FROM THE STREETS TO THE ED: PEDIATRIC CASE REVIEWS

Marianne Gausche-Hill, MD, FACEP, FAAP
Medical Director, Los Angeles County EMS Agency
Professor of Clinical Medicine and Pediatrics,
David Geffen School of Medicine at UCLA
Director, EMS Fellowship
Harbor-UCLA Medical Center, Department of Emergency Medicine

Disclosures

• I have no actual or potential conflict of interest in relation to this program.
• I also assume responsibility for ensuring the scientific validity, objectivity, and completeness of the content of my presentation.

Case: 3-year old “Seizure”

Seizure management

• How many of you would immediately treat this patient with benzodiazepines according to your protocols?
Case: 3 year old boy - “Seizure”

- 3 year old boy seizing for 5 min PTA
- No signs of trauma; History of seizures
- Weight 11 kg; Purple on the Broselow Tape
- PMC – Harbor-UCLA Medical Center 14 minutes

Pediatric Assessment Triangle

VS: Good cap refill; RR 18; 11 kg - Purple

Case 3 year old boy - “Seizure”

- What is your general impression?
What are prehospital management priorities in this case?

- Open the airway – jaw thrust
- Place on cardiorespiratory monitor
- Stop seizure with midazolam IN/IM/IV/Buccal?
- Obtain vascular access – en route (IV/IO/none?)
- Obtain rapid glucose if persistent ALOC; treat hypoglycemia if present
- Transport to pediatric receiving facility
- Document scene and patient’s physical findings

Case: 3 year-old boy - “Seizure”

Case development:
Patient received 1.1 mg IV midazolam
Patient stopped seizing
Patient stopped breathing

What do you do now?

Case: 3 year-old boy – “Seizure”

- Position the head
- Open the airway – jaw thrust
- Begin bag-mask ventilation (BMV) using – “squeeze, release, release” method
- Reassess clinical status
- Rapid transport
Hot Issues

- **What are options to manage the airway of a child in the field?**
  - BMV
  - ETI
  - Extra-glottic device

Airway Management Controversies

- BMV with or without airway adjunct – a staple
- ETI – no data that supports improved outcomes and concern with complications (e.g., hypoxia, dislodgement, increase in ICP, aspiration) (Gausche, et al: JAMA 2000)
- Extraglottic devices? Concern when patient regains consciousness
  - Laryngeal mask airway – not yet in scope of paramedics in most systems in USA
  - I-gel – not field tested but has all sizes and may be an alternative
  - King LTD – size NOW available for infants

Cricoid Pressure

- Too much cricoid pressure may lead to airway obstruction
- If no chest rise with BMV – lighten cricoid pressure
- AHA 2015 Guidelines de-emphasize use of cricoid pressure

Why did this child stop breathing?
Why did this child stop breathing?

- Tongue in children relatively large and intraoral – most common cause of airway obstruction
  - Positioning with jaw thrust may relieve obstruction
- High metabolic rate and low oxygen reserves can result in hypoxia after a brief apneic period
  - Begin bag-mask ventilation with 100% oxygen
  - May take a minute for oxygen saturations to rise
- Benzodiazepines may cause respiratory depression in children
  - Unclear true rate of respiratory depression reports 1-32% of patients in the field


- Risk Factors for Apnea in Pediatric Patients Transported by Paramedics for Out-of-Hospital Seizure
  - Study to quantify the risk of apnea attributable to midazolam and identify additional risk factors for apnea in children transported by paramedics for out-of-hospital seizure.
  - 2 year retrospective study of 1584 children (0-15 years) with seizure transported to two peds EDs, California.
  - Median age of 2.3 years (IQR 1.4-5.2); 55% were male.
  - Paramedics treated 214 patients (13%) with midazolam.

- 71 had apnea (4.5%): 44 patients were treated with midazolam and 27 patients were not treated with field medications.
  - Overall 20% of patients receiving midazolam had an apneic event.
- Using multivariate logistic regression: 2 independent risk factors for apnea were identified: persistent seizure on arrival (OR = 15 [95%CI 8-27]) and administration of field midazolam (OR = 4 [95%CI 2-7]).
- Conclusion: We identified 2 risk factors for apnea in children transported for seizure: seizure on arrival to the PED and out-of-hospital administration of midazolam.
The Bottom Line

- Seizure is a common chief complaint in the field.
- Use of benzodiazepines may result in hypoventilation but important to stop seizure.
- Treat the seizure as prolonged seizure greater risk factor for apnea in children (IN or IM preferred as faster administration times).
- Glucose check performed on those with seizure or persistent ALOC.

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Case: 12 month-old boy - “Choked”

- 12 month-old boy – 10 kg – Purple
- Babysitter stated that the boy ate something off the floor; white and hard; now drooling; coughing and crying

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Pediatric Assessment Triangle

VS: HR 140; O₂ sat 96%; 10 kg - Purple
12 month-old boy: “Choked”

• What is your general impression?
  – Respiratory distress - Foreign body aspiration

• What are prehospital management priorities?
  – Assess pulse oximetry reading
  – 15L oxygen by mask
  – Albuterol (?)
  – Transport
  
  Where is the foreign body?

Case: 12 month-old boy - “Choked”

• Foreign body could be in esophagus (drooling) or in lower airway (wheezes on right; clear on the left)

• This child is critically ill/injured – requires subspecialty care
  – Complications include infection, bronchospasm, and respiratory failure – rarely erosion of FB into a blood vessel and exsanguination
What Happened?

- Patient taken to the operating room and a round hard candy was removed was removed from his lower airway

Case: 18 month-old boy -“Choked”

- 18 month-old male – 11 kg – Purple
- Eating chicken and choked
- Baby carried out to paramedics

General Impression

Back to our patient...
Case: 18 month-old boy - “Choked”

- What is your general impression?
  - Respiratory failure - Foreign body aspiration

Foreign Body Aspiration

- >90% of deaths from FB aspiration occur in children < 5 years of age
- Liquids most common substance to cause choking
- Balloons, small objects, and food are most likely FB to cause airway obstruction

~90% will give history of choking episode

Objects Causing FB Deaths

Consumer Safety Commission

- Small parts test fixture
- Children <3 years of age
- Many items including balloons are excluded
Foreign Body Aspiration

- Signs and symptoms:
  - Upper airway: stridor, apnea; cardiopulmonary arrest
  - Lower airway: choking, coughing, wheezing (unilateral), pneumonia

Where is the foreign body?

Foreign Body Aspiration

- FB likely in upper airway
  - Prehospital Management:
    • Alert and breathing: position of comfort and transport; oxygen as needed

BLS: Foreign Body Management

- Infants
  - Back blows and chest thrusts
- Child > 1 year
  - Heimlich maneuver/abdominal thrusts (conscious)
  - Chest compressions (unconscious)
ALS: Foreign Body Management

- Pediatric Magill Forceps under direct visualization
- Remember FBs may not resemble what you expect them to look like (e.g., superball)
  - If it does not look like it belongs there remove it.
  - You will not remove the patient’s tonsils!

Case: 18 month-old boy - “Choked”

- What Happened?
  - Continued BMV in ED - pulse oximetry 90% 
  - Taken to operating room where a chicken nugget was removed from upper airway
  - Child did well discharged next day

Bottom Line

- FB aspiration is a life threatening condition even if child appears well in the field
- Prehospital management is centered around keeping airway open or removing FB and transport to ED
- Remember anatomy – FB can be in esophagus, or upper/lower airway and compress the trachea leading to respiratory distress/failure
Case: 5 year old male with SOB

• 5 year old male (60 lbs (ugh)) at home SOB; history of asthma
• Respiratory distress stridor; seal like cough
• Pulse ox on room air 60-70%
• Pulse rate 135; BP 132/P; RR 30
• Nebulized epinephrine 5 mg/5 ml inhaled by mask
• ETA 6 min
• 15 L oxygen – Pulse ox 90% range

Case: 5 year old male with SOB

• Differential for stridor?
• Croup
• FB aspiration
• Anaphylaxis
• Other congenital conditions

Case: 5 year old male with SOB

• Croup treatment considerations
• Cool mist – gives parents something to do
• Epinephrine – works – may prevent respiratory failure
  • Field use Epi 1 mg/mL solution HHN (2.5 mL until age 5 then 5 mL at 5 and older)
• In the ED: Corticosteroids
  • Dexamethasone (0.15-0.6 mg/kg) better than prednisolone (in ED)
Pediatric CPA

- 2 year old respiratory to cardiac arrest

The H’s and T’s of PEA

H’s
- Hypoxia
- Hypovolemia
- Hydrogen ion (acidosis)
- Hypo-hyperkalemia
- Hypothermia
- Hypoglycemia

T’s
- Toxins
- Tamponade (cardiac)
- Tension pneumothorax
- Thrombosis, pulmonary
- Thrombosis, coronary
Compression to Ventilation

- Infants and Children:
  - NEW 2015 Conventional CPR (chest compressions and rescue breaths) should be provided for pediatric cardiac arrests.
  - Health care providers – if alone 30:2; otherwise compression to ventilation rate 15:2
  - “Push hard, push fast” — compress chest in infant 1.5 inches (4 cm) and 2 inches (5 cm) in children – allow chest to recoil (DO NOT LEAN) — compress at 100-120/min
  - Breaths 8-10/min – avoid excessive ventilation
  - Switch rescuers every 2 min to avoid fatigue when doing chest compressions

Consider technique - squeeze bag just until chest rise initiated and then release
Time ventilations by saying “squeeze, release, release”

Two thumb-encircling hands chest compression in newborns and infants (PREFERRED 2010)

Automated External Defibrillator (AED)

- AED – OK for infants < 1 year (preference Manual defibrillator – followed by AED with dose attenuator – followed by AED without dose attenuator) (Class Iib, LOE C).
- Recent review suggest adult AED safe to use in infants (Pediatr Emerg Care 2015)
Minute Ventilation

• Avoid excessive ventilation of infants and children during resuscitation from cardiac arrest; insufficient data to identify optimal tidal volume or rate
  – Animal studies show excessive ventilation decreases cerebral perfusion pressure, ROSC and survival
  – Excessive ventilation increases intrathoracic pressure impeding venous return, reduces CO and cerebral and coronary blood flow
  – During CPR ventilate 8-10 times per minute for infants and children

DON'T BAG TOO FAST!!! Say "Squeeze, release release"

In the ED: Cuffed vs Uncuffed Endotracheal Tubes

• Will the cuff cause pressure on the cricoid cartilage leading to pressure necrosis?
• Short answer….NO

2246 children RCT (1119/1127 cuffed/uncuffed)
Post-extubation stridor was noted in 4.4% of patients with cuffed and in 4.7% with uncuffed TTs (P=0.543).
TT exchange rate was 2.1% in the cuffed and 30.8% in the uncuffed groups (P<0.0001).

In The ED: Cuffed vs Uncuffed ETT

– <1 year
  • Uncuffed 3.5 mm ID; Cuffed 3.0 mm ID
– 1-2 years
  • Uncuffed 4.0 mm ID; Cuffed 3.5 mm tube
– >2 years:
  • Uncuffed (age (yrs)/4) + 4 = mm ID
  • Cuffed (age (yrs)/4) + 3.5 = mm ID

– What I do is determine standard uncuffed size then use ½ size smaller...
Quick Calculation

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Weight (kg)</th>
<th>ETT Uncuffed/Cuffed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>4.0 mm / 3.5 mm</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>5.0 mm / 4.5 mm</td>
</tr>
<tr>
<td>8-10</td>
<td>30</td>
<td>6.0 mm cuffed</td>
</tr>
</tbody>
</table>

In the ED: Atropine

- There is no evidence to support the **routine** use of atropine as a premedication to prevent bradycardia in emergency pediatric intubations.
- There is no evidence to support a minimum dose of atropine when used as a premedication for emergency intubation – dose by weight at 0.02 mg/kg

In the ED: Sedatives for RSI

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Etomidate</td>
<td>0.3 mg/kg</td>
<td>Head trauma, hypotension not due to sepsis</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>2-10 mcg/kg</td>
<td>Head trauma, avoid high doses</td>
</tr>
<tr>
<td>Ketamine</td>
<td>1-2 mg/kg</td>
<td>Hypotension from any cause, reactive airway disease</td>
</tr>
<tr>
<td>Midazolam</td>
<td>0.1-0.4 mg/kg</td>
<td>Status, respiratory failure without hypotension</td>
</tr>
</tbody>
</table>
In the ED: Other issues with RSI

- Paralytic depends on your practice either rocuronium or succinylcholine OK
- Preoxygenate with 100% oxygen – use high flow nasal cannula during apneic period (5-15 L/min)
- If in shock do your best to give fluids prior to paralysis – push pull technique or give saline flushes to rapidly infuse prior to intubation

Endtidal CO₂

- Capnography is recommended to confirm ETT placement and assess adequacy and success of CPR (Class IIa, LOE C)
- Post-ROSC ventilation strategies in children should target a PaCO₂ that is appropriate for each patient while avoiding extremes of hypercapnia or hypocapnia.

Oxygen

- After ROSC in children, it may be reasonable for rescuers to titrate oxygen administration to achieve normoxemia (oxyhemoglobin saturation of 94% or above).
- Oxygen should be weaned to target an oxyhemoglobin saturation within the range of 94% to 99%.
- The goal should be to strictly avoid hypoxemia while maintaining normal oxygenation.
Length-based resuscitation Tape

- Regardless of the patient’s habitus, use the actual body weight for calculating initial resuscitation.
- If the child’s weight is unknown, it is reasonable to use a body length tape with precalculated doses (Class Ila, LOE C).

Dosing Errors Minimized with Color-Coded Prefilled Syringes

  - 10 emergency physician and nurse teams managed 2 simulated pediatric arrest scenarios.
  - Median time to delivery of all doses for the conventional and color-coded delivery groups was 47 seconds (95% confidence interval [CI] 40 to 53 seconds) and 19 seconds (95% CI 18 to 20 seconds), respectively (difference=27 seconds; 95% CI 21 to 33 seconds).
  - With the conventional method, 118 doses were administered, with 20 critical dosing errors (17%); with the color-coded method, 123 doses were administered, with 0 critical dosing errors (difference=17%; 95% CI 4% to 30%).

PALS Medications

- Higher doses of adenosine may be needed to convert SVT in children – AHA still uses 0.1 mg/kg but consider higher starting dose may be 0.2-0.3 mg/kg versus 0.1 mg/kg (max 12 mg).
- Continue use of epinephrine as drug of choice for symptomatic bradycardia and cardiac arrest.
- Atropine may be added for symptomatic bradycardia (if cardiac or toxic cause) – no evidence atropine is effective in CPA – only real use in children organophosphate toxicity.
**REFERENCE NO. 1309**

**DEPARTMENT OF HEALTH SERVICES**  
**COUNTY OF LOS ANGELES**  
**PARAMEDIC/MCN**  
**REFERENCE NO. 1309**

**MEDICAL CONTROL GUIDELINE: COLOR CODE DRUG DoSES - L.A. COUNTY KIDS**

**PRINCIPLES:**
1. Correct dosing of medications based on weight in kilograms is a safety concern for delivery of medications to children in the prehospital setting.
2. To optimize safety in dosing medications for children, a standard formulary has been created. This Color Code Drug Doses L.A. County kids medical control guideline pre-calculates all doses based on kilogram weight in children.
3. EMS provider agencies shall procure medications and stock approved Assessment and ALS Units in accordance with the drug formulation specified in this medical control guideline.
4. The Color Code Drug Doses L.A. County Kids and the Treatment Protocols shall be used to determine drug doses.

<table>
<thead>
<tr>
<th>MEDICATION</th>
<th>FORMULATION</th>
<th>DOSAGE</th>
<th>Maximum Pediatric Single Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenosine</td>
<td>12mg/4mL</td>
<td>0.1mg/kg</td>
<td>12mg</td>
</tr>
<tr>
<td>Albuterol</td>
<td>2.5mg/3mL</td>
<td>2.5mg (&lt;1yr); 5mg (1yr or older)</td>
<td></td>
</tr>
<tr>
<td>Amiodarone</td>
<td>150mg/3mL</td>
<td>5mg/kg</td>
<td>300mg</td>
</tr>
<tr>
<td>Atropine</td>
<td>1mg/10mL</td>
<td>0.02mg/kg</td>
<td>0.5mg</td>
</tr>
<tr>
<td>Calcium Chloride</td>
<td>100mg/1mL</td>
<td>20mg/kg</td>
<td>1,000mg</td>
</tr>
<tr>
<td>Dextrose 10%</td>
<td>0.1mg/mL</td>
<td>5mL/kg</td>
<td>250mL</td>
</tr>
<tr>
<td>Diaphyridine</td>
<td>50mg/1mL</td>
<td>1mg/kg</td>
<td>50mg</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>0.1mg/mL (IV)</td>
<td>0.01mg/kg</td>
<td>1mg</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>1mg/mL (IM)</td>
<td>0.01mg/kg</td>
<td>0.5mg</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>1mg/mL (for inhalation)</td>
<td>2.5mL (&lt;5yr); 5mL (5yr or older)</td>
<td></td>
</tr>
<tr>
<td>Fentanyl IV</td>
<td>50mcg/1mL</td>
<td>1mcg/kg</td>
<td>50mcg</td>
</tr>
<tr>
<td>Fentanyl IN</td>
<td>50mcg/1mL</td>
<td>1.5mcg/kg</td>
<td>50mcg</td>
</tr>
<tr>
<td>Glucagon</td>
<td>1mg/1mL</td>
<td>0.5mg (&lt;5yr); 1mg (5yrs or older)</td>
<td></td>
</tr>
<tr>
<td>Lidocaine (IO ONLY)</td>
<td>100mg/5mL</td>
<td>0.5 mg/kg</td>
<td>18mg</td>
</tr>
<tr>
<td>Midazolam</td>
<td>5mg/1mL</td>
<td>0.1mg/kg</td>
<td>5mg</td>
</tr>
<tr>
<td>Morphine Sulfate</td>
<td>4mg/1mL</td>
<td>0.1mg/kg</td>
<td>4mg</td>
</tr>
<tr>
<td>Mescaline</td>
<td>2mg/1mL</td>
<td>0.1mg/kg</td>
<td>2mg</td>
</tr>
<tr>
<td>Normal Saline</td>
<td>0.9% NaCl</td>
<td>20mL/kg</td>
<td>1,000mL</td>
</tr>
<tr>
<td>Ondansetron</td>
<td>4mg/1mL</td>
<td>4mg</td>
<td>4mg</td>
</tr>
<tr>
<td>Sodium Bicarbonate</td>
<td>1mEq/1mL</td>
<td>1mEq/kg</td>
<td>50mEq</td>
</tr>
</tbody>
</table>

**Length 107 - 119.5 cm | 5 - 8 years**

<table>
<thead>
<tr>
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<th>DOSAGE</th>
<th>Maximum Pediatric Single Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenosine</td>
<td>1.9mg 0.59%</td>
<td>19mg</td>
<td>0.38%</td>
</tr>
<tr>
<td>Albuterol/HN</td>
<td>5mg 6%,</td>
<td>28.5mg</td>
<td>0.5%</td>
</tr>
<tr>
<td>Atropine</td>
<td>0.33% 5.8%</td>
<td>9.5%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Calcium Chloride</td>
<td>300mg 3.8%</td>
<td>1.8mg</td>
<td>0.3%</td>
</tr>
<tr>
<td>Dextrose 10%</td>
<td>95% 0.5%</td>
<td>1.5mg</td>
<td>0.4%</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>0.15% 1%</td>
<td>1.6mg</td>
<td>1.6%</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>0.15% 1%</td>
<td>0.25%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>40% 1%</td>
<td>0.4%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Fentanyl/HN</td>
<td>3mg 6%</td>
<td>30mg</td>
<td>0.6%</td>
</tr>
<tr>
<td>Glucagon</td>
<td>100mg 2%</td>
<td>1mg</td>
<td>1%</td>
</tr>
<tr>
<td>Atropine</td>
<td>0.4% 4%</td>
<td>0.1%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Calcium Chloride</td>
<td>400mg 4%</td>
<td>2mg</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

**19 Kg**

<table>
<thead>
<tr>
<th>MEDICATION</th>
<th>FORMULATION</th>
<th>DOSAGE</th>
<th>Maximum Pediatric Single Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenosine</td>
<td>2mg 0.6%</td>
<td>20mg</td>
<td>0.4%</td>
</tr>
<tr>
<td>Albuterol/HN</td>
<td>5mg 6%</td>
<td>30mg</td>
<td>0.6%</td>
</tr>
<tr>
<td>Atropine</td>
<td>0.4% 4%</td>
<td>0.1%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Calcium Chloride</td>
<td>400mg 4%</td>
<td>2mg</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

**20 Kg BLUE**
Bottom Line with Medications Be Organized and Avoid Calculation in Crisis

Pediatric Bradycardia With a Pulse and Poor Perfusion Algorithm

Identify and treat underlying cause
- Diagnose patient status, avoid treating as necessary
- Oxygen
- Cardiac monitor to identify rhythm; monitor blood pressure and oximetry
- IO/IV access
- 12-Lead ECG if available; don’t delay therapy

Bradycardia persists?
- Support ABCs
- Give oxygen
- Observe
- Consider expert consultation
- Epinephrine
- Atropine for increased vagal tone or primary AV block
- Consider transthoracic pacing/transvenous pacing
- Treat underlying causes

New Epinephrine Labeling
- Say good-bye to 1:1,000 and 1:10,000
- Now it is 1 mg/1 mL for IM dosing
- 0.1mg/mL for IV dosing
17 year old male collapses

- 17 year old male playing basketball
- Sudden collapse; family did chest compressions
- No family or prior history
Defibrillation (New 2015)

- It is reasonable to use an initial dose of 2 to 4 J/kg of monophasic or biphasic energy for defibrillation (Class IIa, LOE C-LD), but for ease of teaching, an initial dose of 2 J/kg may be considered. (Class IIb, LOE C-E0)
- For refractory VF, it is reasonable to increase the dose to 4 J/kg. (Class IIa, LOE C-LD)
- For subsequent energy levels, a dose of 4 J/kg may be reasonable and higher energy levels may be considered, though not to exceed 10 J/kg or the adult maximum dose. (Class IIb, LOE C-LD)

17 year-old male S/P CPA

- Patient did well
- Survived arrest neurologically intact
- Transferred to UCLA for electrophysiologic studies – AICD placed
- Unclear cause of arrest at this point – ruled out prolonged QT
- Referred to genetics

Family Presence

- Family presence for resuscitations is recommended
- Numerous studies have documented that parents wish to be given option of being present during resuscitation of their children
- Develop protocol for family centered care – improves safety as well
Case Presentation 2 month old

ALTE destination

- How many of you would transport this patient to a specialized center according to your protocols?

Case Presentation

- EMS transports a 2 month infant with “ALTE” Apparent Life Threatening Event.
  - Weight 3 kg – Gray on Broselow
  - Born at 25 weeks – Mom fed baby then he started coughing and choking, baby went limp and turned blue
  - Mom started CPR for 2-3 minutes

Pediatric Assessment Triangle

VS: HR 160; RR 24; O₂ sat 99%; 3 kg – Gray on Broselow Tape

Alert
No retractions
Color normal
General Impression

- Normal
- Abnormal
- +/- Abnormal

△ = STABLE
□ □ □ = RESPIRATORY DISTRESS
△ □ □ = RESPIRATORY FAILURE
△ △ △ △ △ = SHOCK
△ △ △ △ △ △ △ = CNS / METABOLIC
△ △ △ △ △ △ △ △ = CARDIO-PULMONARY FAILURE

Back to our patient...

Case: 2 month- baby male

- What is your general impression?
  - Stable at this time; history of respiratory failure (apnea) - ALTE/BRUE
- What are prehospital management priorities?
  - Continuous monitoring of cardiorespiratory status
  - Assess pulse oximetry reading
  - Transport

Hot Issues

- How often do infants with ALTE/BRUE have abnormal physical exam findings in the field?
- Do all infants and children with ALTE/BRUE require transport?

- Retrospective cohort of infants ≤12 months of age over 2 months in Los Angeles County, CA
  - 804 infants of which 60 (7.5%) met criteria for ALTE
  - Mean age for ALTE - 3 months
  - 83% appeared to be in no acute distress
  - 48% of these had serious/life threatening illness at ED evaluation

- Serious illness identified:
  - Anemia
  - Apnea
  - Bacterial meningitis
  - Bronchiolitis*
  - Dehydration
  - Gastroesophageal reflux*
  - Intracranial hemorrhage
  - Pneumonia
  - Seizure
  - Sepsis

* Most common diagnoses

Do all children with ALTE require transport?

- Yes...
- United States standard is transport yet emerging data may allow for transport to noncritical care centers


- Do Infants Less Than or Equal to 12 Months of Age with an Apparent Life Threatening Event (ALTE) Need Transport to a Pediatric Critical Care Center (PCC)?
  - 513 patients with ALTE were transported by EMS to 4 PCCs; 51 (9.9%) had an intervention warranting PCC management.
  - 3 independent predictors for requiring PCC management (sensitivity of 96.3%, specificity of 25.8%, NPV of 98.3%)
    - resuscitation attempt before EMS arrival
    - cyanosis
    - greater than one ALTE in 24 hours
  - Only 9.9% of infants presenting in the field with ALTE needed PCC management, suggesting that many ALTE patients may be safely transported to hospitals without PCC capability.
Case: 2 month-baby male
What Happened?

• Baby noted to have intermittent apnea in the ED
  – RSV infection
• Transferred to PICU
  – Intubated that eve
• Discharged 3 days later doing well

Definitions

• Apparent Life Threatening Event (ALTE): An episode that is frightening to the observer and that is characterized by some combination of apnea, color change, marked change in muscle tone, choking or gagging.

• Brief Resolved Unexplained Event (BRUE): an event occurring in an infant <1 year of age when the observer reports a sudden, brief, and now resolved episode of ≥1 of the following:
  – cyanosis or pallor, absent, decreased, or irregular breathing, marked change in tone (hyper- or hypotonia), altered level of responsiveness (choking or gagging not included)
BRUE

- Clinicians should diagnose a BRUE only when there is no explanation for a qualifying event after conducting an appropriate history and physical examination
- Goal: to foster family-centered care, reduce unnecessary medical evaluations, improve outcomes and foster research.
### BRUE

<table>
<thead>
<tr>
<th>Includes</th>
<th>Excludes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brief/resolved</td>
<td></td>
</tr>
<tr>
<td>• Duration &lt;1 min; typically 20-30 secs</td>
<td></td>
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<tr>
<td>• Patient returns to baseline</td>
<td></td>
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<tr>
<td>• Normal VS and appearance</td>
<td></td>
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<tr>
<td>• &gt;1 min</td>
<td></td>
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<tr>
<td>• Serious underlying symptoms, such as fever, tachycardia, ALOC, petechiae or bruising</td>
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<tr>
<td>• Repeat Events</td>
<td></td>
</tr>
<tr>
<td>Unexplained</td>
<td></td>
</tr>
<tr>
<td>• No identifiable medical condition</td>
<td></td>
</tr>
<tr>
<td>• Event consistent with GERD, child abuse, congenital conditions, infections</td>
<td></td>
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<tr>
<td>Event with cyanosis or pallor</td>
<td></td>
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<tr>
<td>• Central or obstructive apnea</td>
<td></td>
</tr>
<tr>
<td>• Periodic breathing</td>
<td></td>
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<tr>
<td>• Breath holding spell</td>
<td></td>
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<tr>
<td>Marked change in tone</td>
<td></td>
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<tr>
<td>• Hypotonia/hypertonia</td>
<td></td>
</tr>
<tr>
<td>• Seizure or other identifiable condition associated with tone changes</td>
<td></td>
</tr>
<tr>
<td>Altered responsiveness</td>
<td></td>
</tr>
<tr>
<td>• LOC, AMS, lethargy, somnolence</td>
<td></td>
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<tr>
<td>• LOC associated with breath holding</td>
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</tbody>
</table>

### Keys to History

- Sibling death/ sudden death in the family/ sibling with underlying metabolic disease
- Previous illness or exposures to illness
- Loss of milestones
- Recurrent neurological conditions
- Inborn errors/prolonged QT/child abuse
- Helps with risk assessment for infection
- Concern for tumor or degenerative conditions
- Seizures/inborn errors

### Risk Assessment with BRUE

**Patient Factors that Determine Low Risk**

- Age > 60 days
- Prematurity age ≥ 32 weeks or postconceptional age ≥ 45 weeks
- First BRUE
- Duration < 1 minute
- No CPR required by trained medical provider
- No concerning historical features
- No concerning physical findings
A word or two on breath holding

http://www.youtube.com/watch?v=2bKVH5e6IVQ

Breath Holding

• Occurs in 5% of otherwise healthy children
  – Usually begins in second year but not uncommon in infants
  – Disappears by age 4 in 50% of children and by age 8 in
    about 83% of children
  – Self-limited and benign
• The Bottom Line
  – Breath-holding especially the first episode appears
    frightening and may be diagnosed as ALTE
  – Obtain EKG; Hgb; Reassurance

Hot Issues

• What should be the extent of the work-up in the ED?
• Do all infants and children with ALTE/BRUE require admission and continuous monitoring?
Emergency Department

- **History:**
  - Features of incident (seizure?, GERD?)
  - Associated symptoms (choking, apnea, loss of tone, change of color? URI ?, fever?)
  - Recurrent neuro syndromes with minor illness consider metabolic disease
  - Sibling death? (child abuse, inborn errors, prolonged QT)

Emergency Department

- **Physical examination:**
  - Assess vital signs including pulse oximetry
  - Cardiorespiratory monitoring
  - Perform complete physical
    - Gastric contents in nose or mouth suggests GERD
    - Wheezing or coughing suggests respiratory infection (RSV or Bordetella pertussis)
    - Assess for signs of child maltreatment (rare)
    - Abnormal mental status for age, decreased muscle tone, jaundice, rash, fever may be serious signs
ED Diagnostic Testing

- Unclear what tests are necessary... for Low risk BRUE few tests needed
- For afebrile, well appearing infant – my testing strategy...
  - ECG
- Febrile: Work-up based on age (as per SBI), risk stratification, immunization status, RSV, pertussis, blood cultures
- Ill appearing: Full septic work-up, consider head CT; lactate; ammonia; RSV, pertussis, tox screen, CO level, stool for botulinum

Bottom Line

- ED evaluation based on presentation in the ED
- Admission?
  - Admit those who appear ill on arrival, >1 ALTE/BRUE, or those with significant PMH
  - If low risk BRUE may D/C with close follow-up

Conclusions

- ALTE/BRUE has many life threatening causes
- ALTE/BRUE management based on presentation – presence of low risk features
  - In the field, transport to the ED regardless of the presentation; selective transport to pediatric critical care centers
  - In the ED, stabilize and recommend admission in recurrent ALTE/BRUE, abnormal exam on presentation, co-morbid disease or in cases where cause is known but may be progressive