

**Pediatric Arterial Ischemic Stroke**

“First Tuesdays” Lecture Series

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**Introduction and Goal of “First Tuesdays”**

- Sabreena Slavin MD – Vascular Neurologist and Neurohospitalist at KU School of Medicine
- Didactic lecture series as part of the Kansas Initiative for Stroke Survival
- Updates in Practice and FAQ’s on Acute Stroke Care
- 30 minutes of didactic/question and answers

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**Classification of Pediatric Stroke**

- Perinatal stroke: 28 weeks gestation to 28 days of life
  - Acutely presents with focal seizures or encephalopathy
  - 80% arterial ischemic stroke, remainder venous stroke or hemorrhage
  - Epidemiology: 1/3500, highest risk in newborns
- Childhood stroke: 28 days to 18 years
  - Variable presentation: similar to adults but more common than adults to have seizures and encephalopathy
  - 50% arterial ischemic, 50% hemorrhagic
  - Epidemiology: 1-2/100,000 in US; highest < 5 years and in boys, Black, and Asian populations

Ferriero et al, Stroke 2019

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## Perinatal stroke

- Seizures most common presentation in 94%: focal motor seizures in 1 extremity
- Can also present with encephalopathy
- Predilection for left hemisphere (80% of cases)
- Pediatric risk factors: thrombophilia or coagulation disorders, cardiac dysfunction, infection, trauma, asphyxia, genetic mutations (COL4A1), cryptogenic
- Maternal risk factors: preeclampsia, coagulation disorders, chorioamnionitis, oligohydramnios, premature rupture of membranes, vacuum delivery, emergency C-section
- Hemorrhage often seen in cases of Vitamin K refusal and maternal drugs that can cause Vitamin K coagulopathy (warfarin, phenytoin)
- Outcomes: majority have cerebral palsy (motor deficits) with about half also having cognitive /speech impairment and epilepsy

Ferriero et al, *Stroke* 2019

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## Diagnosis and management of perinatal stroke

- MRI, MRA, MRV for diagnosis. Avoid CT due to radiation.
- Treatment is mostly supportive: seizure control, hydrate, correction of factors, etc.
- Treatment with antiplatelet or anticoagulation in arterial stroke not always indicated due to low risk of recurrence but should be given to those with documented thrombophilia or congenital cardiac disease
- No evidence for thrombolytics, endovascular devices usually too small

Ferriero et al, *Stroke* 2019

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## Childhood ischemic stroke: most common causes

- Cardiac disease: in 6 months-3 years; presents with more abrupt onset
- Postinfectious arteriopathy: usually affects major intracranial vessel (commonly ICA/MCA), can immunosuppress
  - Associated with Varicella most commonly, also HSV
- Moyamoya arteriopathy: median age 7 years; high prevalence of TIA's over years and silent radiographic infarcts. May need surgical bypass.
  - Hyperventilation can precipitate symptoms
- Arterial dissection: common in younger boys after recent minor trauma
- Sickle cell disease: chronic blood transfusions can prevent strokes if TCD's show high velocities
- Thrombophilia/hypercoagulable disease

Moharir et al, *Continuum: Pediatric Arterial Stroke* 2014

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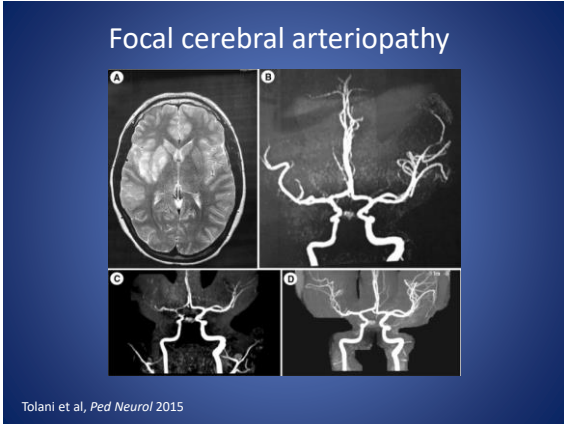
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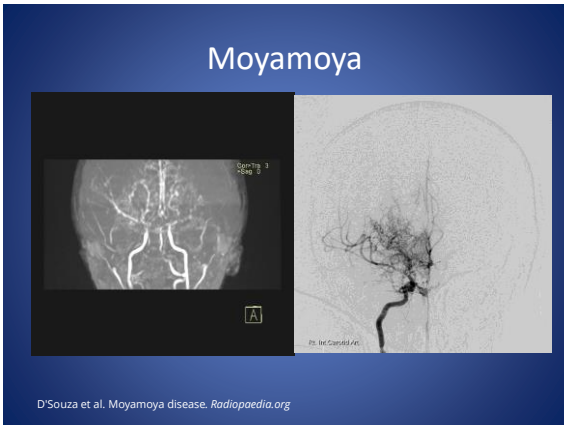
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#### Table 1. Suggested Basic Evaluation of a Child With AIS for Common Causes

| Category                   | Common Causes  | Examination   |
|----------------------------|--|---|
| Stroke confirmation        | Ischemia (ischemia mimickers (ingrains))   | Brain MRI with DWI, FLAIR, GRE or SWI, T1, and T2 (optional: T1 after gadolinium, DTI, PCASL) <sup>100</sup>  |
| Cardiac <sup>a</sup>       | PFO (controversial role as a stroke cause in childhood)<br>Congenital cardiac anomaly<br>Acquired cardiac anomaly<br>Arrhythmias | TTE with bubble study<br>ECG and rapid/irregular rhythm<br>Consideration of 4-extended Doppler ultrasound in cryptogenic stroke with positive bubble study  |
| Arteriopathy               | Extracranial dissection<br>FCA1/FCA2<br>Moyamoya<br>Takayasu arteritis   | Brain MRA 3-D TOF and MRA of the neck without gadolinium (optional VSA) <sup>100</sup><br>of CTA of the head and neck (not preferred given exposure to radiation and intravenous contrast)  |
| Thrombophilic <sup>b</sup> | Inherited thrombophilias<br>Acquired thrombophilias  | CRP<br>FVL mutation<br>Prothrombin G20210A mutation<br>Protein C <sup>c</sup><br>Protein S <sup>c</sup><br>Antithrombin mutation<br>Lupus anticoagulant<br>Anticardiolipin antibody (IgG/IgM)<br>Anti-β <sub>2</sub> -glycoprotein antibody (IgG/IgM) |
| Inflammatory <sup>d</sup>  | Lupus  | ESR, CRP, ANA   |

Ferriero et al, *Stroke* 2019

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## Delays with childhood stroke diagnosis

- 60-90% of children presenting to ED with acute neurological symptoms do NOT have stroke
  - Common mimics: migraine with aura, seizure, Bell’s palsy, tumor, demyelinating disease, infection, psychogenic
- Symptom detection to ED visit average 1.7-21 hours

Ferriero et al, *Stroke* 2019

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## Hyperacute treatment: TIPS trial

- Completed in 23 centers with dedicated pediatric stroke teams, order sets, MRI protocol
- Prospectively included patients 2 years and older presenting within 4.5 hours
- Used same dose of alteplase as in adults (0.9 mg/kg)
- Used same exclusions as adults. In addition, excluded sickle cell, endocarditis, meningitis, Moyamoya
- Confirmed stroke or clot with imaging

Rivkin et al, *Stroke* 2016

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Characteristics of 93 patients age 2 -17 years screened for TIPS

| Screens                   | No (%)   | Reason patient not enrolled                                 |
|---------------------------|--|---|
| 43 (46%) confirmed stroke | 21(22%)  | Medical contraindications ± time to presentation > 12 hours |
|                           | 5(5%)  | PedNIHSS < 6 (2,2,3,4, < 6)                                 |
|                           | 10(11%)  | Diagnosed at 4.5 to 12 hours                                |
|                           | 4(5%)  | PedNIHSS < 6 and outside time window                        |
|                           | 2(2%)  | Without clot visualized                                     |
|                           | 1(1%)  | Not applicable, child was enrolled                          |
|                           | 50 (54%) stroke mimics                         | 36(41%)   |
| 12(13%)                   |  | Non-benign mimic  |
|                           |  | 2-hemorrhagic stroke  |
|                           |  | 3-mass lesion   |
|                           |  | 2-infection   |
|                           | 2-methotrexate toxicity                        |   |
|                           | 2-posterior reversible encephalopathy syndrome |   |

Rivkin et al, *Stroke* 2016

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## Endovascular thrombectomy

- More than 35 cases of recanalization therapy in pediatric ischemic stroke has been pooled, most with successful outcomes
  - May have issues in inflammatory arteriopathies that can cause stroke or Moyamoya

Ferriero et al, Stroke 2019

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## Management of arterial childhood stroke

- BP management: allow permissive HTN
- Seizure management
- Can consider hemicraniectomy: study in 41 children who had hemicraniectomy after large acute ischemic stroke, 95% survived, 41% with mild to moderate deficits, 59% with severe deficits. Survival overall improved with surgery over medical management
- Children (not neonates) have high risk of recurrent stroke, especially those with arteriopathies. Need to use antiplatelet agents or LMHW for initial treatment, can transition to warfarin if needed. No data yet for DOACs.

Ferriero et al, Stroke 2019

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## Outcomes in childhood stroke

- Mortality around 5%. 70% had neurological deficits long-term: 36% mild, 23% moderate, 10% severe
- May have issues with higher order cognition, quality of life, mood disorders
- Worse outcomes with seizures
- Rehab is important. Good data with constraint therapy but has poor compliance.

Ferriero et al, Stroke 2019

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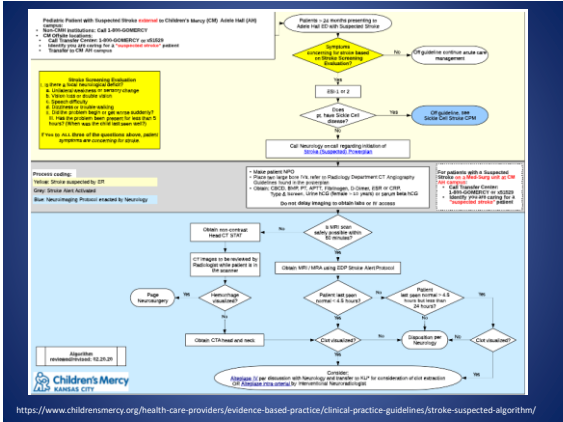
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## Summary of childhood stroke

- Many stroke mimics are possible with acute neurological symptoms
- If acute neurological symptoms, obtain stat MRI/MRA if possible. Obtain CT and consider CTA if no MRI. Work with Children's Mercy.
- Can consider tPA (adult dosing) and transfer to KU for EVT. Do not give tPA if no clot or stroke seen on imaging unless directed otherwise.

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## Questions?

- Call for help anytime!
- KU BAT phone: 913-588-3727
- Children's Mercy: 1-800-GOMERCY
- <http://www.kissnetwork.us/>
- [sslavin2@kumc.edu](mailto:sslavin2@kumc.edu)

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