

## **Carolinas HealthCare System ADULT Post-Cardiac Arrest Resuscitation Care Guidelines**

**GOAL:** Provide optimal post-cardiac arrest resuscitative care that includes active temperature, hemodynamic, and ventilator management to improve survival and good neurologic outcome in patients resuscitated from cardiac arrest.

**NOTE:** If recovery from the underlying disease process that led to the cardiac arrest is unlikely, do not proceed with aggressive resuscitative measures via this guideline.

### **INCLUSION CRITERIA:**

- (1) Adults (age  $\geq$  18 years)
- (2) Comatose (GCS < 9 or no motor response to loud stimuli)
- (3) Intubated
- (4) ROSC following resuscitation from cardiac arrest regardless of initial rhythm

### **EXCLUSION CRITERIA:**

#### **Absolute Contraindication:**

- (1) Severe terminal illness preceding the cardiac arrest
- (2) Do Not Resuscitate (DNR) Status

#### **Relative Contraindications:**

- (1) Pregnancy: Case reports show its feasibility and has been done successfully at CHS.
- (2) GCS  $\geq$  9: This protocol is intended for comatose patients.
- (3) Resuscitation time (time of collapse to ROSC) > 60 minutes for initial rhythm of VF/VT.
- (4) Resuscitation time (time of collapse to ROSC) > 40 minutes for initial rhythm of PEA/asystole.
- (5) Core temperature below 33° C (91.4° F): Rewarm to 33° C and maintain.
- (6) Encephalopathy unrelated to cerebral anoxia: This protocol was developed for patients suffering cerebral anoxia due to cardiac arrest. Other causes of coma including: overdose/intoxication, stroke and trauma should be considered prior to implementation of cooling.
- (7) Traumatic arrest due to exsanguination: Patients involved in a traumatic event (i.e., motor vehicle crash) with the participating event of cardiac arrest without evidence of significant traumatic injury should be considered for cooling.
- (8) Imminent cardiovascular collapse despite aggressive resuscitative measures.
- (9) Active or suspected bleeding or severe coagulopathy: Hypothermia may increase the risk of bleeding. Consider targeting 36° C which eliminates the coagulopathic effects of therapeutic cooling. Patient may receive antiplatelets, anticoagulation or thrombolytics during hypothermia therapy even if targeting 33° C.
- (10) Systemic infection/sepsis: Hypothermia may suppress the immune response. Consider targeting 36° C.
- (11) Intra-cranial hemorrhage: order CT head if any suspicion of head trauma or intracranial hemorrhage. Consider targeting 36° C.

\*\*\* The inclusion and exclusion criteria are provided as a guideline and clinical discretion supersedes these criteria if the benefit outweighs the risk \*\*\*

### **ACTIVATION & LOGISTICS:**

- (1) Upon meeting inclusion/exclusion criteria, Activate ADULT CODE COOL via the CHS-Physician Connection Line (PCL) at 704-512-7878 or other connection line). This is imperative for patient tracking and should be done at both Level I (Receiving) and Level II (Transferring) Cardiac Resuscitation Centers for both out-of-hospital and in-hospital cardiac arrests. If questions arise regarding the candidacy of the patient for the ADULT CODE COOL pathway, discussion with the Emergency Medicine and Pulmonary Critical Care Medicine attending at the Level I Center should be done.

- (2) Therapeutic hypothermia should be started as soon as possible following ROSC. Patient will likely benefit from cooling initiated up to 12 hours post-arrest.
- (3) Patients transferred from Level II facilities to Level I facilities should have cooling initiated prior to transfer with cold IV fluids, ice packs, and paralytics.
- (4) Comatose cardiac arrest patients with ST-elevation myocardial infarction (STEMI) are candidates for emergency percutaneous coronary intervention (PCI) and hypothermia should not be withheld or delayed. Activation of Code STEMI should be done per institutional/hospital guidelines.
- (5) Once the patient is at the Level I Cardiac Resuscitation Center, Pulmonary Critical Care Medicine and Cardiology consultant teams should be consulted.
- (6) Notify provider when goal temperature is achieved (goal is to reach 33°C within 4 hours of reaching a Level I Cardiac Resuscitation Center and within 5-½ hours from ROSC.
  - a. If intolerance or contraindication to cooling to 33°C (sepsis, active life-threatening bleeding) then target temperature should be 36°C with active temperature management.

## **I. INDUCTION PHASE**

**Goal:** Achieve goal temperature of 33° C as quickly as possible. Modify below measures if 36°C is needed as target temperature due to intolerance to 33°C, sepsis, or bleeding.

- (1) Infuse refrigerated normal saline (NS) 30 mL/kg IV bolus as rapidly as possible.  
Refrigerated 4-6° C NS should be stored in the ED, ICU, CCU, and Cath Lab medication refrigerators.
- (2) Ice packs should be applied to the patients head/neck, axilla, groin, and extremities during the induction phase, with a minimum of 15 large zip-lock bags applied.
- (3) Do not delay cooling induction for cardiac cath lab or CT imaging, as cold IV fluids, ice packs, and paralytics are effective for cooling and should be instituted despite need for patient transport.
- (4) When Code Cool is activated in the ED, the ED RN is responsible for placing temp-sensing foley catheter, ice packs, and starting the cold IVF.
- (5) Obtain baseline neuro status (GCS) prior to initiating sedation and paralytic.
- (6) Neuromuscular blocking agents are necessary for rapid cooling during induction phase and should be given at the onset of cooling (First line: Vecuronium 0.1 mg/kg Injection). Additional vecuronium 0.1 mg/kg IV boluses should be administered every hour PRN during induction phase to eliminate shivering.
- (7) Sedation:
  - a. Propofol – Start infusion at 10 mcg/kg/min; For titration: Increase rate by 10 mcg/kg/min (May titrate infusion every 5 mins) for RASS -4; Notify provider if infusion rate is 50 mcg/kg/min OR for 5 rate increases in 24 hours; Check Triglyceride level according to Code Cool Firstnet PowerPlan (or similar orderset if not using Cerner).
  - b. Fentanyl – Give 50 mcg IV Bolus and increase rate by 10 mcg/hr (May titrate every 15 mins) to achieve pain control based on behavioral pain scale; Notify Provider if infusion rate is 200 mcg/hour or greater OR if 5 boluses given within 24hrs.
- (8) Magnesium Sulfate Bolus – 2 gm Injection IV PIGGYBACK, once for shivering control.
- (9) Failure to reach goal temperature is likely a consequence of clinical or subclinical shivering. See shivering therapy below.
- (10) Adherence to Hemodynamic and Ventilator goals as described in maintenance phase is essential.
- (11) Continued cooling via automated device via Arctic Sun or Zoll device should be implemented within 90 minutes of initiation of cooling process. This can occur either in the ED or the ICU depending on duration of time in the ED. The automated cooling device can be started during cold saline administration and ice pack application.
- (12) Nursing Documentation
  - a. Pre-induction GCS. Patient temperature, water temperature, and shivering should be documented every 15 minutes during this phase. Skin checks every two hours when pads are used.

## **II. MAINTENANCE PHASE**

**Goal:** Maintain goal temperature of **33° C for 24 hours.**

- (1) Therapeutic hypothermia is to be maintained for 24 hours once goal temperature of 33° C is achieved.
- (2) The temperature control device (i.e., Arctic Sun pads or Zoll catheter) should remain in place during patient transfers, radiography and procedures. Open access to the groin and torso generally permits procedures including central venous access and PCI.
- (3) Treating physicians may use their discretion to raise goal temperature or terminate hypothermia therapy early. Examples include a patient who regains consciousness or develops complications or instability that may be related to cooling. Rewarming at rate of <0.5°C/hour is essential to avoid cerebral complications but clinical judgment may dictate more rapid warming. Slower rewarming may be indicated if hemodynamic instability develops.
- (4) Controlled rewarming should be initiated following 24 hours of therapeutic hypothermia at goal temperature (33° C).
- (5) Nursing Documentation
  - a. Patient temperature, water temperature, and shivering should be documented every hour during this phase. Skin checks every two hours when pads are used.

### Sedation/Shivering Protocol

- (1) Sedation and analgesia are applied similar to non-comatose patients undergoing uncomfortable therapies, but often higher doses are required.
- (2) Initiate sedation with **fentanyl** 50 mcg/hour and **propofol** (Diprivan) 10mcg/kg/min IV and titrate to resolution of clinical shivering and temperature control. Midazolam may be substituted for propofol if needed. See CRIT Sedation and Analgesia for the Mechanically Ventilated Patient.
- (3) The desired level of sedation is Richmond Agitation Sedation Scale (RASS) -3.
  - a. Optimize/maximize sedation with fentanyl and propofol.
  - b. Midazolam 1 mg Injection IV PUSH q2h PRN Other for MILD agitation; Notify Provider if 5 doses given within 24 hours.
  - c. Midazolam 2 mg Injection IV PUSH q2h PRN Other for MODERATE agitation; Notify Provider if 5 doses given within 24 hours.
  - d. Midazolam 5 mg Injection IV PUSH q2h PRN Other for SEVERE agitation; Notify Provider if 5 doses given within 24 hours.
- (4) The desired level of shivering control is a Bedside Shivering Assessment Scale (BSAS) ≤ 1.
  - a. If BSAS GREATER than 1, continue titration of propofol and fentanyl to maximal doses,
  - b. If BSAS still GREATER THAN 1 after 15 minutes, begin Magnesium Sulfate 0.5 gram/hour IV (INTRAVENOUS) for target serum Magnesium 3 mg/dL. Notify Provider if Magnesium is GREATER THAN 3 mg/dL,
  - c. If BSAS still GREATER THAN 1 after 30 minutes from starting Magnesium Sulfate infusion, administer Ketamine 0.5 mg/kg IVP.
  - d. If BSAS still GREATER THAN 1, 30 minutes after initiation of above meds, add vecuronium 0.1 mg/kg IV Q1 hour PRN. Paralysis should only be necessary under extraordinary circumstances. Paralytic agents via continuous infusion should be avoided and are rarely, if ever, needed.

### Hemodynamic Recommendations

- (1) Target mean arterial pressure (MAP) > **70 mmHg**. May need MAP > 80 mmHg for improved Cerebral Perfusion, especially in patients with chronic hypertension.
- (2) Anticipate post-cardiac arrest shock, as 50% of post-arrest patients will develop hypotension.
- (3) If needed, begin **Norepinephrine** (Levophed) at 5 mcg/min and titrate q5min by 5 mcg/min to a MAX rate of 30 mcg/min. Notify physician if higher doses required.
- (4) Post-arrest hypertension (MAP > 120 mmHg) is common and may improve cerebral perfusion. Blood pressure in this range should not be lowered in the absence of end-organ dysfunction.
- (5) Central venous catheters (CVC) are not mandatory. Refrigerated IVF should be preferentially administered via a peripheral intravenous line. If a central venous catheter is clinically indicated, STERILE technique is essential.

- (6) Avoid CVC placement in the LEFT subclavian vein to preserve this site for internal defibrillator placement.
- (7) Sinus bradycardia is common during cooling and can be expected, but does not require therapy unless contributing to hemodynamic compromise.
- (8) Vasodilators, beta-blockers, and anti-dysrhythmics should be used judiciously.

#### **Ventilator Recommendations**

- (1) Avoid hypoxia and hyperoxia. Aim for normoxia.
- (2) Titrate  $F_iO_2$  rapidly down while ensuring oxygen saturation remains  $\geq 95\%$ . Target  $P_{A}O_2$  to approximately 100 mmHg.
- (3) Avoid hyperventilation. Target  $P_aCO_2$  40 – 45 mmHg, or titrate  $P_{ET}CO_2$  for 35 – 40 mmHg.

#### **III. RE-WARMING PHASE:**

**Goal:** Controlled re-warming  $\leq 0.5^\circ\text{C}/\text{hour}$  to  $37.0^\circ$ .

- (1) After 24 hours at maintenance temperature, begin controlled re-warming no faster than 0.5 degrees Celsius to  $37^\circ\text{C}$  via Temperature Control Device.
- (2) The Medivance Arctic Sun is manually programmed for controlled rewarming over 16 hours.

**Maintain sedation until patient reaches  $36^\circ\text{C}$ .**

- (3) Changes in blood pressure, blood sugar and electrolytes may occur during rewarming.
- (4) The goal of re-warming is to achieve normothermia with strict avoidance of hyperthermia. Rewarming is a high-risk period as patients can develop dysrhythmias, potassium shifts due to extracellular potassium shifts, and hemodynamic instability due to warming-associated vasodilation. Careful cardiac monitoring, cautious potassium repletion and close monitoring, and close monitoring of vital signs to avoid hypotension are essential.
- (5) Nursing Documentation
  - a. Patient temperature, water temperature, and shivering should be documented every hour during this phase. Skin checks every two hours when pads are used.

#### **IV. NORMOTHERMIA PHASE:**

**Goal:** To maintain normothermia (no temperature  $\geq 38^\circ\text{C}$ ) during the first 2 days after rewarming phase completed to prevent further brain injury in accordance with the AHA's Get-With-the-Guidelines® Resuscitation recommendations.

- (1) Cooling Device to remain in place and operational with goal temperature of  $36^\circ\text{C} - 37^\circ\text{C}$  for 48 hours (or until provider order to discontinue) for unconscious patients.
- (2) After patient is rewarmed to  $37^\circ\text{C}$ , the Arctic Sun machine can be released if another patient requires therapeutic hypothermia. If Arctic Sun is released and utilized on another patient, ensure normothermia is maintained by others means as needed (i.e., anti-pyretics, cooling blanket, and/or ice packs).
- (3) Nursing Documentation
  - a. Post-cool (completion of entire Code Cool clinical pathway) GCS. Patient temperature and water temperature should be documented every hour during this phase. Skin checks every two hours when pads are used.

### **Neurology Consultation, EEG Monitoring, and Neurological Prognostication**

- EEG monitoring is encouraged for all Code Cool patients, if available.
- Urgent EEG use (within 6 hours of admission to the ICU) is encouraged and should be continued through the duration of maintenance and the rewarming phases when possible. EEG is often extended into the normothermia phase for epileptiform activity or seizures.
- Consult neurology for assistance with prognostication or seizure control.
- Neurological prognostication should be performed per institutional/hospital-specific guidelines.
- Neurological prognostication is challenging in the post-arrest patient that undergoes therapeutic hypothermia and typically should not be attempted until 72 hours after completion of the maintenance phase of therapeutic hypothermia with the exceptions of myoclonus status (as defined as generalized myoclonic convulsions in face and extremities and continuous for a minimum of 30 minutes) in the first 24 hours after admission, brain death due to cerebral herniation, or because of ethical reasons (for instance: previously unknown information about disseminated end-stage cancer or refractory shock with end-stage multi-organ failure). However assumptions of a poor neurological function should be avoided as the sole reason for withdrawal of active treatment prior to 72 hours after the intervention period/maintenance phase.

### **Assistance with Temperature Management Devices:**

- (1) For technical issues related to the Arctic Sun cooling device, assistance may be obtained by calling the Medivance Territory Manager Brian Marlowe at (336) 403-9003 (cell phone, best number) or Medivance U.S. corporate clinical and technical support hotline at 866-840-9776.
- (2) For technical issues related to the Zoll intravascular cooling device, assistance may be obtained by calling the Zoll Territory Manager Bill Haun at (864) 313-9213 (cell phone) or Zoll technical support hotline at (800) 663-3911.

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Based on initial versions of: Carolinas Medical Center Therapeutic Hypothermia After VT/VF Arrest Care Guidelines, 3<sup>rd</sup> revision 10/2007. Original Authors: Alan Heffner, MD; Alan Jones, MD; David Pearson, MD.

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**Table 1. Bedside Shivering Assessment Scale\***

<b>Score</b>	<b>Type of Shivering</b>	<b>Location</b>
<b>0</b>	None	No shivering is detected on palpation of the masseter, neck, or chest muscles
<b>1</b>	Mild	Shivering localized to the neck and thorax only
<b>2</b>	Moderate	Shivering involves gross movement of the upper extremities (in addition to neck and thorax)
<b>3</b>	Severe	Shivering involves gross movements of the trunk and upper and lower extremities

\*Badjatia et al. *Stroke* 2008.