Pediatric Stroke

Tabitha Cheng, MD

UCSD EMS Fellow

Stroke is one of the

TOP 10 CAUSES OF DEATH

in children

Epidemiology

- Greatest risk in 1st year of life
- 1 in 4,000 live births
- Boys and African-American children more common
- Incidence:
  - 2-3/100,000 child-years
  - Ischemic Stroke: ~1.2/100,000 child-years
  - Hemorrhagic Stroke: ~1.1/100,000 child-years
    - ICH: 0.8/100,000
    - SAH: 0.3/100,000

Pediatric Stroke: Epidemiology

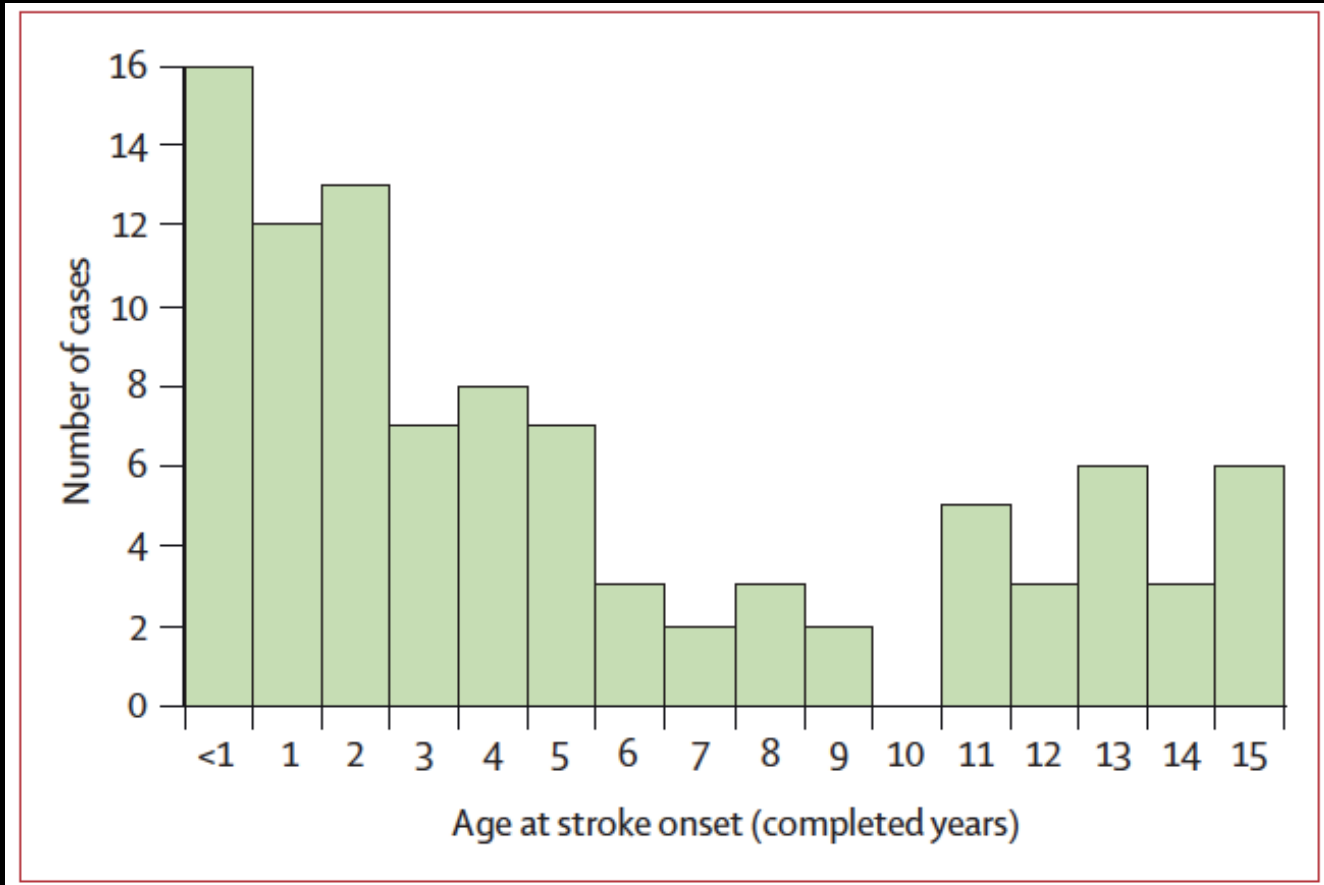


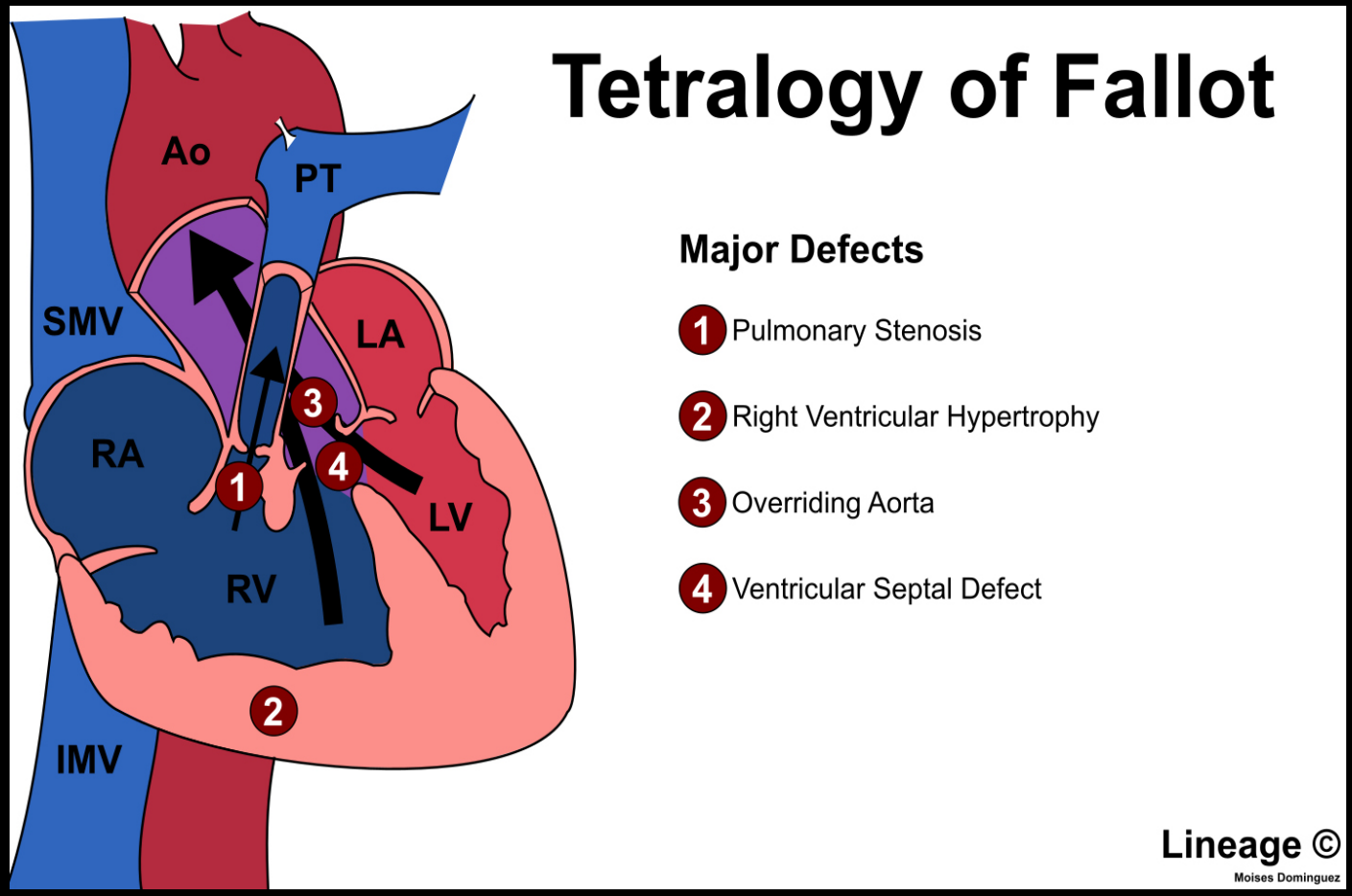
Figure 2: Age distribution of cases of arterial ischaemic stroke (n=96)

Lancet Neurol, 13 (1) (2014), pp. 35-43

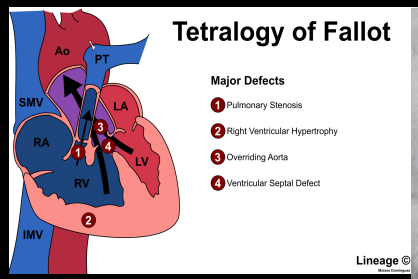
About **HALF** of the children presenting with a stroke have a

PREVIOUSLY IDENTIFIED RISK FACTOR

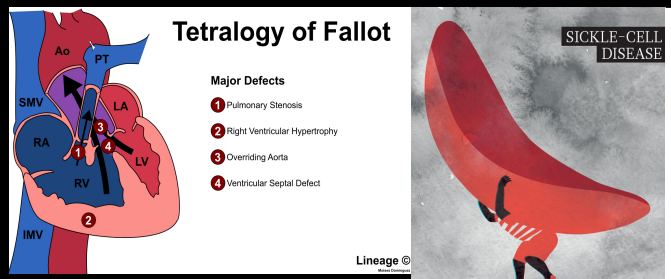
Risk Factors for Stroke in Children

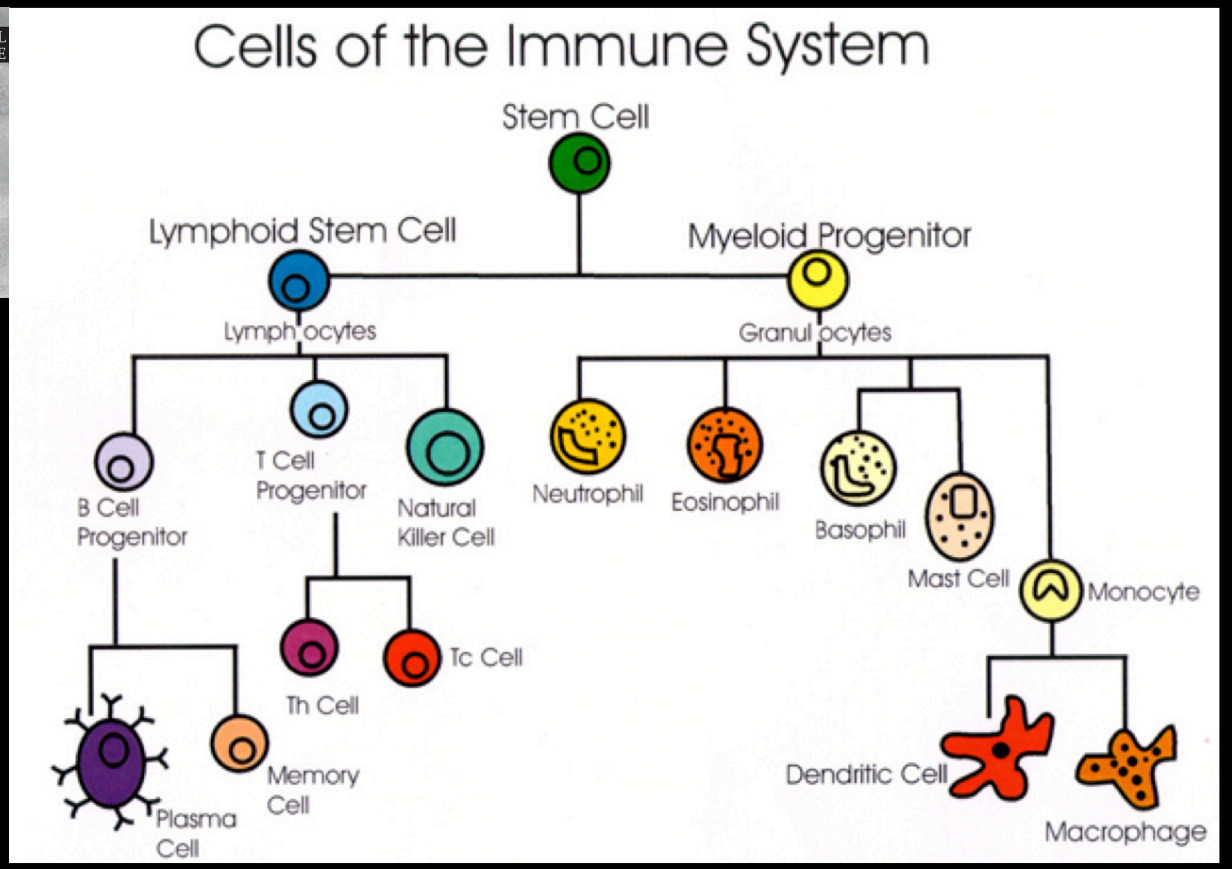


Risk Factors for Stroke in Children

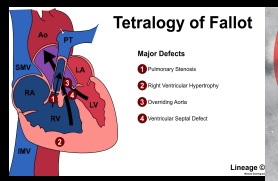


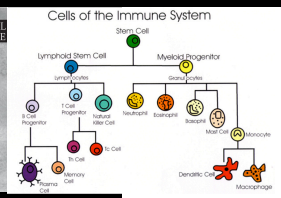
Risk Factors for Stroke in Children



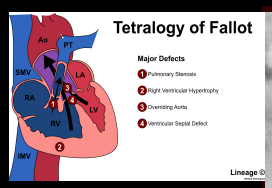


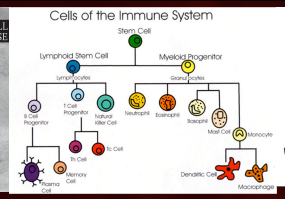
Risk Factors for Stroke in Children

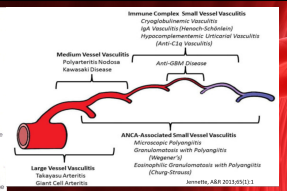




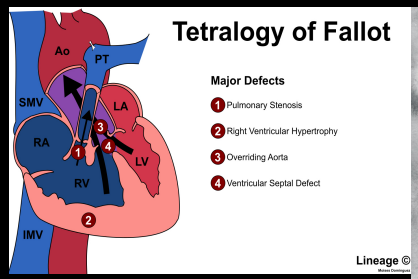
Risk Factors for Stroke in Children

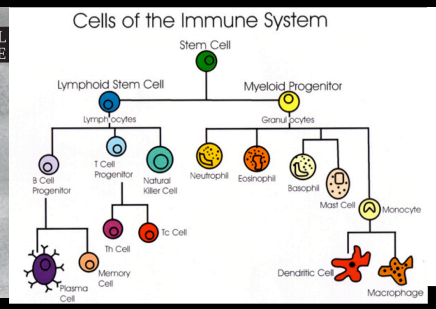


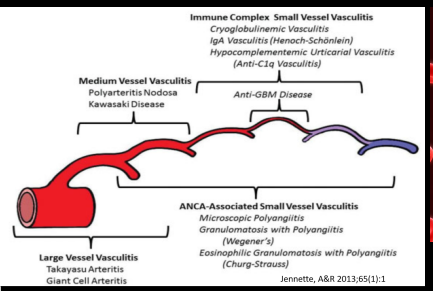


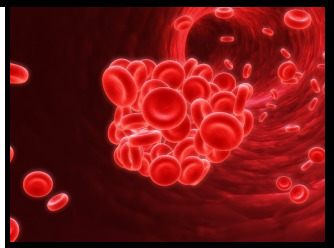


Risk Factors for Stroke in Children

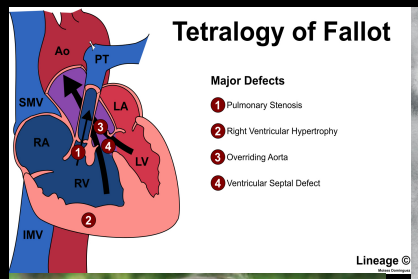


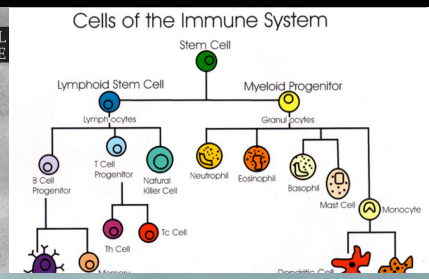


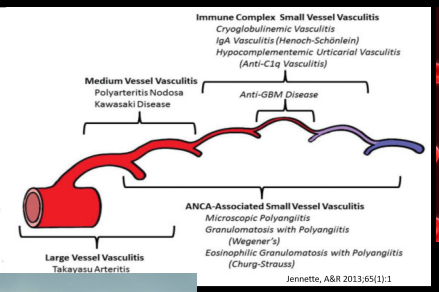


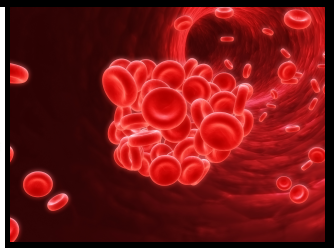


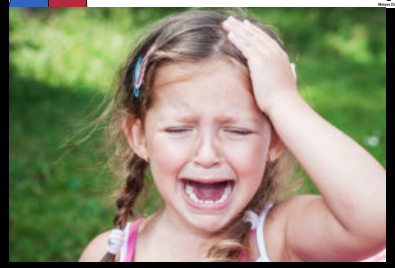
Risk Factors for Stroke in Children



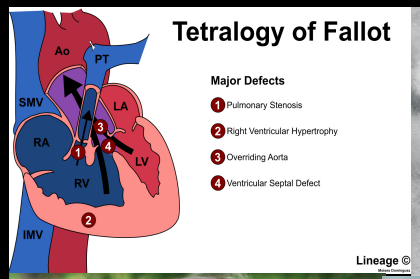


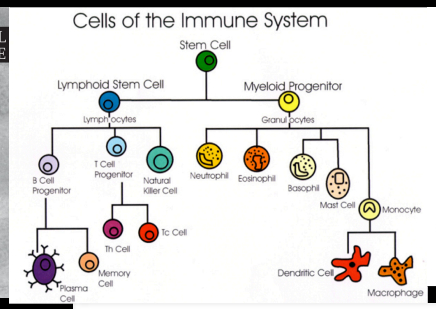


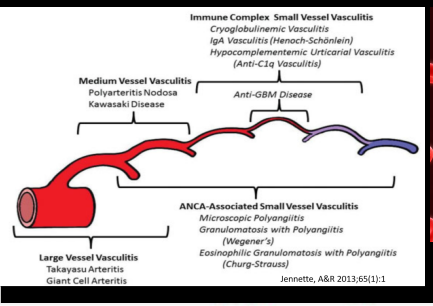


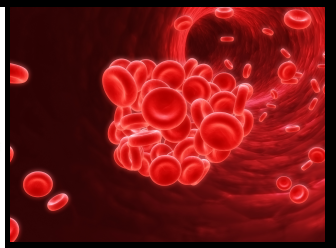


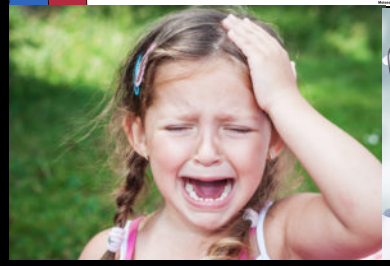
Risk Factors for Stroke in Children

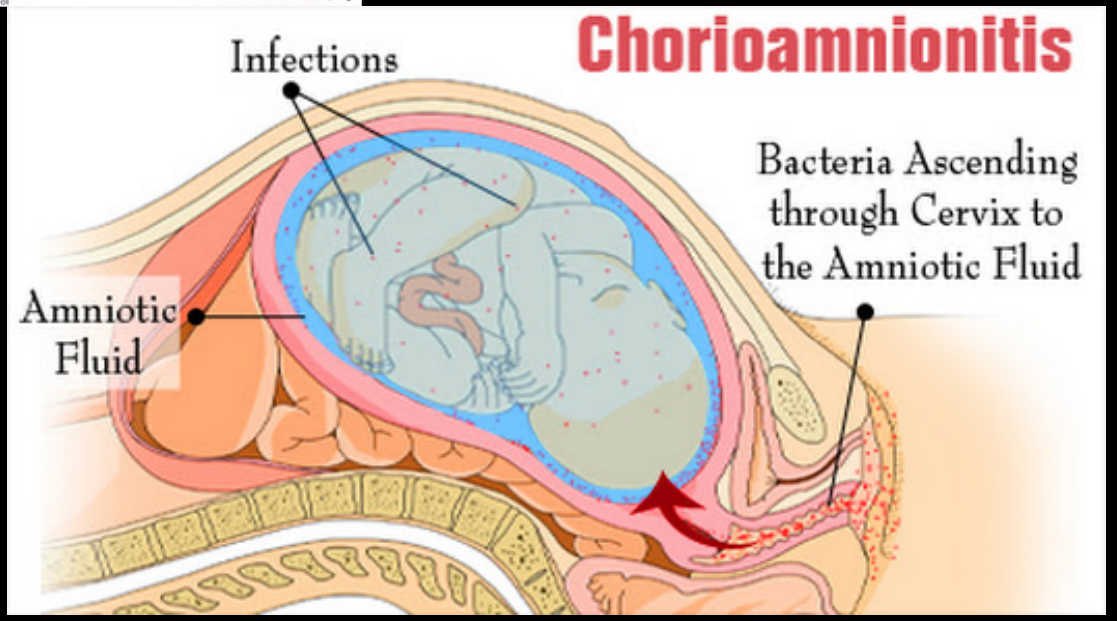




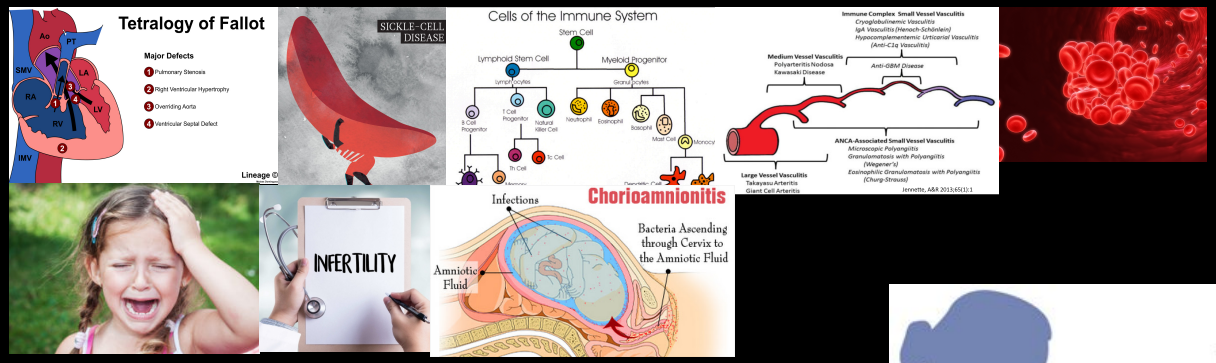


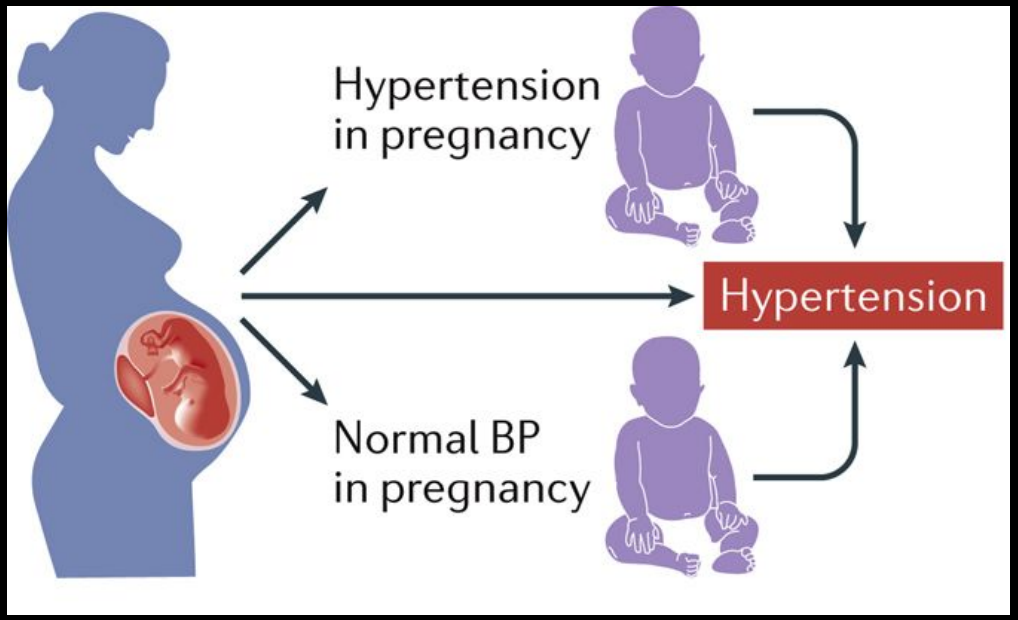




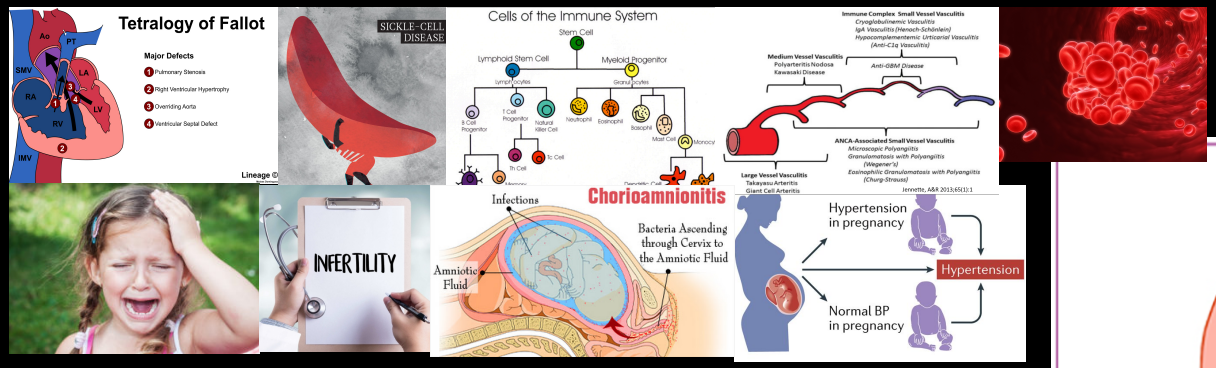


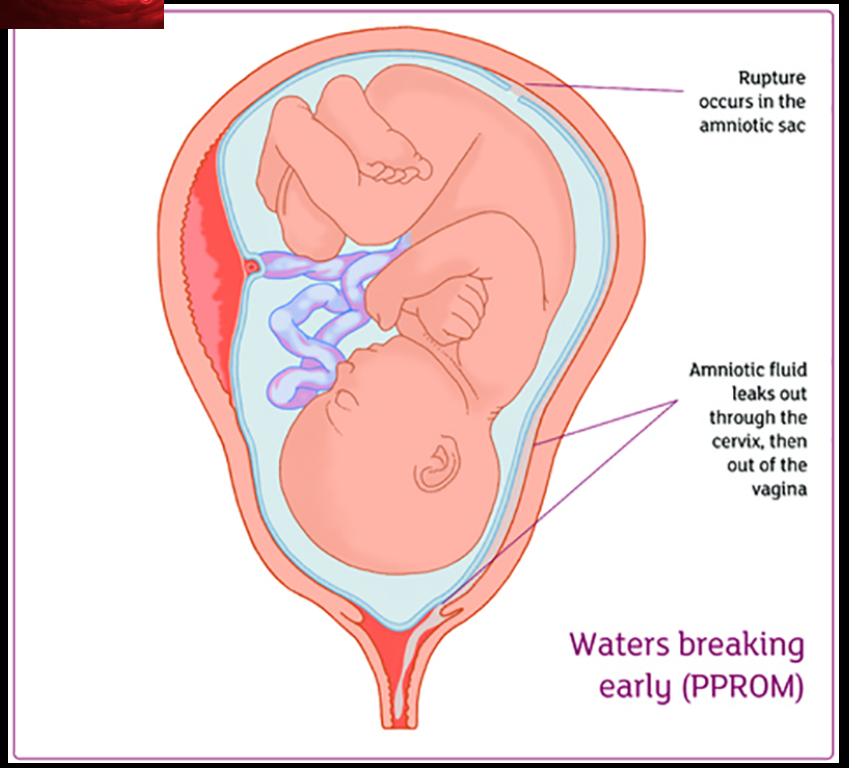
Risk Factors for Stroke in Children



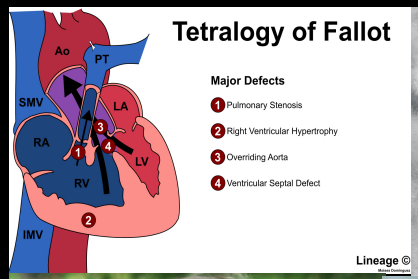


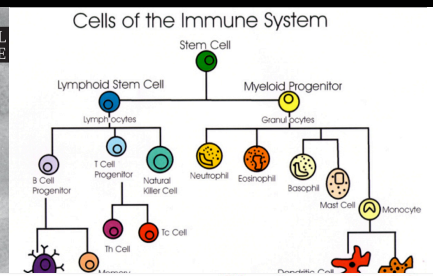
Risk Factors for Stroke in Children

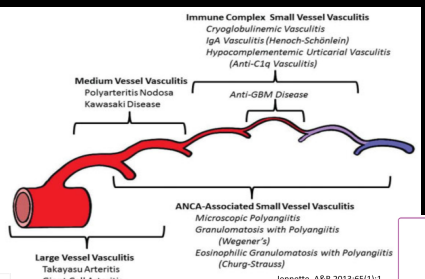


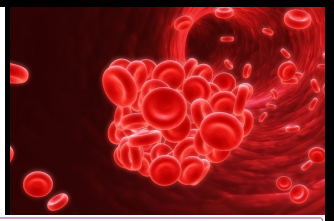


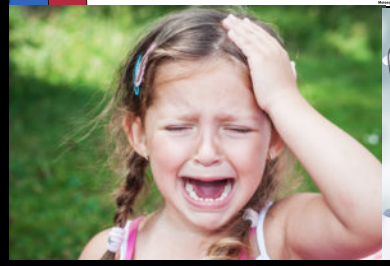
Risk Factors for Stroke in Children

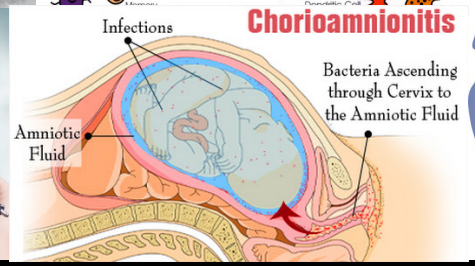


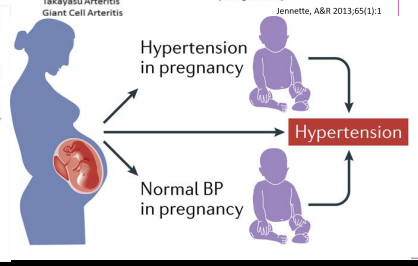


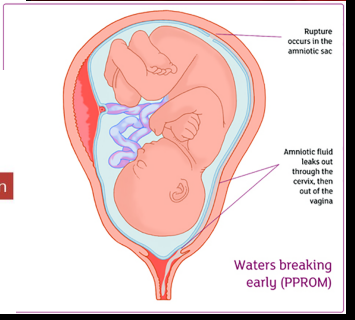












FAST+

FACE Drooping

ARM Weakness

SPEECH Difficulty

TIME to Call 911

+ Additional Warning Signs in Children

- Severe sudden headache
- Sudden numbness on one side of the body
- Sudden confusion or difficulty understanding others
- Sudden trouble seeing
- Sudden difficulty walking, dizziness, loss of balance or coordination
- New-onset of seizures usually on one side of the body

Signs/Symptoms: Pediatric Stroke

- Hemiparesis/focal motor deficit
  - 6/10 pediatric strokes vs 8/10 adult strokes

Signs/Symptoms: Pediatric Stroke

- Headaches
  - ~1/3 pediatric strokes

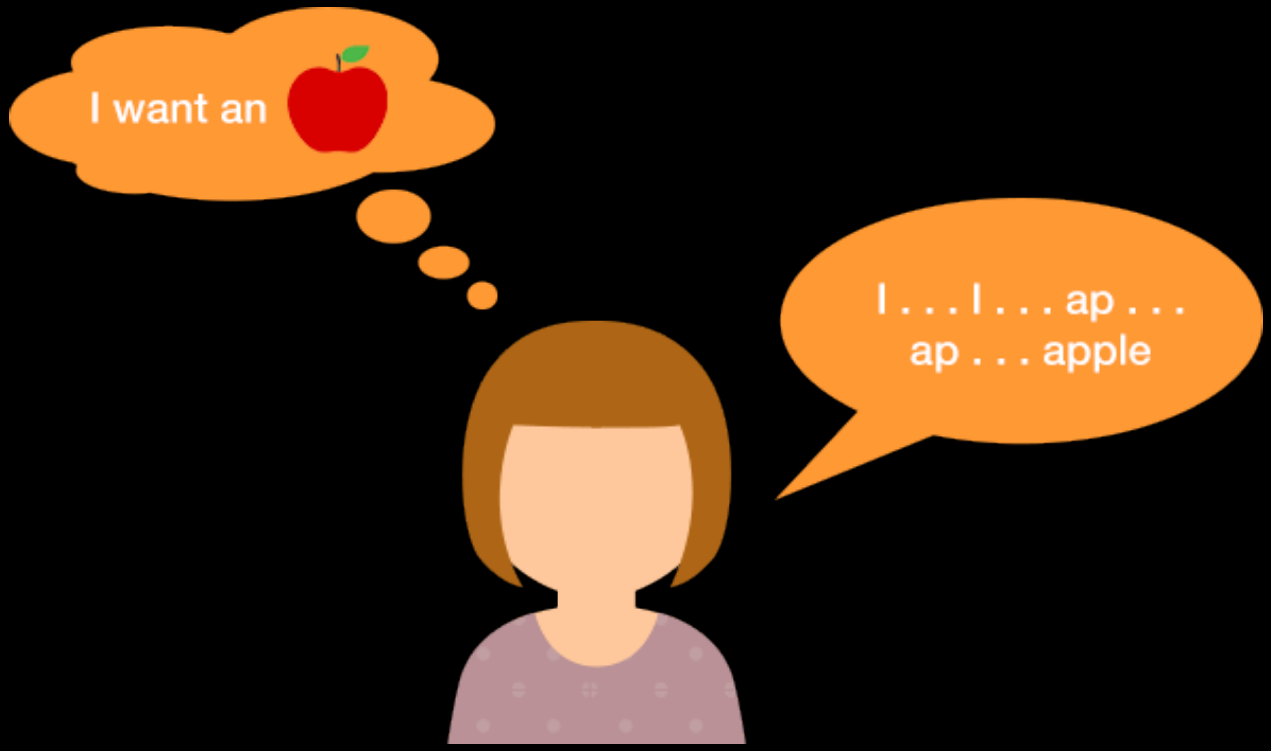
Signs/Symptoms: Pediatric Stroke

- Seizures
  - ~1/4 pediatric strokes vs ~1/20 adult strokes

Signs/Symptoms: Pediatric Stroke

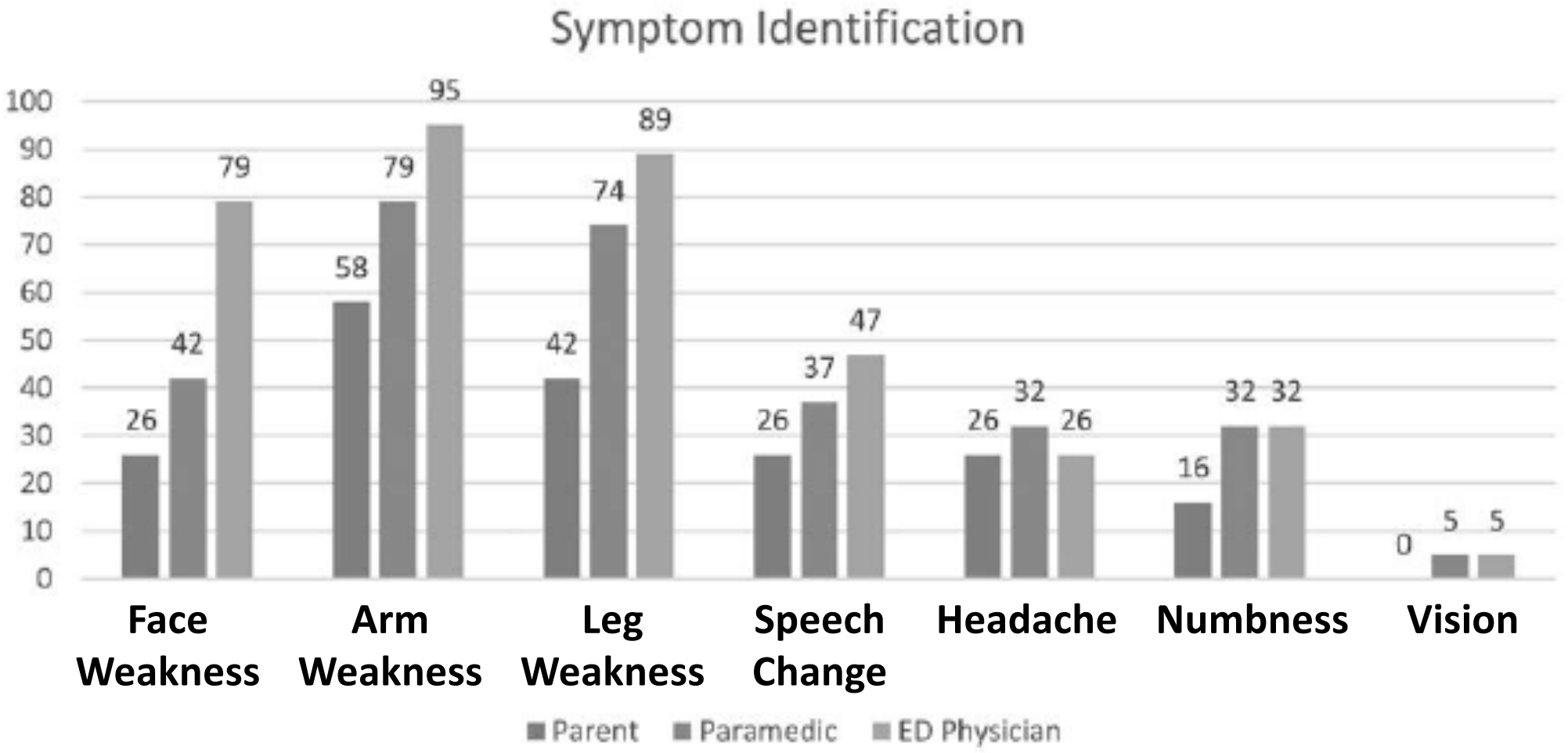
- Altered mental status
  - ~1/5 pediatric strokes

Signs/Symptoms: Pediatric Stroke



- Aphasia
  - 1-1.5/10 pediatric strokes

Presenting features reported by parents, paramedics, and ED physicians



Differential: Pediatric Stroke

- Stroke
- Complex migraine
- Focal seizure with postictal focal weakness
- Hypoglycemia
- HTN Encephalopathy
- Intracranial infection
- Tumor
- Drug toxicity
- Pseudotumor cerebri
- Inflammatory disease
- Other focal brain pathology

Prehospital Assessment, Treatment, & Destination

San Diego County **Pediatric** Treatment Guideline and Protocol

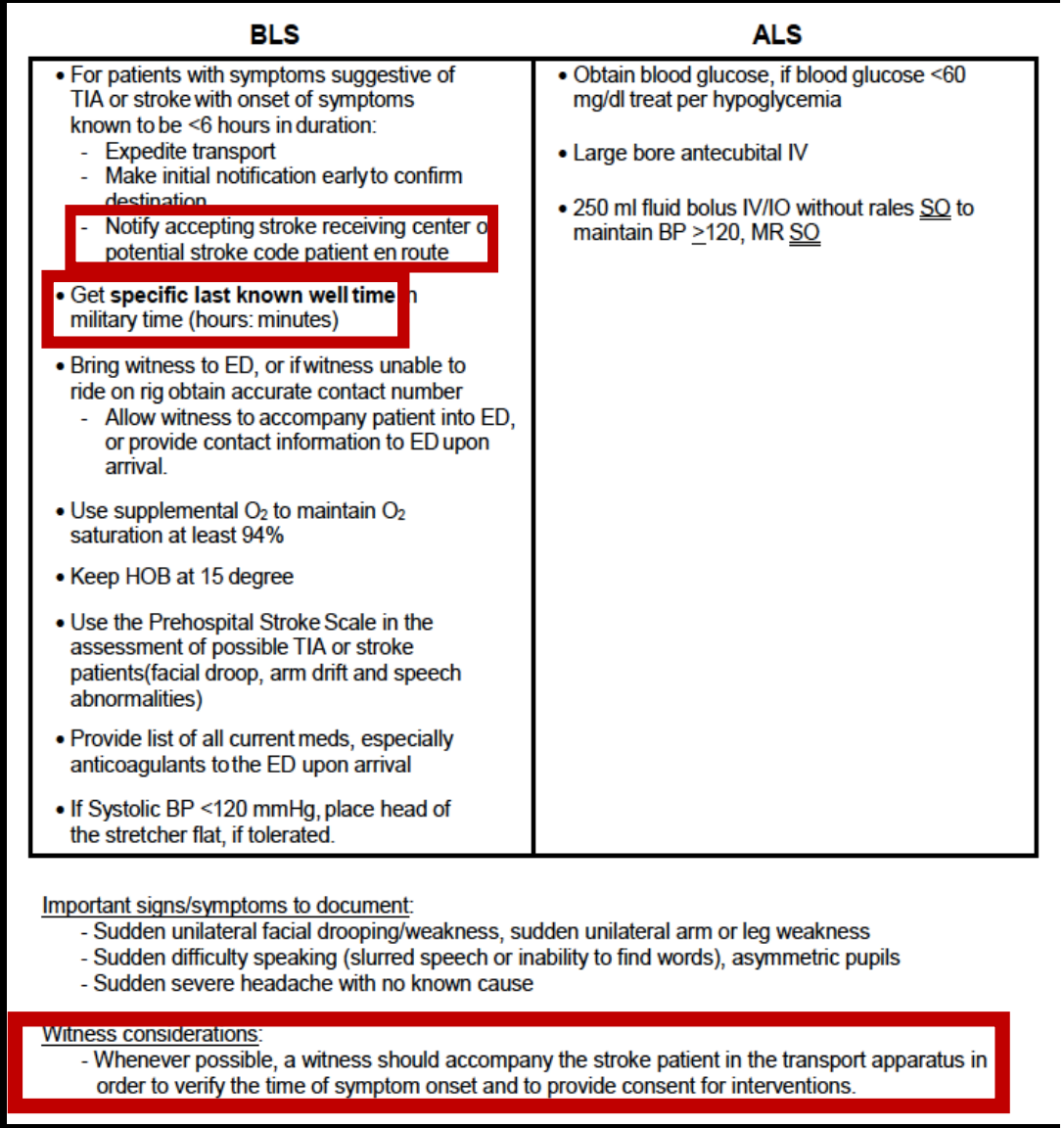
- S-161 Altered Neurologic Function (Non-Traumatic)

BLS	ALS
• Ensure patent airway, O_2 and/or ventilate prn • O_2 Saturation • Spinal stabilization when indicated • Secretion problems; position on affected side • Do not allow patient to walk • Restrain prn **Hypoglycemia (suspected) or patient's glucometer results, if available, read <60 mg/dL (Neonate <45 mg/dL):** o If patient is awake and has gag reflex, give oral glucose paste or 3 tablets (15 g). Patient may eat or drink if able. o If patient is unconscious, NPO. **Seizures:** o Protect airway, and protect from injury. o Treat associated injuries. o If febrile, remove excess clothing/covering. **Behavioral Emergencies:** o Restrain only if necessary to prevent injury. o Avoid unnecessary sirens. o Consider law enforcement support.	• IV SQ adjust prn • Monitor EKG /blood glucose prn • Capnography SQ prn **Symptomatic ?opioid OD (*excluding opioid dependent pain management patients*):** o Narcan per drug chart IN/IV/IM SQ. MR SQ **Symptomatic ?opioids OD in opioid dependent pain management patients:** o Narcan titrate per drug chart IV (dilute IV dose per drug chart) or IN/IM per drug chart SQ. MR BHO **Hypoglycemia:** Symptomatic patient unresponsive to oral glucose agents: o D_{10} per drug chart IV SQ if BS <60 mg/dL (Neonate <45 mg/dL) o If patient remains symptomatic and BS remains <60 mg/dL (Neonate <45 mg/dL) MR SQ o **If no IV**: Glucagon per drug chart IM SQ if BS <60 mg/dL (Neonate <45 mg/dL) **Seizures:** For: A. Ongoing generalized seizure lasting ≥5" (includes seizure time prior to arrival of prehospital provider) SQ B. Partial seizure with respiratory compromise SQ C. Recurrent tonic-clonic seizures without lucid interval SQ GIVE: o Versed per drug chart slow IV, (d/c if seizure stops) SQ MR x1 in 10" SQ **If no IV:** o Versed per drug chart IN/IM SQ. MR x1 in 10" SQ Note: Versed not required for simple febrile seizures.

San Diego County **Adult** Treatment Guideline and Protocol

- S-144 Stroke & Transient Ischemic Attack

- **Witness**
- **Last known well time**
- **Notify stroke center**



BLS	ALS
• For patients with symptoms suggestive of TIA or stroke with onset of symptoms known to be <6 hours in duration: - Expedite transport - Make initial notification early to confirm destination - Notify accepting stroke receiving center o potential stroke code patient en route • Get **specific last known well time** n military time (hours: minutes) • Bring witness to ED, or if witness unable to ride on rig obtain accurate contact number - Allow witness to accompany patient into ED, or provide contact information to ED upon arrival. • Use supplemental O_2 to maintain O_2 saturation at least 94% • Keep HOB at 15 degree • Use the Prehospital Stroke Scale in the assessment of possible TIA or stroke patients(facial droop, arm drift and speech abnormalities) • Provide list of all current meds, especially anticoagulants to the ED upon arrival • If Systolic BP <120 mmHg, place head of the stretcher flat, if tolerated.	• Obtain blood glucose, if blood glucose <60 mg/dl treat per hypoglycemia • Large bore antecubital IV • 250 ml fluid bolus IV/IO without rales SO to maintain BP >120, MR SO

Important signs/symptoms to document:
- Sudden unilateral facial drooping/weakness, sudden unilateral arm or leg weakness
- Sudden difficulty speaking (slurred speech or inability to find words), asymmetric pupils
- Sudden severe headache with no known cause

Witness considerations:
- Whenever possible, a witness should accompany the stroke patient in the transport apparatus in order to verify the time of symptom onset and to provide consent for interventions.

Pediatric Stroke Prehospital Treatment Protocols Across the Nation

- NASEMSO model guidelines adds pediatric stroke into their adult guideline
- States that add pediatric specific stroke into adult protocol:
  - Alabama
  - Maryland
  - Oklahoma
  - Washington DC
- Counties that have specific pediatric stroke protocols:
  - Los Angeles County, California
  - Austin County, Texas

Los Angeles County: Pediatric Stroke

DEPARTMENT OF HEALTH SERVICES
COUNTY OF LOS ANGELES

Treatment Protocol: STROKE / CVA / TIA **Ref. No. 1232-P**

Base Hospital Contact

Base Hospital Contact: Required prior to transport for all patients with suspected Stroke or TIA

1. Assess airway and initiate basic and/or advanced airway maneuvers prn (MCG 1302)
2. Administer **Oxygen** prn *(MCG 1302)*
3. Advanced airway prn *(MCG 1302)*
4. Initiate cardiac monitoring *(MCG 1308)*
   Perform 12-lead ECG if dysrhythmia suspected prn
5. Establish vascular access prn *(MCG 1375)*
6. Check blood glucose
   If < 60mg/dL or > 250mg/dL, treat in conjunction with *TP 1203-P, Diabetic Emergencies*
7. Assess for signs of trauma ❶
   If traumatic injury suspected, treat in conjunction with *TP 1244-P, Traumatic Injury*
8. Document focal neurologic deficits, and date and time of Last Known Well Time (LKWT) ❷
9. **CONTACT BASE** and transport to PMC

Check Blood Glucose

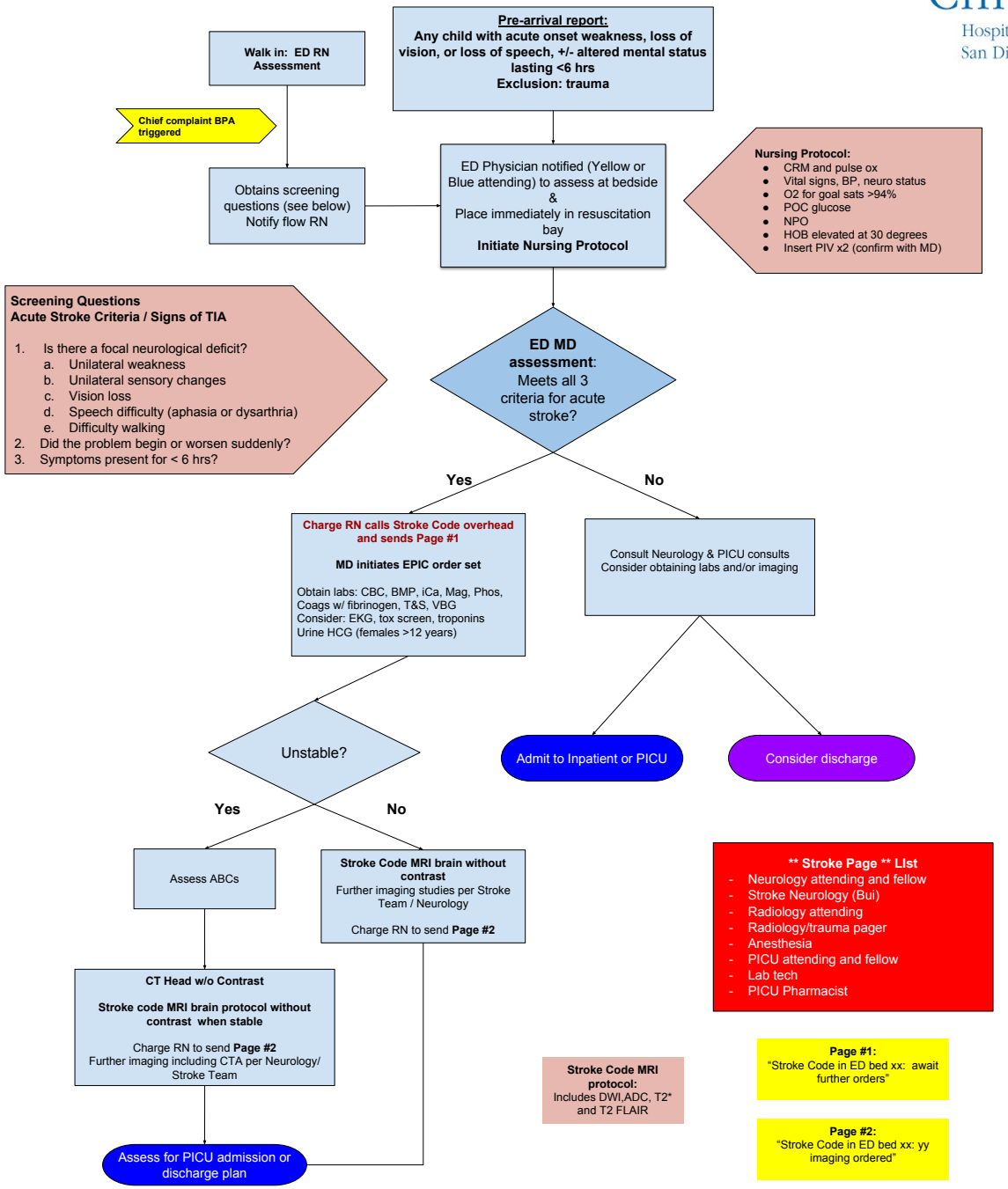
Last Known Well Time

Transport Decision

Hospital Treatment: Pediatric Stroke

Rady Children's ED Stroke Pathway

Rady Children's Hospital San Diego



Revised 07-11-2018 SS

Hospital Treatment: Pediatric Stroke

Rady Children's Hospital San Diego

Suspected stroke on pre-arrival or ED RN walk-in assessment?

MD Assessment: Meets all 3?

Screening Questions
Acute Stroke Criteria / Signs of TIA

1. Is there a focal neurological deficit?
   a. Unilateral weakness
   b. Unilateral sensory changes
   c. Vision loss
   d. Speech difficulty (aphasia or dysarthria)
   e. Difficulty walking
2. Did the problem begin or worsen suddenly?
3. Symptoms present for < 6 hrs?

Nursing Protocol:

- CRM and pulse ox
- Vital signs, BP, neuro status
- O2 for goal sats >94%
- POC glucose
- NPO
- HOB elevated at 30 degrees
- Insert PIV x2 (confirm with MD)

Hospital Treatment: Pediatric Stroke

Rady Children's Hospital San Diego

MD Assessment:

Meets all 3? → **Activate Stroke code**

Charge RN calls Stroke Code overhead and sends Page #1

MD initiates EPIC order set

Obtain labs: CBC, BMP, iCa, Mag, Phos,
Coags w/ fibrinogen, T&S, VBG
Consider: EKG, tox screen, troponins
Urine HCG (females >12 years)

Stable -> MRI Stroke Protocol

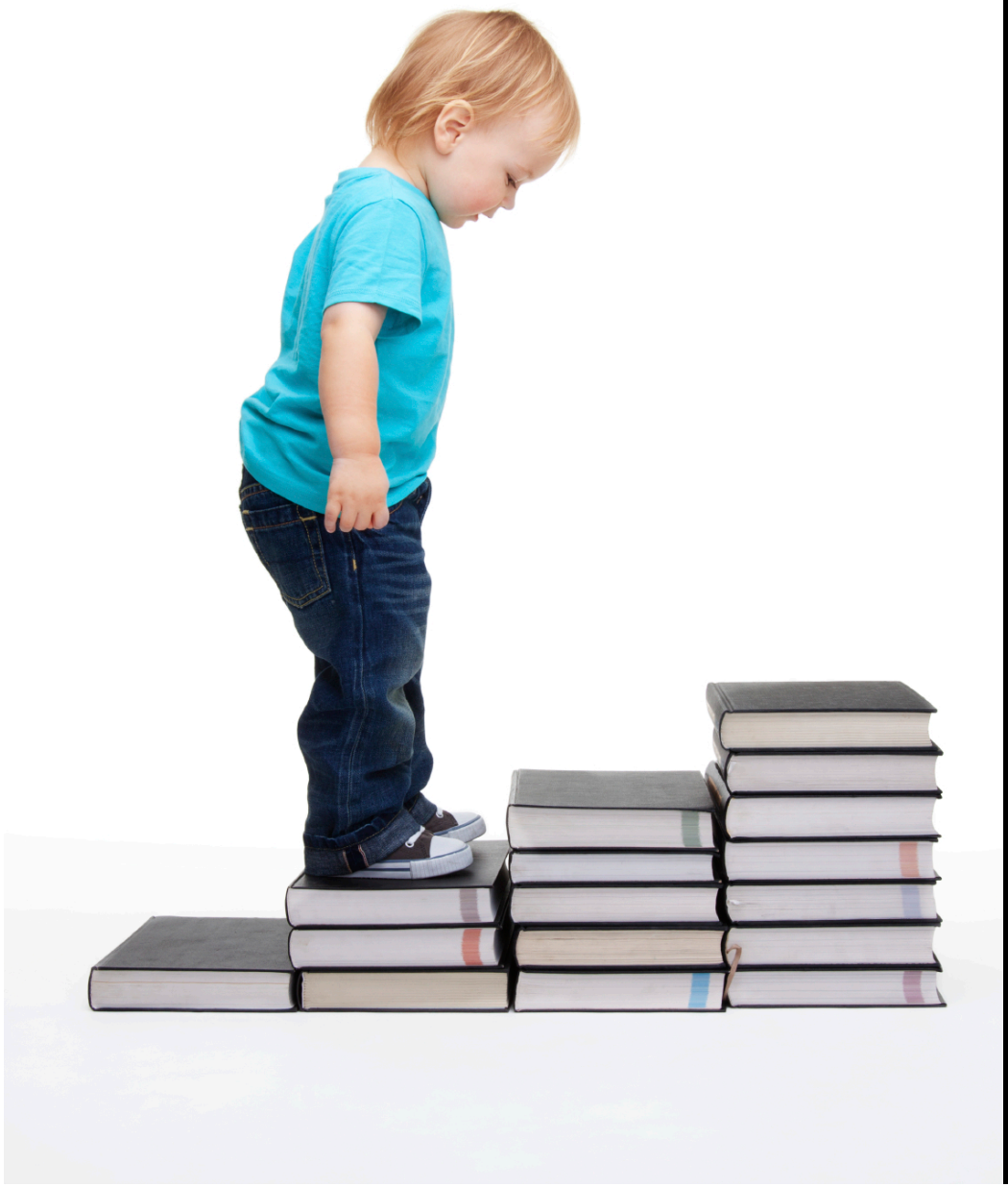
Unstable -> CT Head without contrast

Additional Treatments for Pediatric Stroke:

- **Supportive care goals:**
  - Cerebral perfusion
    - Head of Bed Flat if alert, or 30 degrees if not alert or vomiting
    - Maintain blood pressure with isotonic IV fluids
    - Control high blood pressure
  - Oxygenation
    - Oxygen prn to keep SpO2 > 95%
  - Minimize demands for cerebral blood flow
    - Detecting and treating seizures: EEG / anticonvulsants
    - Acetaminophen if temp > 37F
    - Avoid hyper/hypoglycemia
- **Anticoagulation/Aspirin as recommended**
- **Disease specific treatment**
  - Sickle cell disease: Blood transfusions

Pediatric Stroke Outcomes

- 49-60% pediatric stroke patients have disability that affects daily life
- Physical deficits
- Seizures/epilepsy
- Social functioning deficits



Next Steps

- Should we update S-161 Altered Neurologic Function?
  - Include notification and transport to Rady Children's Hospital for pediatric stroke?
  - Include last known well time and bring witness?

Thank You!

- Dr. Joelle Donofrio
  - For your subject matter help and editing
- Dr. Kristi Koenig
  - For the opportunity to present and guidance

QUESTIONS?


Kids have strokes too!


i am a stroke survivor!


Stroke Survivor

RESOURCES

- Stojanovski B, et. Al. Prehospital Emergency Care in Childhood Arterial Ischemic Stroke. Stroke. 2017;48:00-00. DOI: 10.1161/STROKEAHA.116.014768.
- Maryland Institute for Emergency Medical Services Systems. The Maryland Medical Protocols for Emergency Medical Services Providers. July 1, 2017.
- Austin County EMS Protocols. http://www.austincountyems.com/about-us.html
- Los Angeles County EMS protocols. http://dhs.lacounty.gov/wps/portal/dhs/ems/prehospitalcaremanual
- Oklahoma State EMS protocols. https://www.ok.gov/health/Protective_Health/Emergency_Systems/EMS_Division/Protocols/index.html
- Washington DC EMS protocols. https://fems.dc.gov/page/ems-protocols
- Alabama State EMS protocols. https://www.alabamapublichealth.gov/ems/assets/9thEditionProtocolsFinal.pdf
- MacKay M. More awareness, fast response key to combating stroke in children. American Stroke Association Meeting Report: Feb 2014.
- A.A. Mallick, et al.Childhood arterial ischaemic stroke incidence, presenting features, and risk factors: a prospective population-based study. Lancet Neurol, 13 (1) (2014), pp. 35-43.
- Greenham M, Gordon A, Anderson V, Mackay MT. Outcome in Childhood Stroke. Stroke. 2016 Apr;47(4):1159-64. Epub 2016 Mar 8.

RESOURCES

- Rady Children's ED Stroke Pathway. July 2018.
- National Stroke Association. Pediatric Stroke. 2018. http://www.stroke.org/understand-stroke/impact-stroke/pediatric-stroke
- American Heart Association, American Stroke Association. Pediatric Stroke. https://www.strokeassociation.org/STROKEORG/AboutStroke/StrokeInChildren/Stroke-In-Children_UCM_308543_SubHomePage.jsp
- American Heart Association, American Stroke Association . Pediatric Stroke Infographic. http://www.strokeassociation.org/STROKEORG/AboutStroke/StrokeInChildren/What-is-Pediatric-Stroke-Infographic_UCM_466477_SubHomePage.jsp
- Fullerton HJ et al. Risk of stroke in children: ethnic and gender disparities. Neurology. 2003;61:189–194
- Gabis LV, et al. Time lag to diagnosis of stroke in children. Pediatrics, 2002 Nov; 110(5): 924–8.
- Shellhaas RA, Smith SE, O'Tool E, et al. Mimics of childhood stroke: characteristics of a prospective cohort. Pediatrics 2006;118(2):704–9.
- Brody AS, Frush DP, Huda W, Brent RL, Radiology AAoPSo. Radiation risk to children from computed tomography. *Pediatrics* 2007; 120:677-682.
- Shellhaas RA, Smith SE, O'Tool E, Licht DJ, Ichord RN. Mimics of childhood stroke: characteristics of a prospective cohort. Pediatrics. 2006;118(2): 704-709. doi: 10.1542/peds.2005-2676
- Mackay MT, Chua ZK, Lee M, et al. Stroke and nonstroke brain attacks in children. Neurology. 2014; 82(16): 1434-1440. doi: 10.1212/WNL.0000000000000343
- DeLaroche AM, Sivaswamy L, Farooqi A, Kannikeswaran N. Pediatric Stroke and Its Mimics: Limitations of a Pediatric Stroke Clinical Pathway. *Pediatr Neurol.* 2018;80:35-41.