Stroke Pediatric Case Study

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Disclaimer

• I will be discussing the use of tPA in the Pediatric population which is not FDA approved.
History

• 11 year old male patient that has history of ADHD-taking Adderall.
• Was outside playing, came in the house with complaints of a headache. Mom gave the patient an Aspirin for his headache.
• Patient quickly became unresponsive and had a left side facial droop
• He had no recent fall, trauma or surgery
EMS Timeline

• Symptom onset: 1440
• EMS Dispatch: 1500
• EMS intercept with POV: 1508
• Initial assessment by EMS: Left side facial droop, Slurred speech, tongue deviation, left side limbs flaccid.
• Accucheck-131
• VS-BP 117/77, HR 90, Resp 22, O2 sats 99%
• 12-lead EKG completed
• EMS Enroute: 1515
Trinity Hospital

- Stroke Alert: 1522
- Arrival: 1523
- ETC Physician Eval: 1523
- Neurology notified 1526
- CT started: 1532
- MRA: 1533
- Sanford-Fargo Notified: 1602
- NIHSS-10
  - 1- Dysarthria, 2-left lower facial weakness, 1-gaze preference, 3-left arm weakness, 2- left leg weakness
- Alteplase was given: 1625
- Delay to needle, obtaining consent from family
  - VS prior to transfer: BP 118/84, HR 107, RR-20, O2 Sats 98%
Transport to Fargo

- Flight team Dispatched: 1609
- Flight team at bedside: 1610
- Depart bedside: 1644
- Depart Minot: 1655
- Arrive Fargo Airport: 1748
- Arrive Sanford-Fargo: 1804
Fargo Emergency Center

• Arrival: 18:11
• VS:HR 108, RR: 32, BP: 125/98, O2 Sat: 98% RA
• NIHSS score of 6
  • Symptoms: minimal movements of the left upper and lower extremities
  • Exam difficult due to minimal cooperation
• MRI/MRA Brian: 18:49
  • MRA: right ICA smaller than left, question of dissection and possible small clot among supraclinoid portion. Right M1 shows diffuse irregularity and mild narrowing
  • MRI: Indicated right basal ganglia stroke and subocclusive thrombus in right MCA territory
    • CT Scan not performed to avoid radiation exposure
Fargo Cath Lab

• 19:14: Cath Lab
  • Potential mechanical thrombectomy candidate due to M1 segment of the right MCA had diffuse irregularity on MRA
  • Thrombectomy was not performed due to partial recanalization of subocclusive clot-likely due to Alteplase administration.

• Cerebral angiogram:
  • Normal course and caliber of the distal common carotid artery. The bifurcation is at C3. The cervical ICA has normal. There is no evidence of dissection or dural AV fistula.
Pediatric ICU

- **Day 1 of hospitalization:**
  - NIHSS score of 4 for left upper and lower extremity weakness, arm weakness improving
  - Orders: Hourly neuro checks, NPO,
  - Consults: Child life specialist, hematology, neurology, PT, OT, ST, Case Management
  - Possible etiology felt this might be due to a family history for factor V Leiden
    - Hematology was consulted.
    - ANCA, ANA, SSA, SSB, ESR, and CRP ordered
  - MRI: evolving ischemic infarct of the right basal ganglia. No evidence of hemorrhage
  - MRA: narrowing of the right M1 segment of the MCA less evident. Linear hypodensity could represent a dissection
  - Aspirin ordered post MRI/MRA. Anticoagulation was held due to high risk of hemorrhage
  - Transthoracic Echocardiogram: negative for PFO
Pediatric ICU

- Day 2

- SLP:
  - Clinical Dysphagia/Swallow Eval completed-regular diet with thin liquids was recommended
  - Orders: Rehab consult, Nutrition
Pediatric Unit

• **Day 3**
  - NIHSS score of 2 for left sided weakness, mild facial droop
  - Transferred to pediatric unit
  - Every two hour neuro checks completed and stable
  - PT: Flat affect, decreased attention to talks, follows simple commands
  - OT: appeared fatigued needing multiple cues with tasks
  - Hypercoagulation workup largely unremarkable

• **Day 4**
  - Child Life Therapy: Therapy dog provided
  - EKG: Normal Sinus rhythm: 98
  - Telemetry and holter monitor: negative arrhythmias

• **Day 5-7**
  - Continued work with therapy with a goal of rehab
  - NIHSS score remained a 2
Pediatric Unit

• Day 8:
  • NIHSS score 2: left sided weakness
  • Concern for re-narrowing of the distal ICA/proximal MCA

• Day 9:
  • NIHSS score of 2: left sided weakness
  • Cerebral angio completed and indicated possible vasculitis, fibromuscular dysplasia or moyamoya
  • Cerebral angiogram:
    • Right anterior cervical circulation demonstrate normal distal common carotid artery. The bifurcation is at C3. The cervical ICA has normal flow. There is no evidence of dissection or dural AV fistula
Pediatric Unit

• **Day 10:**
  • Lumbar puncture and MRA completed for CNS vasculitis work up
  • MRA: evolution of right basal ganglia infarct with enhancement consist with breakdown of blood brain barrier. Beaded appearance of the distal right ICA, right M1 segment. Overall appearance suggestive of possible fibromuscular dysplasia, moyamoya.
  • Interdisciplinary team determined further workup was needed by a pediatric rheumatologists for possible CNS vasculitis.
  • Patient transferred to Children’s Hospital in Minneapolis via Air ambulance (In the hospital there for 4 days)
  • The patient was diagnosed with vasculitis
Alteplase and Pediatric Stroke Patients

- **Pediatric Stroke Statistics:**
  - Stroke occurs in 13/100,000 children <18 years of age with an incidence of 25/100,000 neonates per year with the highest amongst premature infants
  - 50% of neonates and 65% of children > 1 month sustain lasting motor deficits
  - Due to it being so rare, there is usually a delay in presentation and diagnosis

- **Evidence behind the treatment:**
  - Per Activase Prescribing Information, “Safety and effectiveness of Activase in pediatric patients has not been established.”
  - Initial evaluation of treatment for pediatric stroke patients started with the *Thrombolysis in Pediatric Stroke (TIPS)* study.
    - This study was organized systematically to gain competence in the response to and assessment of children presenting with acute stroke for treatment with Alteplase/tPA
  - *Guidelines for Urgent Management of Stroke in Children* by Michael J. Rivkin MDa,b,c,d, Timothy J. Bernard MD, MSCS e, f, Michael M. Dowling MD, PhD, MSCS g,h, i, Catherine Amlie-Lefond MDj. Pediatr Neurol 2016; 56: 8-17. [www.elsevier.com/locate/pnu](http://www.elsevier.com/locate/pnu)
    - Provided guidelines for pediatric acute stroke protocols
Seizure is a very common presenting sign of acute stroke in children, any first time seizure in a child should urgently be evaluated for stroke

- Seizure should be treated with anticonvulsant therapy
- Activation of the acute stroke team
- Consider neuroprotective measures
  - Hyperglycemia
  - Hyperthermia
  - Blood pressure
- MRI with DWI-evaluation of stroke and rule out hemorrhage
- If MRI cannot be done CTA can be substituted to rule out ICH and presence of arterial obstruction in a vessel sub-serving the region of parenchymal ischemia
- Alteplase is dosed the same for adults; 0.9 mg/kg,
  - First 10% given as a bolus, remaining 90% to infuse over an hour
• Blood Pressure and neuro checks such as modified NIHSS should be monitored prior and during Alteplase administration

• Other treatment options
  • Malignant MCA syndrome is an acute infarction involving greater than 50% of the MCA territory by cranial CT or >145 mL of MCA volume on DWI along with decreased LOC can indicate significant cerebral edema.
  • Decompressive hemicraniectomy (DCH) can be performed to treat cerebral edema and relieve increased Intracranial Pressure.
Caring for the Pediatric Stroke Patient

- Collaboration amongst the Primary Stroke Center physicians
- Stroke Coordinator and Medical Director followed the patient closely
  - Stroke Coordinator and Rescue nurses performed NIHSS
  - Ensured correct work up and consultations were placed
- Stroke education was provided to PICU/PEDs staff and the patient’s family
- Meetings were held to discuss pediatric acute stroke protocols
  - Provided guidelines for any neuro changes
Collaboration

• This patient benefitted in that the facilities worked well together to get the patient from one facility to another and provided continued communication.
• From onset of symptoms to Alteplase was 1 hour and 45 minutes
• From onset of symptoms to Cath lab arrival was 4 hours and 34 minutes
• The patient had a good outcome and is back in school, has been discharged by therapy. For the vasculitis the patient was treated with Cytotoxan (7 doses) and started on daily Aspirin and Xarelto as he also has Serpine-1 variant putting him at further risk for thromboembolism/AMI
References

• Michael J. Rivkin MDa,b,c,d, Timothy J. Bernard MD, MSCS e, f, Michael M. Dowling MD, PhD, MSCS g,h, i, Catherine Amlie-Lefond MDj. Guidelines for Urgent Management of Stroke in Children. Pediatr Neurol 2016; 56: 8-17. www.elsevier.com/locate/pnu
A STROKE CASE STUDY: UNCONTROLLED HYPERTENSION
HYPERTENSIVE CRISIS

• “A hypertensive crisis is a severe increase in blood pressure that can lead to a stroke. Extremely high blood pressure – a systolic pressure of 180 mmHg or higher or a bottom number of 120 mm Hg or higher – can damage blood vessels” (Sheps, S. G, 2017).

• Requires immediate and controlled BP reduction
WHAT WE KNOW

• “More than 60% of patients with acute ischemic stroke present with elevated BP within 1 hour of symptom onset” (Bowry, Navalikele & Gonzales, 2014).

• “About 77% of people who have a first stroke have blood pressure higher than 140/90 mm Hg” (Benjamin, E. J., 2017).

• “Hypertension has been associated with increased risk of poor outcomes and ICH in several studies” (Fugate & Rabenstein, 2015).

• “The use of antihypertensives to achieve BP control in patients prior to rtPA appears to be safe” (Fugate & Rabenstein, 2015).
CASE STUDY

66 Y/O male presents to the CAH ED at 1213

LKW determined to be at 1000
Sx: left sided facial droop and numbness on the left face and arm

Vital Signs at 1221:
HR - 96; NSR
BP: 209/90
No distress
NIHSS: 4

Patient taken directly to CT; CT results at 1226
“No acute intracranial complication. No evidence of mass, hemorrhage or acute stroke”

2hrs 13minutes

2hrs 26minutes
CASE STUDY

Vital Signs at 1236:
HR - 98; NSR
BP - 209/109
No distress
NIHSS: 4

5mg labetalol
IVP given at 1240

Vital signs at 1242:
HR - 97; NSR
BP - 202/102
No distress
NIHSS - 4

5mg labetalol
IVP given at 1251

How long is the window?

2 hours 40 minutes

2 hours 51 minutes
**SEVERE UNCONTROLLED HYPERTENSION**

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td></td>
<td>Absolute Contraindications:</td>
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<tr>
<td></td>
<td>Are the patient’s symptoms suggestive of a subarachnoid hemorrhage or does CT show evidence of hemorrhage?</td>
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<tr>
<td></td>
<td>Does that patient have untreated cerebral aneurysm, arteriovenous malformation or brain tumor?</td>
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<td></td>
<td>Has the patient experienced head trauma, intracranial surgery, intraspinal surgery, or stroke in the past 3 months?</td>
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<td>Has the patient had an arterial puncture at a non-compressible site in the previous 7 days?</td>
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<td>Does the patient have severe uncontrolled hypertension? Evidenced by systolic blood pressure &gt; 185 mmHg and/or diastolic blood pressure &gt; 110 mmHg despite treatment?</td>
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<td>Does the patient have a known acute bleeding diathesis?</td>
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<tr>
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<td>• Platelet count &lt; 100,000/mm3</td>
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<td>• Heparin received within 48 hours, resulting in abnormally elevated aPTT greater than the upper limit of normal</td>
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<td>Is the patient taking an oral anticoagulant or has an INR &gt; 1.7 or PT &gt; 15 sec?</td>
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<td>Does the CT show evidence of a multilobar infarction (hypodensity &gt; 1/3 cerebral hemisphere)?</td>
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## CASE STUDY

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>1305</td>
<td>Patient is discharged from ED provider and EMTx2 via ground to transport to airport for fixed wing transfer at 1305 - this is a 30 minute transport</td>
</tr>
<tr>
<td>1354</td>
<td>Vitals taken by Air transport team: HR – 83; NSR; BP – 188/96; No distress; NIHSS – 4</td>
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<tr>
<td>1405</td>
<td>10mg labetalol IVP given</td>
</tr>
<tr>
<td>1409</td>
<td>Vitals at 1409: HR – 88; NSR; BP – 186/101; No distress; NIHSS – 4</td>
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<tr>
<td>1459</td>
<td>3 hours 54 minutes</td>
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<tr>
<td>1459</td>
<td>Patient arrives at tertiary center</td>
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<tr>
<td>1459</td>
<td>BP – 253/118</td>
</tr>
<tr>
<td>4 hours 59 minutes</td>
<td>4 hours 59 minutes</td>
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</tbody>
</table>
CASE STUDY SUMMARY

- An IV nicardipine drip was started in ED
- 2 days later the patient is discharged:
  - BP at 168/71
  - Final dx: small vessel right thalamic stroke
  - Continue ASA indefinitely
  - Start 40mg Lipitor indefinitely
  - Lifestyle modifications: quit smoking and exercise daily
  - Strict BP management!
LET'S TAKE ANOTHER LOOK
CASE STUDY

Vital Signs at 1236:
HR - 98; NSR
BP - 209/109
No distress
NIHSS: 4

5mg labetalol IVP given at 1240

Vital signs at 1242:
HR - 97; NSR
BP - 202/102
No distress
NIHSS - 4

5mg labetalol IVP given at 1251

How long is the window?

2 hours 40 minutes

2 hours 51 minutes
Blood Pressure Management for Acute Stroke

**Alteplase (tPA) or Acute Reperfusion Intervention Patient**

Patient is otherwise eligible for IV Alteplase (tPA) or other acute reperfusion therapy except BP >185/110 mmHg

Systolic >185 mmHg or Diastolic >110 mmHg:

- Labetalol 10 to 20 mg IV over 1 to 2 minutes, may repeat x 1; Or
- Nicardipine infusion, 5 mg/hr, titrate up by 2.5 mg/hr at 5- to 15-minute intervals, maximum dose 15 mg/hr, when desired BP attained, adjust to maintain proper BP limits

Or

Other agents (hydralazine, enalaprilat, etc) may be considered when appropriate

If blood pressure is not maintained at or below 185/110 mmHg, do not administer tPA
ANTIHYPERTENSIVES

• Labetalol: beta blocker
  • Recommended to give as a bolus
    • (Infusion rate of up to 2-8mg/min may be used)
  • Dose escalations every 10 minutes
  • Onset of action within 2-5 minutes
  • Also need to consider HR

• Nicardipine (Cardene): CA channel blocker
  • Titratable infusion
  • Onset of action is 5 to 15 minutes
  • Smooth muscle relaxer
CASE STUDY

Patient is discharged from ED provider and EMTx2 via ground to transport to airport for fixed wing transfer at 1305 - this is a 30 minute transport

Vitals taken by Air transport team at 1354:
- HR – 83; NSR
- BP – 188/96
- No distress
- NIHSS - 4

10mg labetalol IVP given at 1405

Vitals at 1409:
- HR – 88; NSR
- BP – 186/101
- No distress
- NIHSS – 4

1459
- Patient arrives at tertiary center
- BP – 253/118

3 hours 54 minutes

4 hours 59 minutes
CONSIDERATIONS

• Consider keeping patient in ED until 4.5 hours if possible?
• Would need to rule out LVO
  • Consultation
  • Other resources?
ANY QUESTIONS?
REFERENCES


