PEDIATRIC POST CARDIAC ARREST ALGORITHM

Inclusion Criteria:
- Any patient who has a cardiac arrest lasting greater than 1 min before ROSC who is admitted to PICU

Exclusion Criteria:
- Cardiac arrest patients admitted to the CICU or NICU
- Cardiac arrest with return of spontaneous circulation (ROSC) CPR greater than 1 min
- Persistent alteration of mental status (AMS) from baseline and/or requiring intubation/mechanical ventilation

Initial Studies
- Blood gas, RFP, Mg, iCa, lactate, type and screen, CXR, EKG, tox screen
- Additional studies as clinically indicated

Initial Studies
- CMP, Mg, phos, iCa, glucose, CBC, coags, fibrinogen, blood gas, lactate, type and screen, CXR, EKG, Tox screen
- Consider: Troponin, Cortisol, Co-oximetry, cultures, ECHO

Monitoring
- Schedule antipyretics for 48 hrs
- Target normal vital signs for age
- Consider Neurocritical care consultation

Other Considerations (all patients)
- Consider rehab consult as indicated
- Cardiology consult for V-fib or V-tach arrests
- Early enteral nutrition when clinically stable; goal to start within 48 hours of ROSC

Targeted Temperature Management
- PICU TTM orders can be found in either Post Cardiac Arrest or PICU TTM order sets
- Refer to Critical Thermoregulation Policy as needed
- Goal temp 36.5°C for 24-48 hours and afebrile for at least 5 days from ROSC

Suggested Lower Limit of Blood Pressure (Hypotension) based on age
- Age less than 1 year: SBP greater than 75 or MAP greater than 45
- Age 1-9 years: SBP greater than 85 or MAP greater than 55
- Age 10-17 years: SBP greater than 100 or MAP greater than 65
- Details can be found on page 5

Consider targeting a GIR instead of IVF
- Dextrose Concentration for patients less than 12 months or those with hypoglycemia
- Infants less than 5kg: GIR 7.0
- Details can be found on pages 5-6

Clinical Goals/Strategies
- Maintain for at least 72 hrs, or return to neurologic baseline
- Avoid hypotension (see green box on left)
- Normoxia (SpO2 92%-95% or PaO2 60-300 mmHg)
- Normocarbia (pCO2 35-45 mmHg)
- Normonatremia (Na 135-145 mmol/L)
- Normothermia (see Targeted Temperature Management box for details)
- Euglycemia (80-180 mg/dL); refer to Critical Care Hyperglycemia protocol as indicated
- Isotonic IV fluids w/o dextrose (add dextrose with concern for hypoglycemia or age less than 12 months)(see green box on left)

Recommended Lab Schedule
- Blood glucose q 2 x 6 hrs or until dextrose added to IV fluids
- Blood gas, iCa, RFP, Mg q 6 x 24-48 hrs
- CBC, coags, CMP q 12 x 24-48 hours, then as clinically indicated
- Consider brain MRI at 72 hrs
TARGET POPULATION

Inclusion Criteria

- All patients admitted to the PICU after out-of-hospital cardiac arrest or in-hospital cardiac arrest who:
  - Regain spontaneous circulation after CPR lasting greater than or equal to 1 minute, OR
  - Undergo eCPR (CPR with cannulation to ECMO)
- Patients must:
  - Exhibit persistence of alteration of mental status from their baseline, AND/OR
  - Require Intubation and/or mechanical ventilation

Exclusion Criteria

- Admitted to the CICU or NICU

BACKGROUND

Each year in the United States, children suffer approximately 5000 out-of-hospital cardiac arrests and 6000 in-hospital cardiac arrests. Many of the children who suffer cardiac arrest and obtain return of spontaneous circulation (ROSC) will develop post cardiac arrest syndrome (PCAS). PCAS is a pathophysiologic inflammatory response that results in brain injury, myocardial dysfunction, systemic ischemia/reperfusion injury and persistent precipitating pathophysiology. The goal of post cardiac arrest care is to increase survival to hospital discharge with favorable neurologic outcome by supporting organ function by adequately supplying tissues with appropriate oxygen and substrate to meet metabolic demand, evaluate for and reverse etiologies of cardiac arrest, and reduce secondary neurologic injury.

DEFINITIONS

- Cardiac arrest: The cessation of cardiac mechanical activity as confirmed by the absence of signs of circulation
- Respiratory arrest: The cessation of spontaneous respiratory effort such that there is ineffective ventilation and/or oxygenation
- Return of spontaneous circulation (ROSC): The restoration of a spontaneous perfusing rhythm that results in more than spontaneous gasp, fleeting palpable pulse or arterial waveform
CLINICAL PATHWAY

• Altered mental status (AMS):
  o Persistently diminished ability to maintain alertness and cognition
  o Including AMS resulting from sedative medications and inability to fully assess mental status as a result of endotracheal intubation or other therapies which might prohibit a full neurologic exam
  o In patients with baseline neurologic dysfunction, determining alteration of mental status can be challenging and appropriateness of this clinical pathway is at the discretion of the treatment team

INITIAL EVALUATION

Initial Evaluation in the PICU

• Comprehensive physical exam including comprehensive neurologic exam
• Specific attention to certain aspects of the neurologic exam:
  o Assess cranial nerves, Glasgow Coma Scale, level of consciousness (careful consideration given to pre-arrest neurologic baseline, as patients who have had short in-hospital cardiac arrest with no change in neurologic status from baseline proceed down the algorithm differently than those with change in neurologic functioning)
• For patients who DO NOT exhibit an alteration of mental status from baseline (ie arousable, attentive, follow commands, localize painful stimuli, not intubated), the following studies are recommended:
  o Arterial or Venous Blood Gas with ionized Calicum
  o Renal function panel
  o Magnesium
  o Ionized calcium
  o Lactate
  o Toxicology screen
  o Type and screen
  o Chest radiograph
  o EKG
  o Other labs to be obtained at the discretion of the attending based on clinical scenario
• For patients who DO exhibit a persistence of altered mental status from baseline (unconscious and/or requiring intubation), the following studies are recommended:
  o Complete metabolic panel
  o Magnesium
  o Phosphorus
  o Ionized calcium
  o Complete Blood Count
  o Coagulation Panel
  o Fibrinogen
  o Lactate
  o Arterial Blood Gas
  o Type and Screen
  o Chest radiograph
  o EKG
Additional studies to be obtained for selected patients at the discretion of the attending physician:

- Echocardiogram
- Troponin
- Urine toxicology screen
- Co-oximetry
- Blood culture
- Urine cultures
- Cortisol
- Non-contrast computed tomography (CT) of the head to evaluate for acute pathology and/or aid in determining etiology of cardiac arrest
  - Also strongly consider early head CT if neurologic exam demonstrates asymmetry
  - Early head CT findings can also potentially provide limited information on prognosis

**Clinical Management**

For patients who **DO NOT** exhibit an alteration of mental status from baseline (arousable, attentive, follow commands, localize painful stimuli, not intubated)

**Monitoring**
- Routine PICU monitoring

**Clinical Goals and Strategies**
- Avoidance of fever: schedule antipyretics for 48 hours
- Target normal vital signs for age
- Consider Neurocritical care team consultation

For patients who **DO** exhibit a persistence of altered mental status from baseline (unconscious and/or requiring intubation)

**Monitoring**
- Routine PICU monitoring
- Continuous invasive blood pressure monitoring via arterial catheter
- Continuous EEG for 24 hours
  - Prolonged monitoring may be indicated based on clinical scenario
- Rectal temperature probe, esophageal probe if rectal contraindicated (refer to Targeted Temperature Management Policy)
- Continuous end-tidal CO₂ monitor while intubated

**Clinical Goals and Strategies**
- ***These strategies should be provided for 72 hours to 5 days, with the ultimate duration determined by improved neurologic status and extubation readiness***
- Controlled normothermia: Goal Temperature 36.5°C
Use Criticool Thermoregulation Device (See PICU Post Cardiac Arrest Order Set and/or Targeted Temperature Management Policy)

For patients presenting with core temperature below 33°C, use Normothermia Mode to rapidly warm to 33°C, then transition to Controlled Rewarming Mode with Goal Core Temp 36.5°C

For patients presenting with core temperature between 33°C and 35°C, use Controlled Rewarming Mode with Goal Core Temp 36.5°C

For patients presenting with core temperature greater than 35°C, use Targeted Temperature Management Mode with Goal Core Temp 36.5°C

- **Normotension:**
  - Hypotension, as defined as a mean arterial blood pressure less than the 5th percentile for age, gender and height, is associated with worsened outcomes following pediatric cardiac arrest
  - Aggressive treatment of blood pressures nearing hypotension is advised. Treatment strategies are to be determined by the clinical team as indicated by the patient’s clinical state.
  - Suggested **lower limit** of blood pressures at which treatment should be initiated to prevent systemic hypotension:

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<tr>
<th>Age</th>
<th>Boys</th>
<th>Girls</th>
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<td></td>
<td>SBP 75 or MAP 45</td>
<td>SBP 85 or MAP 55</td>
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<td>&lt; 1 year</td>
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<td>72/31 (45)</td>
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<td>1-9 years</td>
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- **Normoxia** (SpO2 92%-95% or PaO2 60-300 mmHg)
- **Normocarbia** (pCO2 35-45 mmHg; can target normal pH if the patient has evidence of chronic CO2 retention)
- **Normal serum sodium** (135-145 mmol/L)
- **Normoglycemia** (80-180 mg/dL)
  - If the patient develops hypoglycemia, treat urgently, and recheck glucose quickly and frequently
  - For patients with persistent hyperglycemia, refer to the Critical Care Hyperglycemia policy/order set
- **Intravenous (IV) fluids:**
  - If greater than 12 months of age: For maintenance intravenous fluids (IVF), use isotonic fluids without dextrose initially
Add dextrose to IV fluids at 24 hours post-resuscitation or if serum glucose falls below 80 mg/dl

- If less than 12 months of age and greater than 5kg: For maintenance IVF, use isotonic fluids with 5% dextrose.
  - Because many patients require large volumes of IV medications in addition to their maintenance IVF, and have total fluids orders which reduce the total amount of maintenance IVF the patient is receiving, the medical team could consider targeting a glucose infusion rate (GIR) instead of a total rate of maintenance IVF. Patients greater than 5kg who are receiving maintenance IVF with 5% dextrose would be receiving a GIR of 3.5, thus a GIR of 3.5 could be targeted if IVF rate being delivered to the patient is less than maintenance rate as determined by the 4-2-1 rule.

- If less than 12 months of age and less than or equal to 5kg: For maintenance IVF, use isotonic fluids with 10% dextrose.
  - Because many patients require large volumes of IV medications in addition to their maintenance IVF, and have total fluids orders which reduce the total amount of maintenance IVF the patient is receiving, the medical team could consider targeting a glucose infusion rate (GIR) instead of a total rate of maintenance IVF. Patients less than or equal to 5kg who are receiving maintenance IVF with 10% dextrose would be receiving a GIR of 7.0, thus a GIR of 7.0 could be targeted if IVF rate being delivered to the patient is less than maintenance rate as determined by the 4-2-1 rule.

- Target euvolemia/even fluid balance once hemodynamically stable (defined as no fluid boluses and/or no escalation of vasoactive medications for at least 6 hours)

  - Early enteral nutrition: recommend placing nasoenteric tube when the patient is clinically stable with a goal of initiating enteral feeding within 48 hours of admission
  
  - Recommended lab schedule:
    - Arterial blood gas, iCa, renal function panel, magnesium every 6 hours for 24-48 hours, and then as clinically indicated
    - CBC, coagulation panel, CMP every 12 hours for 24-48 hours, and then as clinically indicated
  
  - Consult Neurocritical care team at admission

**Other Considerations (all patients)**

- For patients with documented or suspected ventricular fibrillation or ventricular tachycardia as initial arrest rhythm, strongly consider cardiology consultation to rule out arrhythmia syndrome

- Rehabilitation Medicine: consider consultation for assistance with optimal rehabilitation (timing, modalities, location, etc), tone management, prognostication and/or efficient transition of care out of the PICU

**IMAGING**

- Early head CT is recommended if etiology of cardiac arrest is unknown or if there is an asymmetric neurologic exam.
  - If obtained for a clinical indication, early head CT can also be combined with other clinical and historical data to aid in understanding of degree of acute neurologic injury

- CT of the neck should be considered in cases of trauma, asphyxiation/hanging and/or drowning to evaluate for cervical spine injury and/or vascular injury.

- If assistance with prognosis is desired, brain MRI can be helpful in providing information related to extent of acute brain injury. This information should be added to the rest of the clinical picture.
  - If MRI brain is desired, do not obtain earlier than 72 hours after admission (wait an additional 48-72 hours if hypothermic arrest and/or if patient has undergone therapeutic hypothermia)
RELATED DOCUMENTS AND LINKS

- Severe Traumatic Brain Injury Guideline
- Glycemic Guidelines: Patients 6 months of age and older in Critical Care Units
- Therapeutic Hypothermia in the PICU and CICU Policy
- Thermoregulation: Targeted Temperature Management PICU Policy
REFERENCES

General

Background

Clinical Goals and Strategies

Monitoring
Nutrition


Imaging


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PICU Quality, Safety and Practice Council – 4/2021  
Neurocritical Care Group – 12/2020  
Pharmacy & Therapeutics Committee – 6/2021  
Clinical Pathways and Measures Committee – 5/24/2021

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COLORADO SPRINGS REVIEW BY

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REVIEW REVISION SCHEDULE

Scheduled for full review on June 15, 2025

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