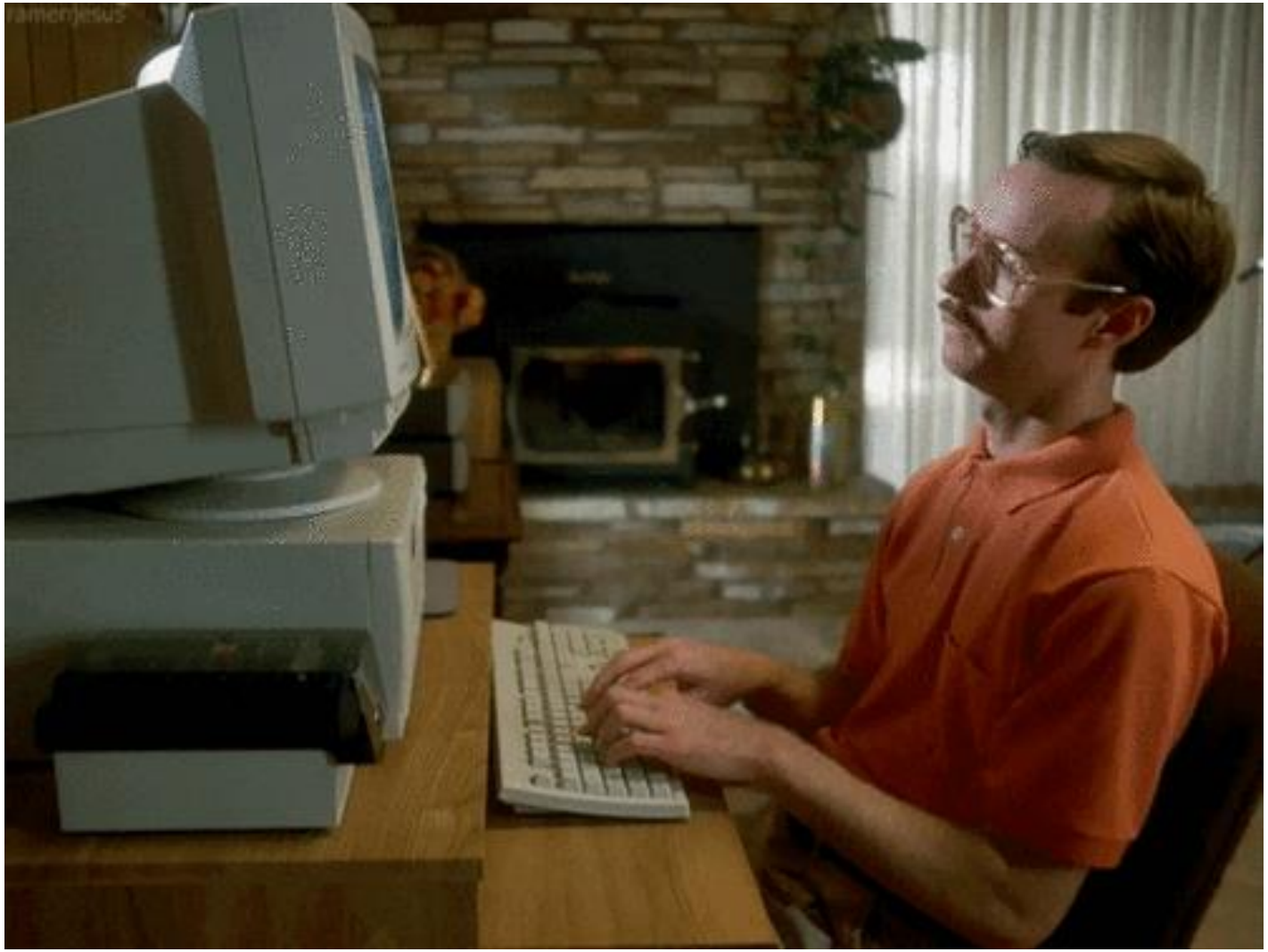
Nystagmus, vertigo, ataxia, cranial nerve problems, crossed sensory and motor signs, depressed mental status, quadriplegia, ‘Locked In’ Syndrome





American Stroke Association®

International Stroke Conference

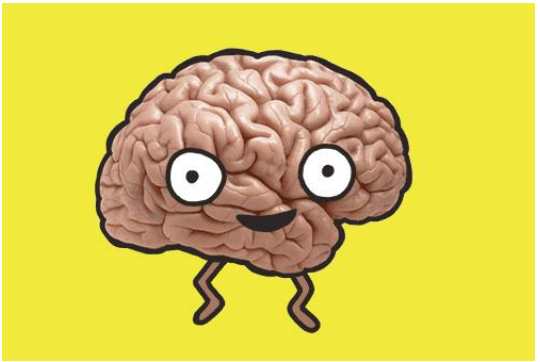


Pediatric Suspected Stroke Evaluation

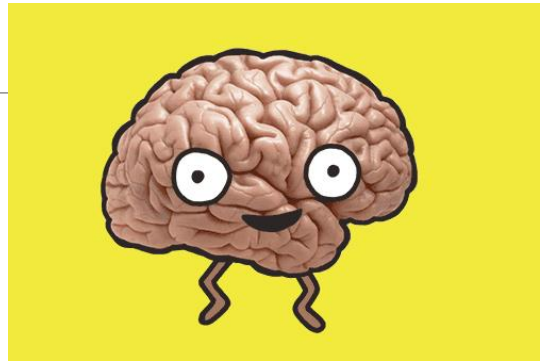
LET'S ANALYZE SOME DATA!

Facts on Pedi Stroke

- **Pediatric Stroke is divided into 4 main types**
- 1. Neonatal Ischemic stroke
  - Most common
  - **1 in 1081 live births!!!**
  - Presents with seizures and lethargy (NON-FOCAL) IF it presents acutely.
    - May present with Cerebral Palsy as a toddler as the first presenting sign
  - Nothing you can do acutely. Once you diagnosed, you just focus on recovery.
- 2. Neonatal Hemorrhagic Stroke
  - EXCLUDING preterm IVH – Those are common
  - Will also present with seizures, lethargy
  - Management is surgical + medical



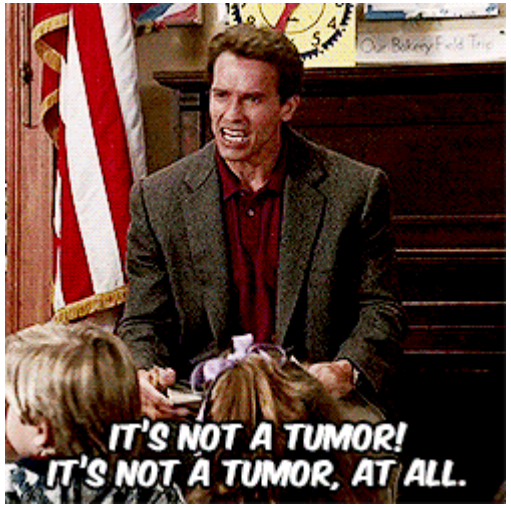
Facts on Pedi Stroke



- **Pediatric Stroke is divided into 4 main types**
- 3. Childhood hemorrhagic stroke
  - Presents with non-focal signs usually
    - Vomiting/headache
  - Most common cause blood vessel malformation (AVM), followed by coagulopathy, then idiopathic
- 4. Childhood Ischemic stroke
  - This is what we're talking about today!
  - NOTE – I'm including both venous and arterial strokes in ISCHEMIC. The venous strokes are usually less time sensitive – they present with headaches and non-focal neurologic signs.

Facts on Pedi Stroke

- **Pediatric Stroke is more common than you think**
- AHA Scientific statement on stroke published November 2019:
- Incidence – **5/100,000 per year** – about the same as CNS tumors



Pediatric Stroke

- **Pediatric stroke is a medical emergency**
  - Mortality is 10%
  - 75% of pediatric patients with stroke will have permane
  - **Stroke is among the <u>top 10</u> causes of death in children**
  - In children, 40% of strokes are hemorrhagic. 60% are is
  - **Patients with congenital heart disease have a baseline**
  - That number increases with complex congenital heart d

Pedi Ischemic Stroke Risk Factors

TABLE 8-2 Risk Factors and Comorbidities for Stroke in Children and Young Adults[a]

Pediatric[b]	You
	Well
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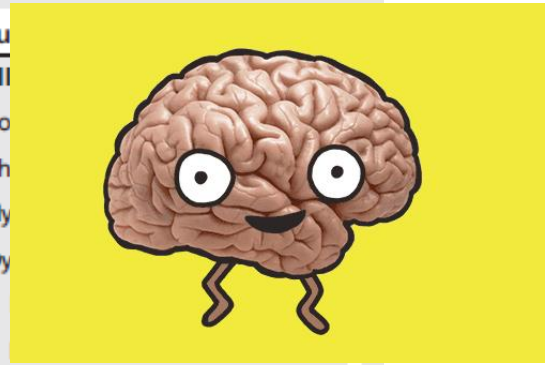
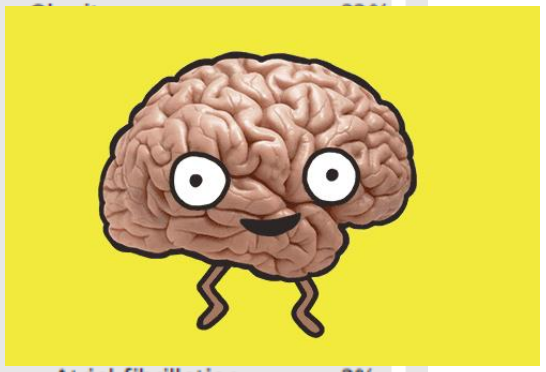
	Dy
Atrial fibrillation	2%





Continued on page 161

TABLE 8-2 Risk Factors and Comorbidities for Stroke in Children and Young Adults[a] *Continued from page 160*

Pediatric[b]	Young Adult[c]
	Potentially Modifiable Risk Factors
	High-risk alcohol consumption 33%
	Migraine, lifetime history 27%
	Sleep ≤6 hours per night 18%
	Obstructive sleep apnea 3%

Pediatric Stroke Diagnosis

- It is missed **frequently** in the emergency and acute care setting
  - Average time to diagnosis after presentation nationwide is anywhere from 3-18 hours
  - (Our numbers are similar)

- Presentation is very varied and can be non-specific
  - Hemorrhagic strokes often present with altered mental status or vomiting
  - Ischemic strokes more often present with **focal neurologic deficits**
    - **Hemiparesis: 50-75%**
    - **Hemisensory loss: 25-50%**
    - **Altered mental status: 10-50%**
    - **Seizure: 25%**
      - **Though most of the time when a child has a seizure it is NOT due to a stroke**

Thrombolysis in Pediatrics Study (TiPS)

22 Prospective sites, **14 active overall. Designed to assess safety of tPA administration in pediatric Acute Ischemic Stroke (Children's Memorial Hermann was one of those sites)**

Had to have:

Acute stroke protocols

Neurosurgery available for surgical emergencies

Intensive Care Units

Ability to rapidly perform either CT or MR imaging on patients screened for acute ischemic stroke

Exactly **0** patients (of the 93 screened) got tPA over an 18 month period, at which point NINDS discontinued funding for the study

One patient did present within the window and didn't have a contraindication…but had 'complications' secondary to his intubation for imaging and did NOT get tPA

Thrombolysis in Pediatrics Study (TiPS)

Thrombolysis in Pediatrics Study

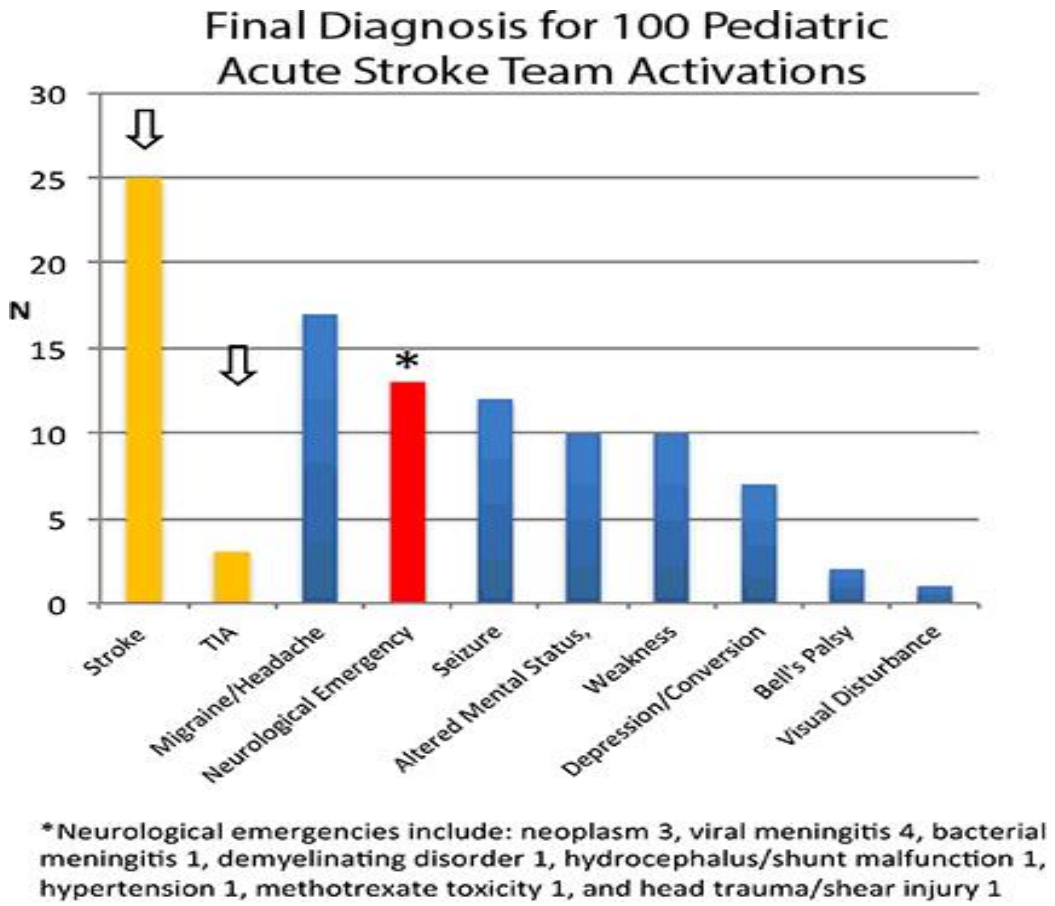
If diagnosed via MRI, **25%** of patients screened for pediatric stroke had an acute ischemic stroke

13% had other neurologic emergencies

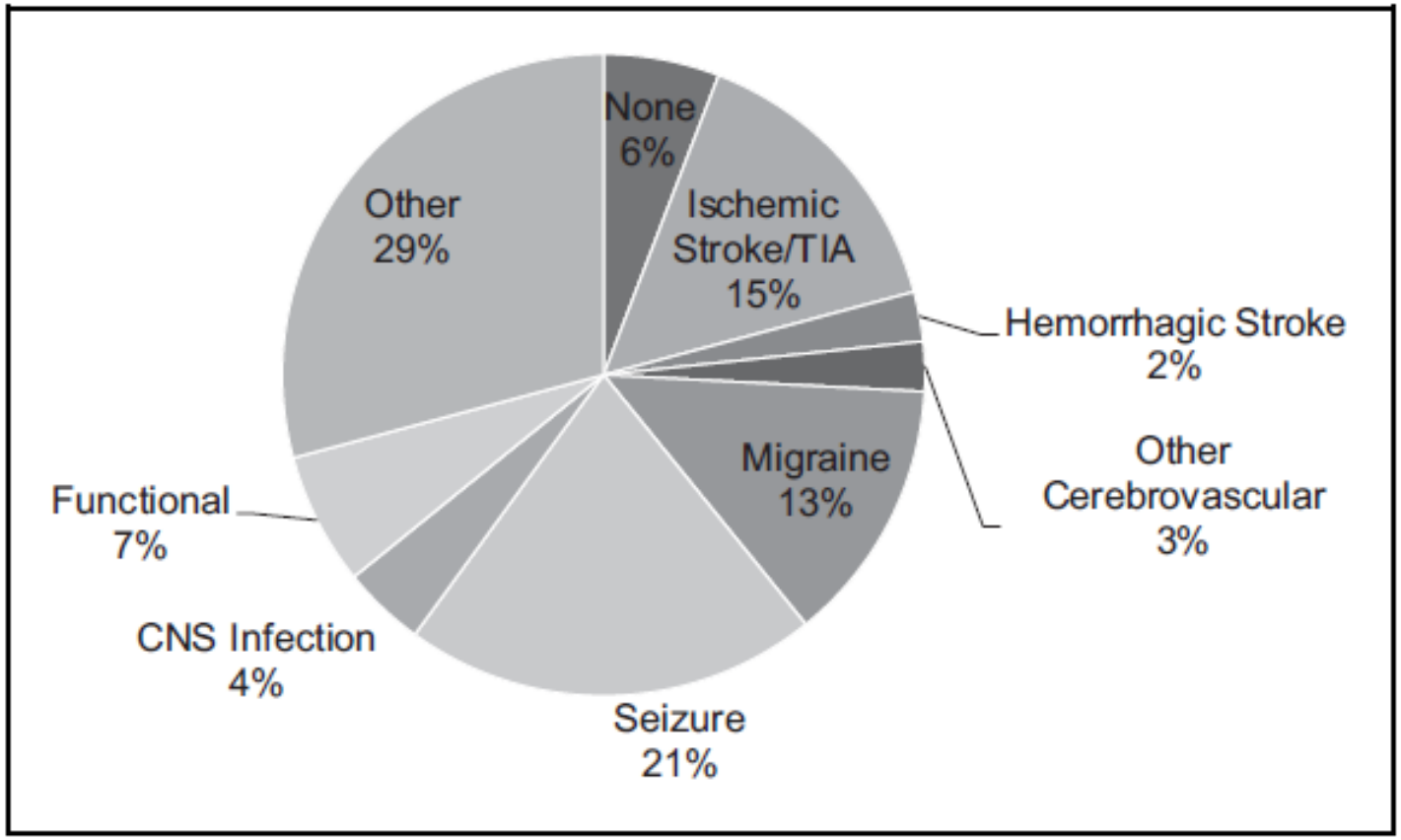
The rest were ‘benign’ stroke mimics

MOST patients that presented within the therapeutic window had a CONTRAINDICATION to tPA, including being on anticoagulation, Moyamoya syndrome, or malignancy

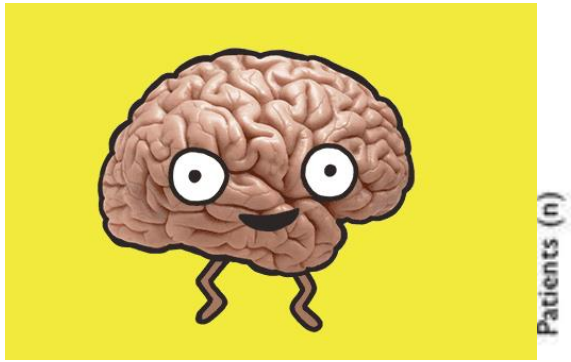
European Stroke Group

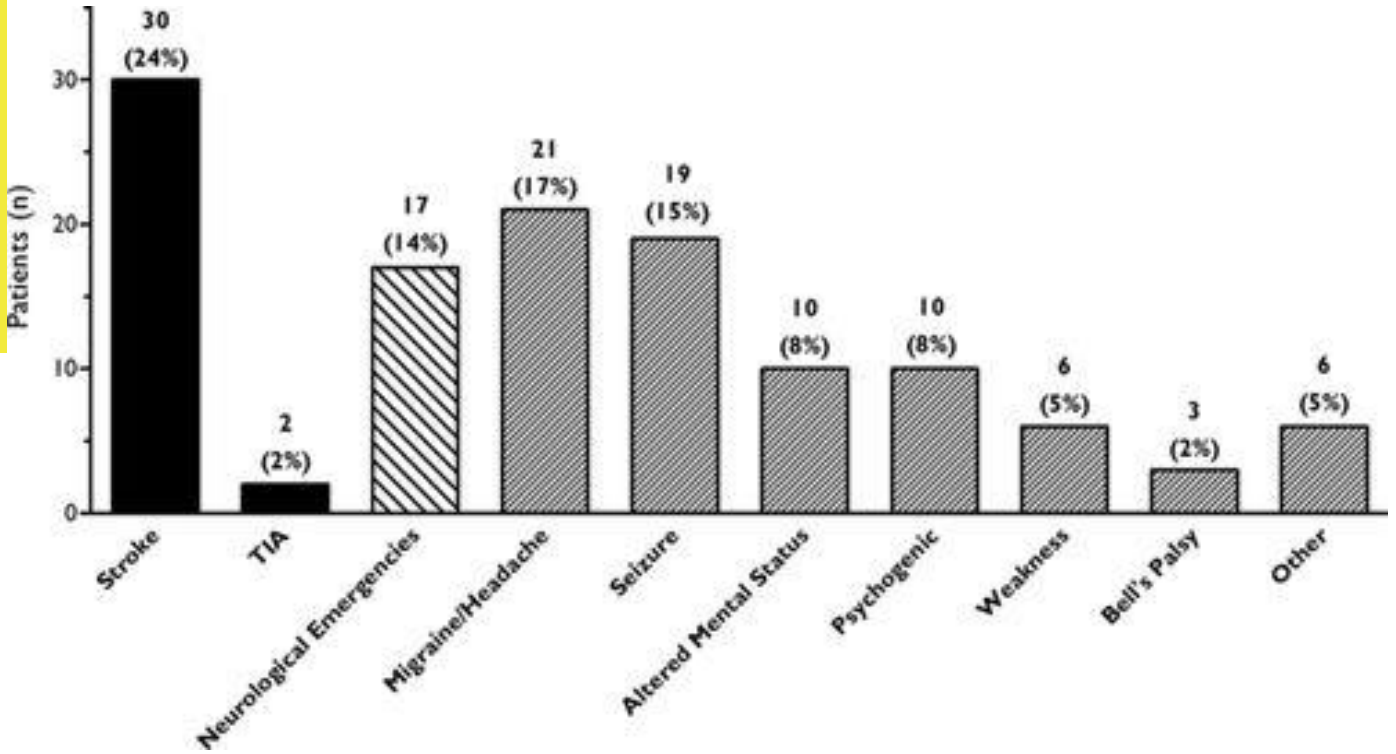


Johns Hopkins



Monroe Children's Hospital (Vanderbilt)





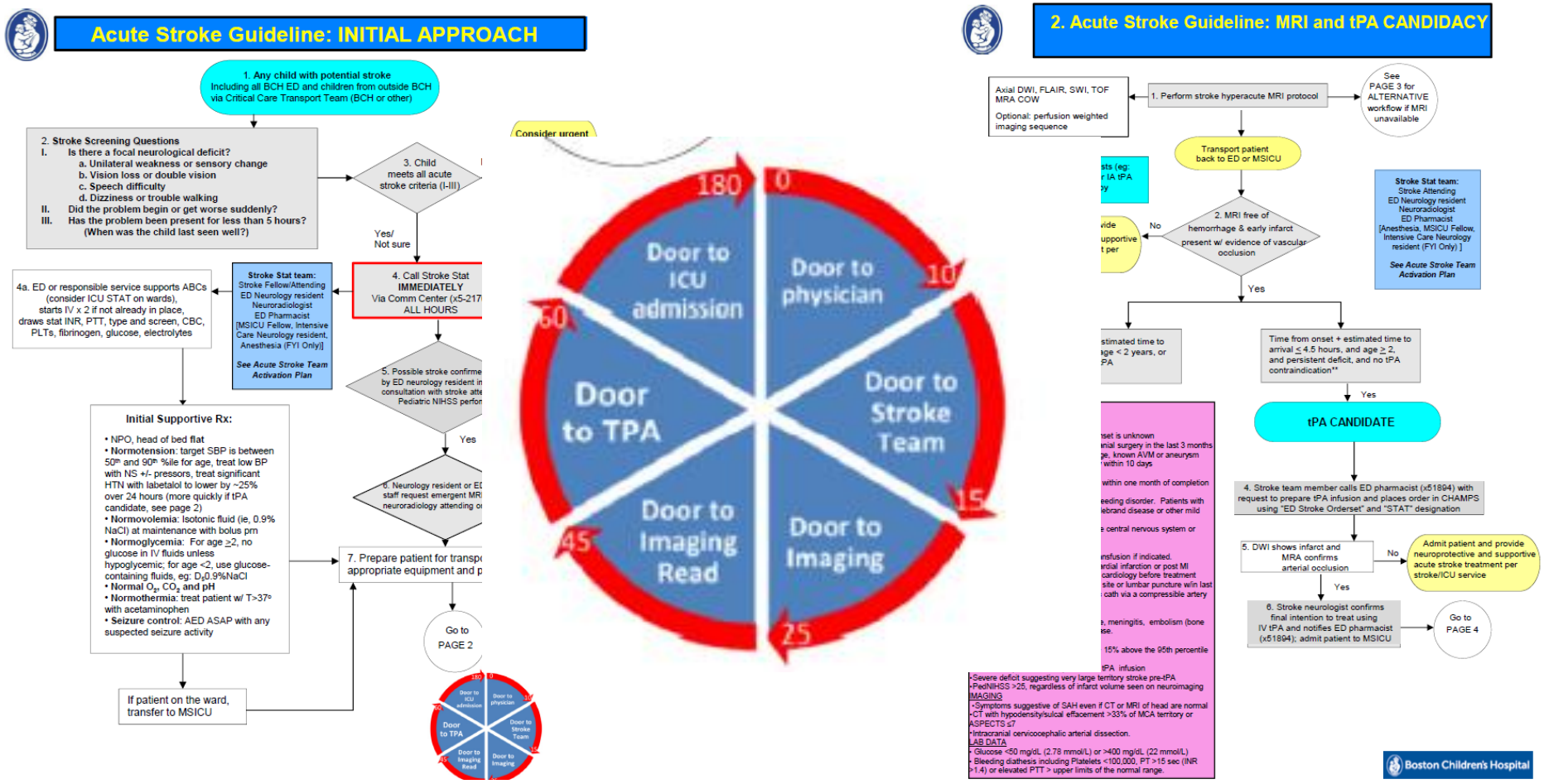
Step 3: Pediatric Stroke Evaluation

- Many pediatric tertiary care centers have published clinical pathways for suspected stroke

- These provide the advantage of rapid diagnosis of potential neurologic emergencies including stroke

- **ALL** of these pathways use MR imaging as their first line imaging modality for children with acute focal neurologic deficits.
  - **CT imaging is not sensitive or specific for childhood ischemic stroke or emergent stroke mimics**

Boston Children's



Timeline

A 16 year old presents with a expressive aphasia and right sided weakness. Symptom onset **30** minutes prior to ED arrival

Patient gets MRI/MR Perfusion, MRA confirming stroke

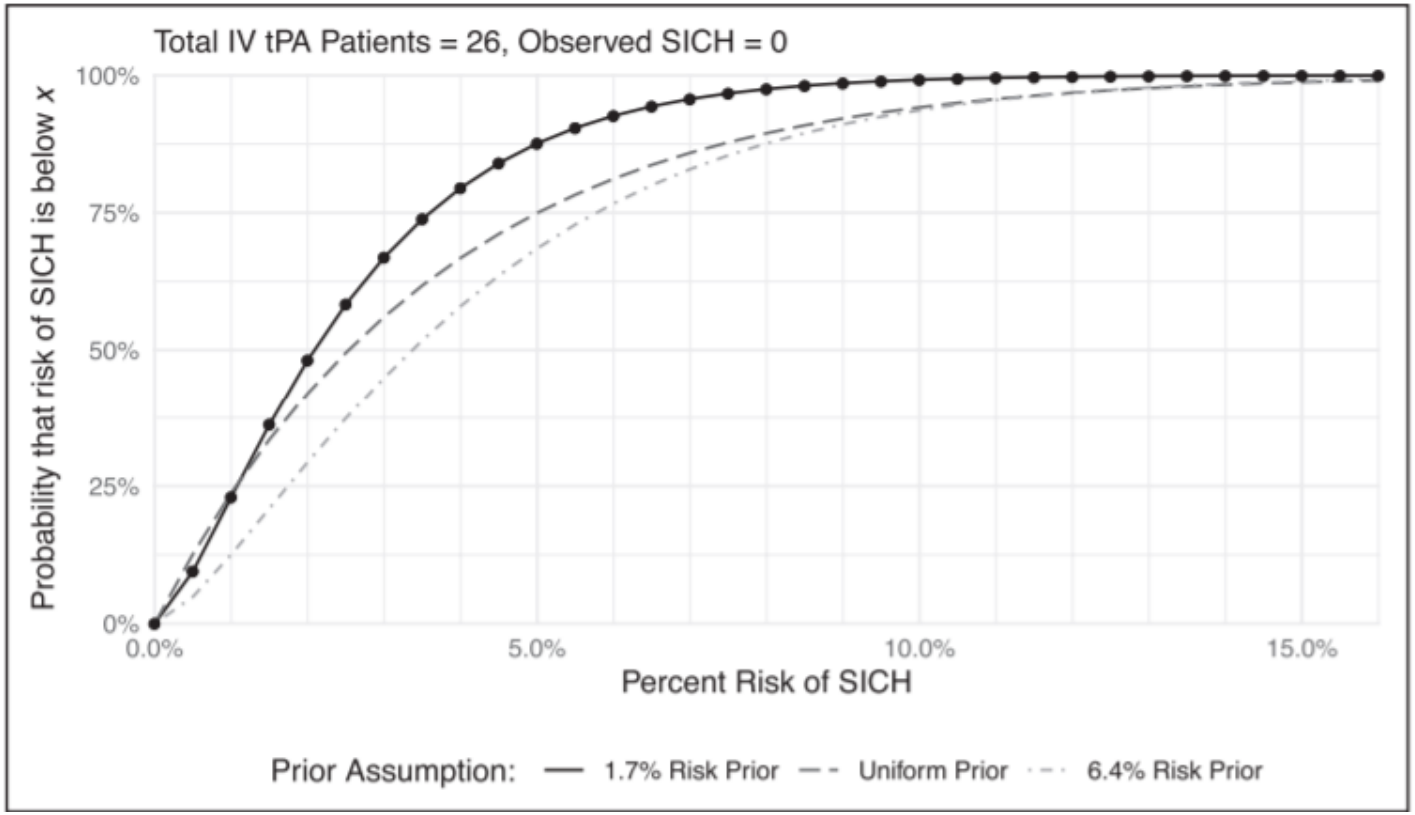
tPA is administered **3.5 hours** after symptom onset (**3 hours after code stroke is called**)

Take home: Things never go as smoothly as you plan them

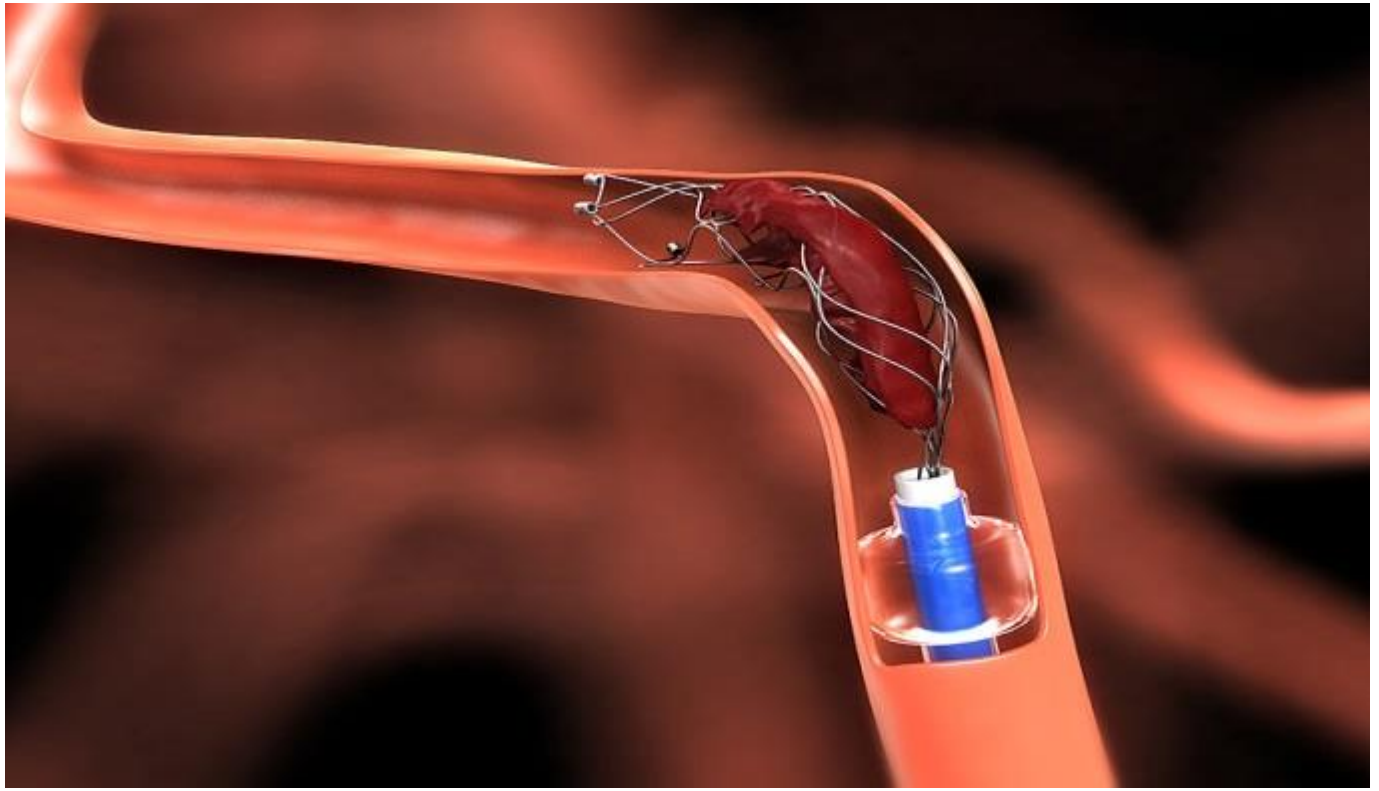
Risk of sICH from 10 years of follow up data

45 patients received tPA

2 petechial hemorrhages on follow up imaging



Thrombectomy in Children



Thrombectomy in Children

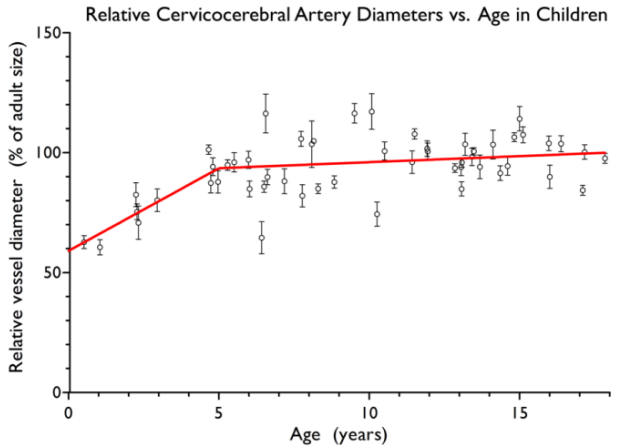
Neuroimaging

ORIGINAL RESEARCH

Rule of 5: angiographic diameters of cervicocerebral arteries in children and compatibility with adult neurointerventional devices

Lucy He,[1,2] Travis R Ladner,[1,3] Sumit Pruthi,[4] Matthew A Day,[4] Aditi A Desai,[4] Lori C Jordan,[5] Michael T Froehler[2]

Our interventionalists routinely access small arteries in infants, the difficulty is usually femoral access

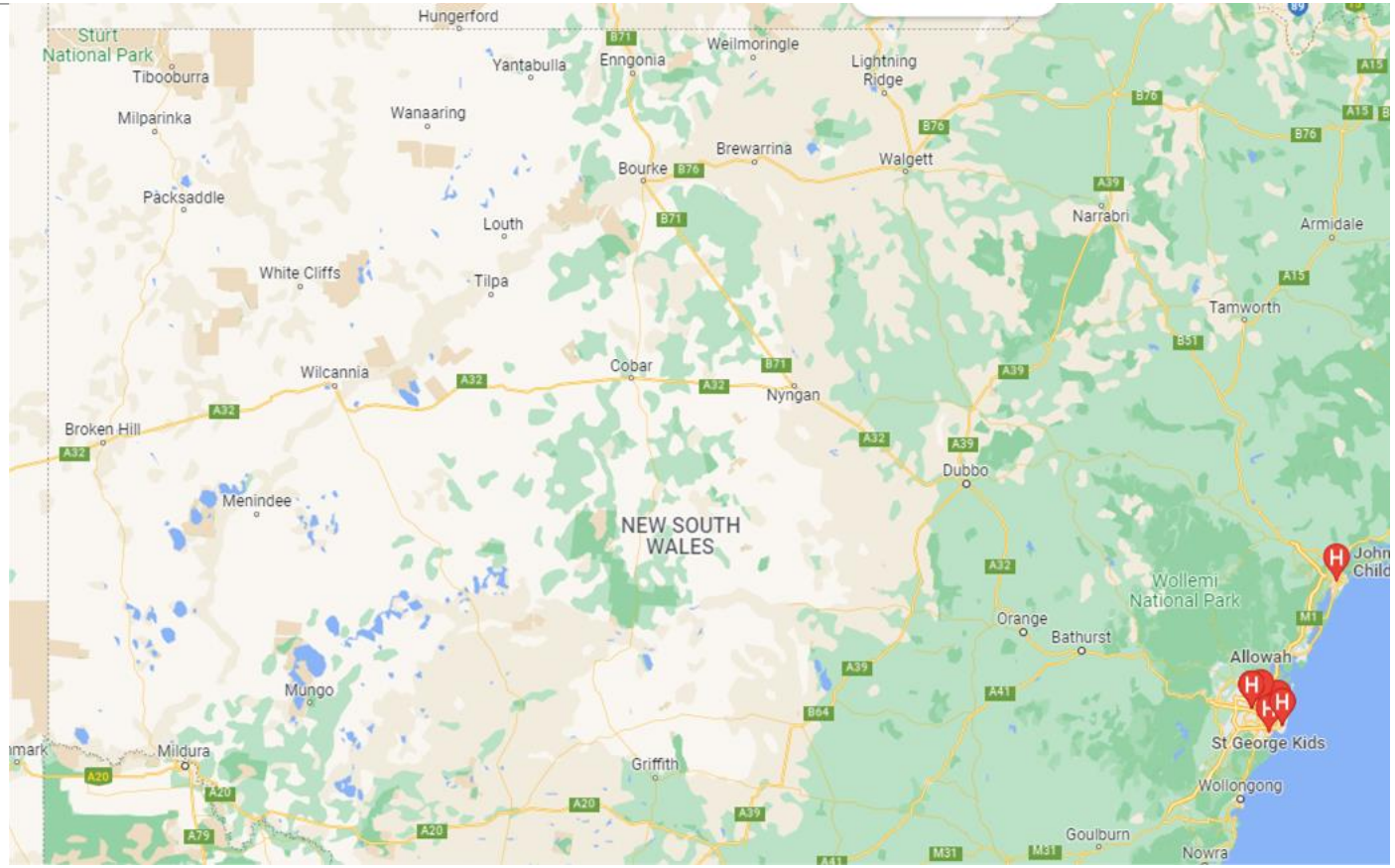


However, intracerebral arteries grow rapidly between birth and 5 years of age, and the smaller the artery the more dangerous the intervention

Large Vessel Occlusion in Children: Registry from Australia

The authors obtained IRB approval from their institutions.

Design: Multicenter retrospective cohort study, aged 30 days to 16 years with acute AIS in this specific region of Australia from January 1st 2010 to December 31st 2019.



Large Vessel Occlusion (LVO) and Children

Table 3. Clinical Outcomes at 3 Months After Stroke (Primary Outcome)

Outcomes	No. (%)						
			LVO				
	AIS	Non-LVO	All	No thrombectomy	Thrombectomy	OR (95% CI)	*P* value
Dichotomous analysis[c]							
ped-mRS score	NA	NA	NA	NA	NA		
0-2	87 (53.0)	74 (58.7)	13 (34.2)	7 (26.9)	6 (50.0)	χ^2_3, 8.803	.01
3-6	77 (47.0)	52 (41.2)	25 (65.8)	19 (73.1)	6 (50.0)		
0-2 (anterior circulation)	NA	NA	11 (33.3)	6 (25.0)	5 (55.6)	NA	NA
3-6 (anterior circulation)	NA	NA	22 (66.7)	18 (75.0)	4 (44.4)		

Take Home: Children who had the clot removed did better than children who did not

Case #5 – Great Outcome

A 6 year boy with congenital heart disease and fontan physiology has an episode of vomiting and seizure at 9:30AM. He presents to the ED at 10:00AM.

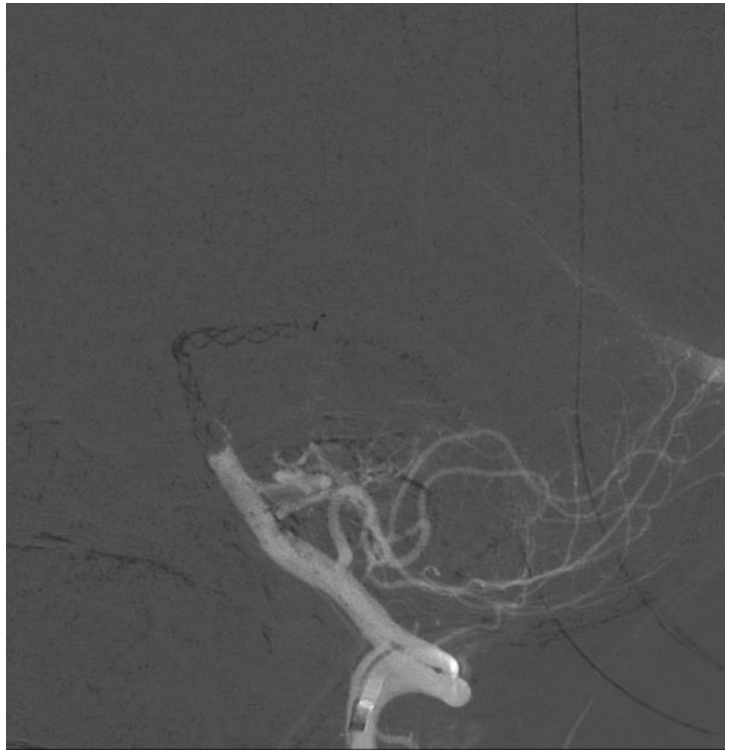
At first he is thought to have had a seizure, but he becomes more lethargic. A code stroke is called at 11:58AM.

The pediatric neurology fellow evaluates the patient and gives an NIHSS of 12. Two IVs are placed as the team arranges STAT CT/CTA while waiting for MRI. There is difficulty gaining IV access, but he is on the CT Scanner at 12:35PM.

Basilar artery occlusion is confirmed by the attending radiologist at **12:42 PM.**

The pediatric neurology fellow confirms the intention to give tPA with the pediatric neurology attending, and the patient receives IV tPA at 12:54PM as he is being emergently intubated for rapidly deteriorating mental status.

The patient is then emergently taken for thrombectomy.



Outcome

The following morning he is playing with his baby Yoda.

3 days later he is ambulating without difficulty.

A week later he is discharged with no focal neurologic deficits.

Case # 5

A 15 year old boy (Kevin) with ADHD presents with 48 hours of headache, followed by 1 hour of lethargy and confusion

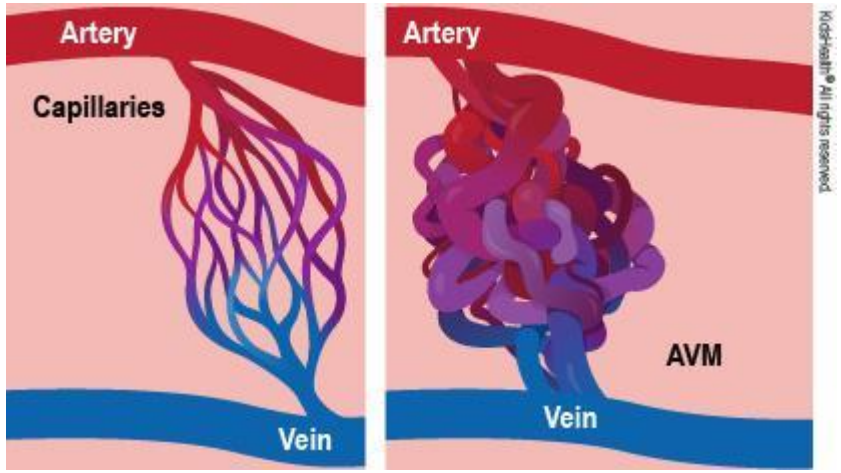
He requires an EVD which is eventually removed, and angiography confirms an arteriovenous malformation in his thalamus and occipital lobe.

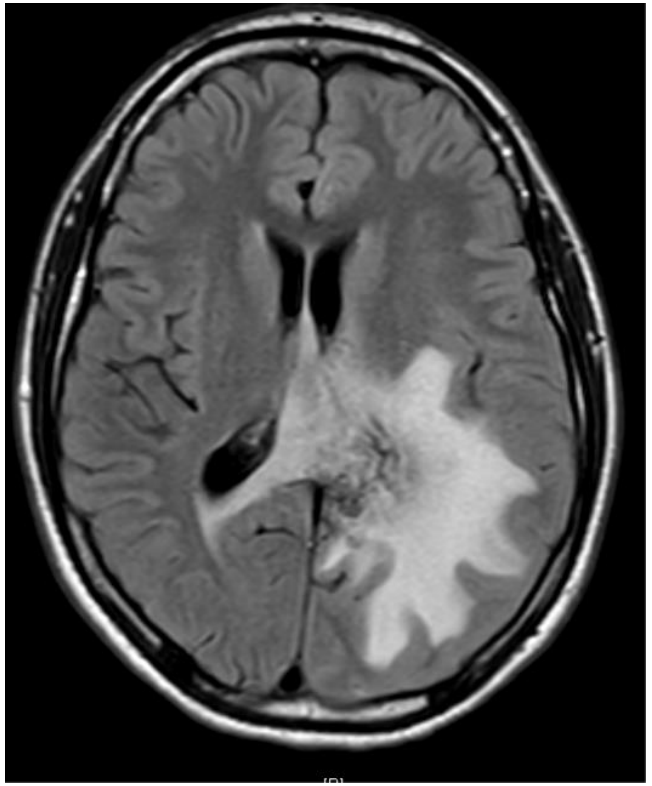
Most (>80%) childhood spontaneous intracerebral hemorrhages are due to vessel malformations, most commonly arteriovenous malformations.

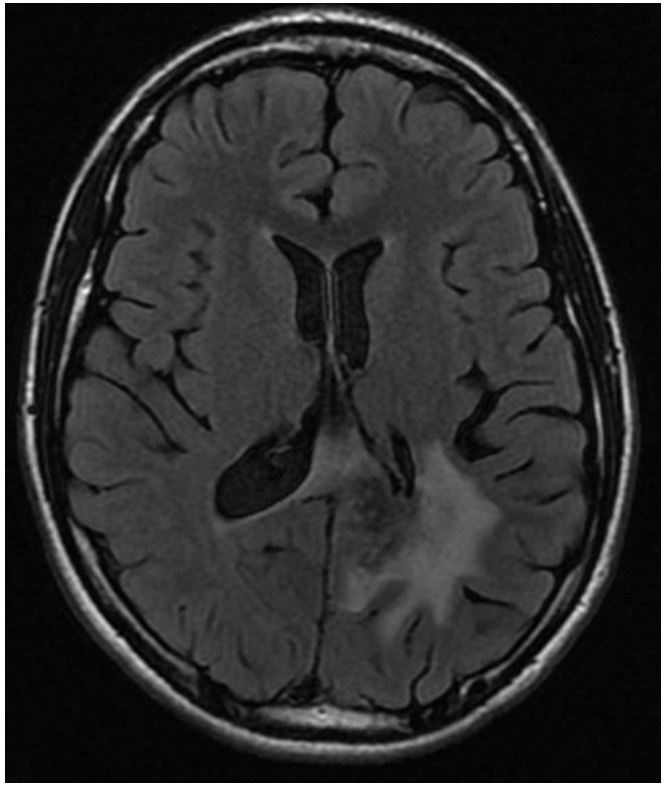
So…now what?

Varies patient to patient
Options Include

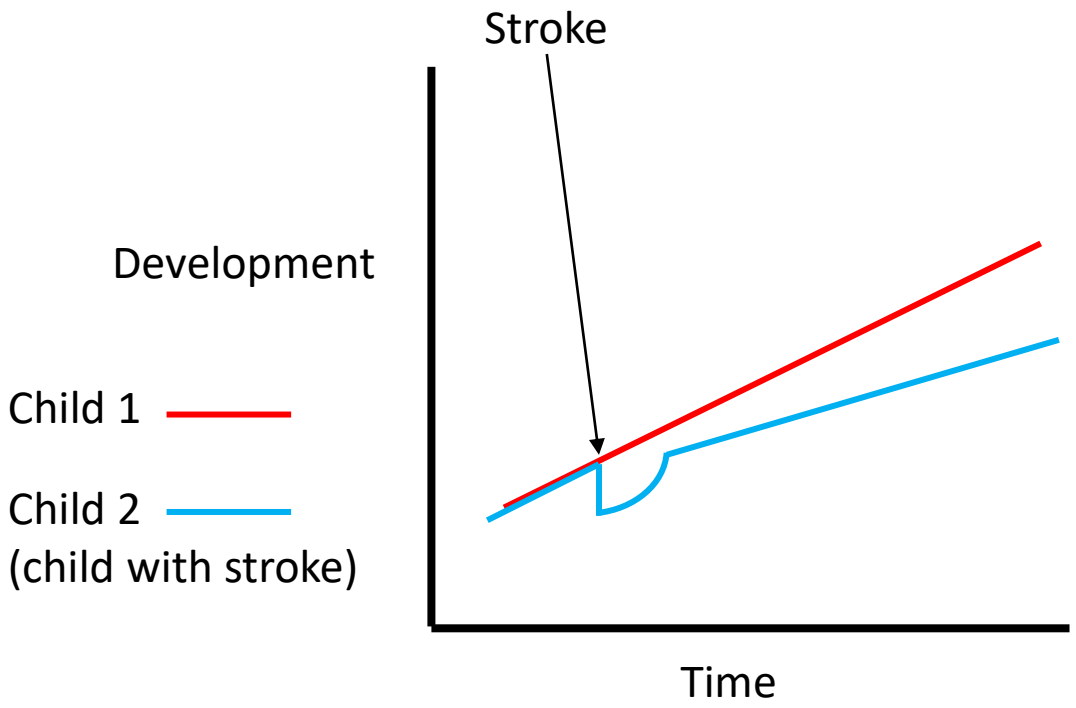
- Surgery
- Endovascular Embolization
- Gamma Knife Radiosurgery
- Or some combination of the above







Life After Pediatric Stroke



How can we help?

Models of rehabilitation:

1) Intensive

(several hours per day) – useful for breaking bad habits and initial recovery but not sustainable long term

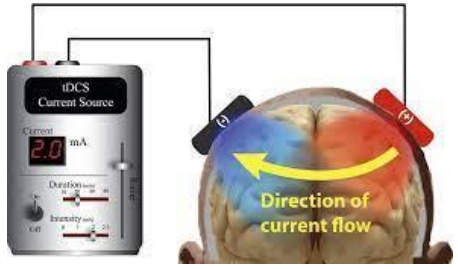
2) Outpatient maintenance

A few hours per week. Typical of neonatal stroke and developmental delay in the USA

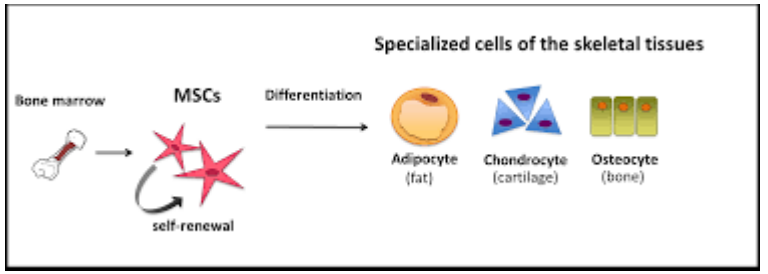
New Horizons

Multiple modalities in the future to investigate neuro-recovery and protection:

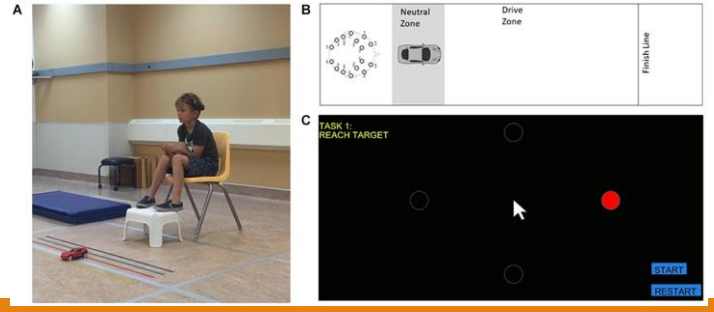
Transcranial stimulation (magnetic/direct current)



Intranasal Mesenchymal Stem Cells



Brain-Machine Interface



tDCS

Figure 1 – Child in our lab wearing tDCS Device

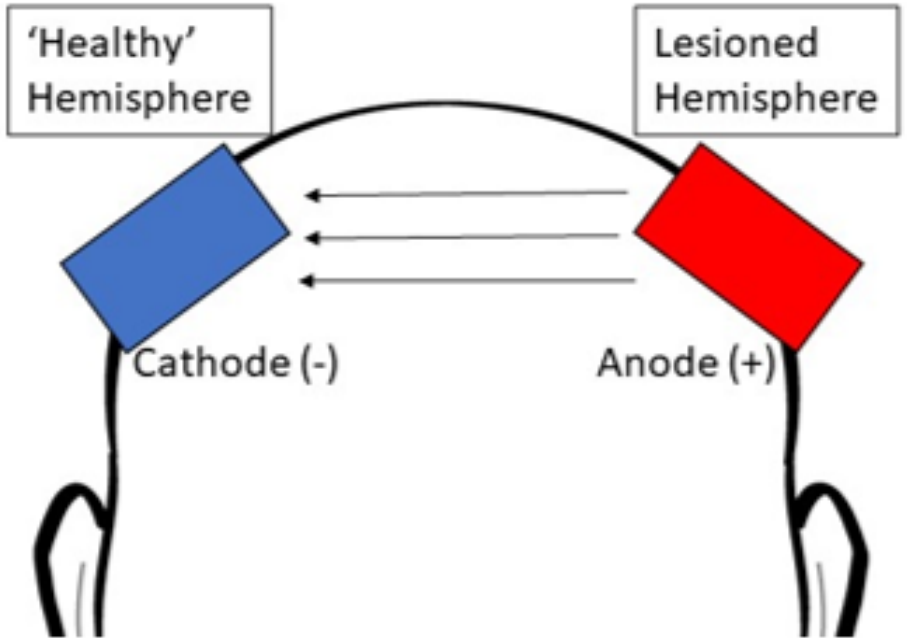
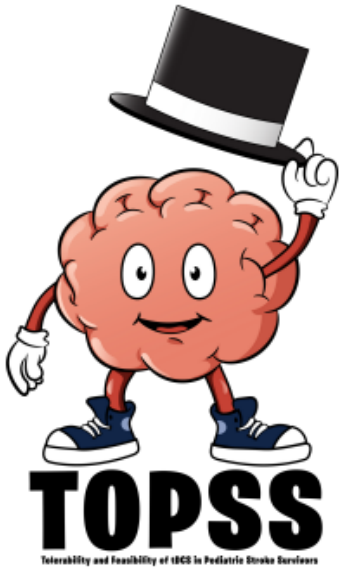


Figure 2 – Simple Schematic of Bihemispheric tDCS

Medical School

WE'RE RECRUITING!
ARE YOU ELIGIBLE?

Children between the ages of 5-19 years old who have arm weakness from a stroke are potentially eligible to participate.



WHAT'S BEING STUDIED?

Transcranial Direct Current Stimulation, a non-invasive form of brain stimulation, is being tested in conjunction with conventional occupational therapy for arm weakness after a stroke. Patients will receive 2 hours of therapy per day for 5 consecutive days if they choose to participate in the study.

WHAT'S THE PURPOSE YOU MAY ASK?

This research study is examining the tolerability and feasibility of Transcranial Direct Current Stimulation (tDCS) in children with arm weakness after stroke.

HOW CAN I LEARN MORE?

Contact Melika Abrahams, RN.

713.500.7164

PEDISTROKE@UTH.TMC.EDU

Questions?

I have some!

Question 1

At what age do cerebral arteries become approximately adult sized?

A. 5-6 years
B. 7-8 years
C. 9-10 years
D. 11-12 years
E. As a teenager
F. When you graduate college, but only if you get a degree in engineering and were born in January.

Question 2

What is the most common presenting symptom or sign for which a pediatrician or ED physician will activate a pediatric ‘code stroke’?

A. Hemiplegia

B. Seizure

C. Altered Mental Status

D. ‘My tummy hurts’

E. Ataxia

Also this one

Question 3

What do you need to confirm first to give tPA to a pediatric patient with stroke like symptoms?

A. Exam consistent with stroke, symptoms are debilitating, no contraindications, and no blood on CT

B. Exam consistent with stroke, symptoms are debilitating, no contraindications, no blood on CT, and artery occluded on CTA

C. Exam consistent with stroke, symptoms are debilitating, no contraindications, MRI demonstrates acute stroke, patient within time window

D. It just FEELS like this kid would benefit from tPA

Question 4

What is the most common ARTERIOPATHY associated with stroke in children?

A. Dissection
B. Focal Cerebral Arteriopathy
C. Vasculitis
D. Moyamoya
E. Arteries that are like bad or whatever

Question 5

Should you administer tPA to a pediatric patient with an obvious stroke-like presentation with a normal head CT?

A. Yes

B. No

Question 6

What percent of pediatric code strokes are ultimately found to be strokes (according to published data)?

A. 10%

B. 15%

C. 25%

D. 50%

E. 75%

Question 7

What percent of pediatric code strokes are ultimately found to be **non-stroke** neurologic emergencies?

A. 10%

B. 15%

C. 25%

D. 50%

E. 75%

Question 8

What are the 3 major groupings of risk factors for pediatric ischemic stroke?

A. Arteriopathy, cardioembolic, and ‘other’
B. Hypertension, diabetes, and afib
C. Obesity, OSA, and sleep deprivation
D. Genetic, syndromic, and acquired

Question 9

What is the most commonly found risk factor in pediatric patients with acute ischemic stroke?

A. Moyamoya
B. Congenital heart disease
C. Cervical dissection
D. Sickle cell disease
E. Contraceptive pill use

Question 10

What is the best first line imaging option for hemodynamically stable patients with suspected acute stroke?

A. An IMMEDIATE stroke-limited ‘fast’ MRI brain including DWI, T2 Flair, ADC, and GRE or SWI sequences and non-contrast vessel imaging

B. A CT brain and CT angiogram

C. Digital subtraction angiography

D. X-ray vision

Question 11

What is the 9th most common cause of death in pediatrics?

A. Trauma
B. Prematurity/lung disease
C. Malignancy
D. Stroke
E. Monsters under the bed

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