Advanced Life Support in Pediatric IR

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Advanced Life Support in Pediatric IR

• Purpose: Review life support scenarios in one Pediatric IR practice.

• Methods:
  – Scenarios requiring urgent interventions during or within one week of a Pediatric IR procedure were identified.
  – 20 events were reviewed and compared to current pediatric life support algorithms (PALS).
Advanced Life Support in Pediatric IR

• Static Poster, October 2012: Pediatric Interventional Radiology Symposium

• *Simulation added:* IR Lab “Mock Codes”
  – Initiated December 2012
  – Coordinator: Leah E. Braswell, M.D.
Scenario 1

- Teenager passed out at school
- Unresponsive, no breathing, no pulse

- Next steps?
Scenario 1

- Teenager passed out at school
- Unresponsive, no breathing, no pulse

- Next step: CPR begun: ? order
Scenario 1

- Teenager passed out at school
- Unresponsive, no breathing, no pulse

Next steps:
- CPR begun: COMPRESSIONS first
- Emergency response activated/AED retrieved
Asystole

next steps?
Asystole (PALS)

- Start CPR: compressions first, airway/breaths
  - 30:2 compression-ventilation ratio (single rescuer)
- Oxygen, monitor/defibrillator:

- Epinephrine every 3-5 min
  - IO/IV: 0.01 mg/kg (0.1 mL/kg of 1:10,000)
  - CPR 2 min, shockable rhythm?:
- Ventricular Fibrillation:
  - Shock: 2J/kg, CPR 2 min, shock: 4J/kg
- Amiodarone: IO/IV: 5 mg/kg (up to 2 doses)
Sudden cardiac arrest

- In-hospital
  - Arrhythmia

- Out-of-hospital
  - Arrhythmia
  - Trauma
  - Drowning
  - SIDS
Reversible Causes
Cardiac Arrest in Children

- H’s
  - hypovolemia, hypoxia, hydrogen ion (acidosis)
  - hypoglycemia, hypo-/hyperkalemia, hypothermia

- T’s
  - tension pneumothorax, tamponade, toxins
  - thrombosis (pulmonary)
  - thrombosis (coronary)
Secondary Assessment

• Focused history: PALS “SAMPLE” mnemonic
  – Signs and symptoms
  – Allergies
  – Medications
  – Past medical history (*Scenario 1: OHT as infant*)
  – Last meal
  – Events
Scenario 2

• Sclerotherapy procedure
  – 8 month old infant
  – extensive buttock/abdominal wall macrocystic lymphatic malformation
  – 10 ml 3% sotradecol injected
Sinus Tachycardia: P waves present, R-R variable

next steps?
Sinus Tachycardia: identify/treat cause

- **Assess patient:**
  - Ventilation: intubated, stable
  - Pulse > 200 for over 6 minutes
  - Perfusion: BP drop

- **Anesthesia staff:**
  - Called for staff back-up
  - Vasopressor medication administered

- **IR staff:**
  - Sclerotherapy stopped
  - Sclerosed contents aspirated
Sinus Tachycardia (PALS)

- Normal heart rate (3 months to 2 years age):
  - 100-190 beats per minute

- Common causes of Sinus Tachycardia:
  - exercise, pain, anxiety, fever
  - tissue hypoxia, hypovolemia, shock, metabolic stress, anemia
  - toxins/poisons/drugs
Sinus Tachycardia

• Common causes:
  – Exercise, pain, anxiety, fever,
  – tissue hypoxia, hypovolemic, shock, metabolic stress, injury, anemia
  – Toxins/poisons/drugs: (Scenario 2: SCLEROSANT)

• Search for and treat cause:
  – Sclerotherapy discontinued
Scenario 3

- 7 day old infant with osteomyelitis requiring PICC
- Single dose IV Versed/Ketamine:
  - Drop in pulse oximetry and apnea
- Next steps?
Oversedation

- Airway repositioned, bag/mask ventilation, 100% O2
- Hypoventilation persisted
- Next step?
Oversedation

- Airway repositioned, bag/mask ventilation, 100% O2
- Hypoventilation persisted

Next step:
Oversedation

• Flumazenil dose given
  – 0.01 mg/kg IV

• Spontaneous ventilation returned

• Observe patient for 2 hours S/P reversal agent to assess for recurrent oversedation
Sedation reversal agent: Flumazenil

- Benzodiazepine receptor agonist
- IV flumazenil (0.01 mg/kg)
  - can repeat up to 1 mg

- Observe patient for 2 hours* given shorter half life of reversal agent:
  - flumazenil half life: 40-80 min
  - versed half life: 1-2.5 hours (up to 7 hours for premature infants)*
Scenario 4

- Central venous guidewire measurement near completion of PICC placement
- HR abruptly increases
  - Normal pulse oximetry
  - Normal BP

- Next steps?
“Mock Code” ACH IR Lab
“Mock Code” ACH IR Lab
SVT:
P waves absent, rhythm uniform
Scenario 4: SVT

- Central venous guidewire measurement near completion of PICC placement
- HR > 220

Next steps?
SVT

• Ice pack to face (vagal stimulation)

• Dose of IV adenosine calculated (0.1 mg/kg)
SVT

• Vagal maneuvers:
  – Infant: ice pack to face (Scenario 4)
  – Older child: blow through obstructed straw, carotid massage

• Dose of IV adenosine calculated
  – 0.1 mg/kg
  – Plan: rapid bolus 2 syringe technique

• Pediatric Cardiology informed

PALS book
SVT: *if* vagal maneuvers unsuccessful

- **Adenosine**: rapid bolus 2 syringe technique
  - 1\(^{st}\) dose: 0.1 mg/kg
  - 2\(^{nd}\) dose: 0.2 mg/kg

- *If unstable*: Synchronized cardioversion
  - 0.5-1 J/kg, if not effective, increase to 2 J/kg
Scenario 6

- 2 days S/P IR Cecostomy tube placement
- Fever, tachycardia, abdominal distention
- Urine output below 0.5 ml/kg over past 12 hours

• Next steps?
Cecostomy tube sinogram: no leak, patient tender
Peritonitis/Septic shock

- Pediatric Surgery consulted
- IV fluid bolus and increased IVF maintenance
- Strict I’s and O’s
- 7 days broad spectrum IV antibiotics

*IVF bolus warranted much earlier in retrospect*
Septic shock (PALS)

- Oxygen, support ventilation, monitor vital signs, establish vascular access
- Aggressive isotonic bolus fluid administration in first hour
- Frequent re-assessment of perfusion
- Vasoactive agents if septic shock is fluid refractory
Scenario 5

- 8 y/o girl autism/severe movement disorder
- 3 days S/P IR G-tube placement:
  - Morning rounds:
    - Tachycardia
    - Low urine output (below 0.5 ml/kg/hour)
    - IVF rate increase recommended to Pediatric team
  - Afternoon:
    - Fluoroscopic contrast check
    - G-tube malpositioned
    - Tube repositioned by IR
Hypovolemic shock

- Evening: patient decline
  - Poor perfusion
  - Cardiopulmonary arrest
  - IVF bolus warranted much earlier in retrospect
  - Patient expired 1 week after ICU care

- Hospital wide “Root Cause” analysis
- Change in IR G-tube placement order sets/team responsibilities
Hypovolemic shock (PALS)

- Children receiving appropriate volume of fluid within the first hour of resuscitation have best chance at survival
- Infuse 20 ml/kg boluses of isotonic crystalloid rapidly to treat hypovolemic shock due to dehydration; deliver each over 5-20 minutes
- Not uncommon to require 3-5 fluid boluses in first hour
Scenario 7

- 10 y/o S/P MVA with facial fractures and subdural hematoma

- In OR for subdural hematoma decompression
  - Anesthesia noted tachycardia/hypotension
  - Pulled back drapes: massive nasal/oral cavity bleeding
  - Vitals unrecordable: CPR begun
Hemorrhagic shock

- IV fluid resuscitation
- Nasal packing
- Common carotid artery ligated (temporary)
- Packed RBC's: 9 units received in OR
- Inotropic support:
  - Epinephrine/norepinephrine IV drips
- To IR Lab for angiography
Carotid Cavernous Fistula: urgent embolization
Hemorrhagic Shock (PALS)

• Moderate/severe hypotensive hemorrhagic shock correlates with 30% loss of blood volume (about 25 ml/kg).

• Transfusion indication:
  – Poor response to IVF boluses (poor perfusion despite 40-60ml/kg of crystalloid)
  – Known significant blood loss
Scenario 8

- 1 month-old with pneumonia and parapneumonic pleural effusion
- IR chest tube placement
- 7 hours later:
  - Increased work of breathing/desaturations
  - Low chest tube output despite post-procedural dose of alteplase
- PICU transfer, chest radiograph ordered
Tension pneumothorax
S/P IR chest tube
Tension pneumothorax

- Chest tube: stopcock was open; tube clogged
- Tube resistance resolved with manual flush (gush of fluid, then air)
- If unable to clear tube and severely distressed:
  - needle thoracostomy
  - 2nd intercostal space mid-clavicular line
- IR bedside rounding: monitor tube output, stopcock alignment, and tube patency
Sudden deterioration intubated patient (PALS)/Chest tube

• DOPE Mnemonic:
  – Displacement of the tube
  – Obstruction of the tube (*Scenario 8: tube clogged*)
  – Pneumothorax
  – Equipment failure
IR Lab: Simulated “Mock Codes”
Simulated: IR Lab “Mock Codes”

ACH “PULSE center” IR scenarios/video
PICU attending supervision

Post simulation team debriefing
Conclusion

- Most interventions followed PALS guidelines
- IV fluid administration was delayed in septic and hypovolemic shock after IR bowel tube placement.
- Knowledge of life support scenarios and required urgent interventions are pertinent in Pediatric IR practice.
- Simulated IR Lab “Mock Codes” helpful
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• Reference:
  • Pediatric Advanced Life Support
    – Provider Manual
    – 2011 American Heart Association

• The “PULSE center”
  – Arkansas Children’s Hospital
Thanks