

PROTOCOL FOR: Hypothermia Protocol for Resuscitated Cardiac Arrest

## I. Eligible Patients

### A. Inclusion Criteria:

1. The adult (>18 yrs) pre-hospital or in-hospital arrest patient whose initial arrest rhythm is ventricular fibrillation or pulseless VT (other rhythms such as asystole or PEA have not been studied and should be cooled at the discretion of the treating physicians).
2. Following CPR, return of spontaneous circulation (ROSC) within 60 minutes of collapse, and able to maintain blood pressure with or without pressors.
3. Persistent coma following ROSC, defined as: not following commands, no speech, no eye opening, no purposeful movements to noxious stimuli (brainstem reflexes and pathological posturing movements are permissible).
4. Thrombolysis, anti-platelet agents, or anticoagulants, as deemed necessary to treat a primary cardiac condition, are **not** a contraindication to cooling.

### B. Exclusion Criteria:

1. Shock refractory to vasopressors is a relative contraindication to therapeutic hypothermia.
2. Therapeutic hypothermia should not be initiated in patients with:
  - a. Persistent life-threatening arrhythmias
  - b. Pulseless for > 60 minutes
  - c. >12 hours since return of spontaneous circulation
  - d. Significant head trauma or any ICH (if clinical suspicion for either is present, obtain non-contrast head CT prior to cooling)
  - e. Any other significant trauma, particularly of neck or trunk
  - f. Pregnancy (if clinical suspicion, obtain urine hCG)
  - g. Primary coagulopathy
  - h. Sepsis as an etiology of arrest
  - i. Coma due to causes other than cardiac arrest i.e. drug overdose, stroke, pre-existing coma
  - j. Isolated pulmonary arrest
  - k. DNR / DNI status

## II. Timing of Cooling

1. Cooling should be initiated as soon as possible after return of spontaneous circulation, preferably within 4 hours of ROSC, and can be done in the emergency department, cardiac catheterization laboratory or ICU.
2. Patients should be cooled as quickly as possible and achieve the target goal of 32 to 34 degrees Celsius within 4 hours of initiation of hypothermia. Goal temperature should be maintained for 24 hours, counting from the initiation of cooling efforts.

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### III. Initiation of Cooling

1. The patient needs to be intubated and mechanically ventilated prior to cooling (make sure the ventilator's heated humidifier is off).
2. The patient **must** be sedated utilizing at least one of the following agents:
  - a. Midazolam - bolus 1-4 mg, followed by 1-7mg/hr continuous infusion  
**AND/OR**
  - b. Fentanyl - bolus 50 mcg, followed by 25-400mcg/hr continuous infusion  
**AND/OR**
  - c. Propofol - start at 5mcg/kg/min, range 5-80mcg/kg/min continuous infusion

Caution: use of Propofol may result in hypotension and require aggressive hemodynamic management including fluid resuscitation and vasopressors.

3. Neuromuscular blockade may be used to prevent shivering during induction of hypothermia. If neuromuscular blockade is necessary, use the minimum dose required to prevent shivering. A continuous infusion is not required if shivering is controlled with intermittent bolus administration.
  - a. Vecuronium bolus 0.10mg/kg over 5-15 seconds. Begin with a single Vecuronium bolus dose, re-evaluate the need and repeat bolus as ordered if required, OR follow initial bolus with infusion of 0.05-2.0 mcg/kg/min  
**OR**
  - b. Cisatracurium bolus 0.15mg/kg over 5-15 seconds. Begin with a single Cisatracurium bolus, re-evaluate the need and repeat bolus as ordered if required, OR follow with continuous infusion 0.5-5 mcg/kg/min.

#### 4. Initiate external cooling methods:

- a. Insert rectal probe and attach device to the cooling blanket. A second means of temperature monitoring may be initiated as available – this may be via a pulmonary artery catheter or a Foley catheter with a temperature sensor.
- b. For patients who are not yet in the ICU, and who have no evidence of pulmonary edema, begin cooling by infusing 1-2 liters 0.9% NaCl at 4° C over 30 to 60 minutes. This should be done via a peripheral or femoral venous line, as the safety of chilled IV fluids via IJ or subclavian sites is unclear. Transfer patient to ICU as expeditiously as possible.
- c. Once patient is in ICU (or before then, if transfer to ICU cannot be made within one hour), apply ice packs to bilateral axilla, groin, sides of neck, and head. Apply cooling blankets above and below the patient (place a sheet between the patient's skin and the cooling blanket to prevent cold injury to patient's skin). Set cooling blanket temperature manual mode to achieve rectal patient temperature of 33 degrees Celsius (recommended initial cooling blanket temperature setting is 10-15 degrees Celsius).
- d. Once target temperature is reached, remove ice packs and use cooling blankets to maintain goal temperature.

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- e. If cooling is initiated in the ICU, at the attending physician's discretion, it can begin with either chilled IV saline or cooling blankets and ice packs.
- f. If patient temperature is not responding adequately to the above measures, perform iced saline (not water) lavages via gastric tube and/or Foley catheter.

**IV. Patient monitoring at induction , maintenance and re-warming**

1. Document that the patient's pre-hypothermia neurologic status is comatose, as defined in Section I, Inclusion Criteria.
2. Obtain baseline troponin, CPK, CPK MB, lactate, electrolytes, glucose, magnesium, ionized calcium, ABG, PT/PTT, CBC. Monitor electrolytes every 4 hours; monitor ABG, PT/PTT, Mg+2, and ionized Ca+2 at least every 12 hours.
3. Continuously monitor the patient's core body temperature from at least one site (rectal probe, indwelling Foley catheter w/ temperature , or pulmonary artery catheter. Document core temperature every 15 minutes during the initial cooling phase, and at least hourly after the goal core temperature of 32 to 34 degrees Celsius is reached.
4. During the 24 hour period of active cooling, there is no indication for specific neuro checks, sedation holidays, or use of the TOF to monitor neuromuscular blockade. This is not meant to preclude passive observation of the patient's spontaneous neurological activity, and response to same, as appropriate.
5. An arterial line should be placed for blood pressure monitoring.
6. To insure adequate cerebral perfusion pressure, goal MAP 70-80 mm Hg; however, the patient's physiology may not allow this to be achieved safely. The treating team will need to balance the cardiac safety of higher blood pressures with the theoretical advantages of increased cerebral perfusion pressure. In the setting of increased ICP or diffuse cerebral edema documented by imaging or measured ICP, the treating team should consider increasing the goal MAP to  $\geq 90$ , so as to maintain a cerebral perfusion pressure of 70 mmHg.
7. Monitor vital signs at least hourly. During initial cooling peripheral vasoconstriction will cause an increase in heart rate and blood pressure. Shivering, if allowed to occur, can also contribute to increased heart rate. Once the patient is controlled with a sedative analgesic and an optional continuous infusion of neuromuscular blockade, the heart rate may progress to bradycardia. Bradycardia in this setting may be refractory to atropine.
8. Monitor and document QTc interval every two hours. If QTc > 500 ms, attending physician should be notified immediately. QTc > 500 ms is associated with Torsades, and is a relative contraindication to continued therapeutic hypothermia.
9. Insulin resistance, sometimes severe, may develop with hypothermia. If hyperglycemia develops, monitor blood glucose every hour. Use insulin infusion to maintain blood glucose < 150, preferably 80-130. **DO NOT** use standard insulin protocol while the patient is hypothermic.
10. In most cases, hypothermia-induced diuresis will occur. Watch for intravascular volume depletion. As well, serum hypokalemia can occur during hypothermia; this shift reverses when the patient is re-warmed and may result in hyperkalemia. If K+ is  $\geq 3.5$ , discontinue potassium administration eight hours before re-warming.

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11. Continue standard supportive care for mechanically ventilated, chemically paralyzed patients, including DVT prophylaxis, stress ulcer prophylaxis, eye lubricant, and head of bed elevated >30 degrees.
12. Insert Salem sump tube via orogastric route and check for ileus; consider intermittent low suction if present. Limit medications via OG tube during cooling.
13. Monitor for potential complications, including hyperglycemia, hypoglycemia, coagulopathy, pneumonia, sepsis, and rhabdomyolysis.
14. Monitor during re-warming for hyperkalemia, hypoglycemia, seizures, hypotension due to vasodilatation, and recurrent ventricular fibrillation.

**V. Re-warming**

1. At 24 hours following the initiation of cooling efforts, the patient should be passively re-warmed.
  - a. Remove cooling blanket and allow passive re-warming. May use regular blankets.
  - b. Optimally, re-warming should occur no faster than 1 degree Celsius/hour
  - c. If not normothermic at six hours, add Bair Hugger Warmer.
2. Neuromuscular blockade, if used solely to prevent shivering, should be stopped when the cooling is discontinued at 24 hours.
3. Sedation should be weaned during re-warming. Attempt to have a sedation holiday once the patient temperature reaches 36 degrees Celsius.
4. Monitor volume status during re-warming as vasodilatation occurs with re-warming.

**Approval:** Critical Care Advisory Committee  
CPR Committee  
Nursing Standards Committee

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