



UCONN JOHN DEMPSEY
HOSPITAL

SECTION: CLINICAL CARE GUIDELINES

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SUBJECT: TARGETED TEMPERATURE MANAGEMENT (TTM) POST RESUSCITATED CARDIAC ARREST

I. Eligible Patients

a. Inclusion Criteria:

- i. The adult (≥ 18 yrs) pre-hospital or in-hospital post-cardiac arrest patient who **remains comatose** following CPR and experience return of spontaneous circulation (ROSC) within 60 minutes of collapse.
- ii. Persistent coma following ROSC, defined as: unarousable unconsciousness, with no voluntary response to verbal or tactile stimuli and no comprehensible speech.
- iii. Prior to initiation of cooling, patient must be intubated, mechanically ventilated, and sedated.
- iv. Patient should be able to maintain blood pressure with or without vasopressors.
- v. Thrombolysis, anti-platelet agents, or anticoagulants, as deemed necessary to treat a primary cardiac condition, are **not** a contraindication to cooling.

b. Exclusion Criteria:

- i. Persistent life-threatening arrhythmias
- ii. Pulseless for > 60 minutes
- iii. > 12 hours since return of spontaneous circulation
- iv. Severe active, life-threatening hemorrhage
- v. Coma due to causes other than cardiac arrest i.e. drug overdose, stroke, pre-existing coma, status epilepticus

II. Targeting 33 degrees Celsius or 36 degrees Celsius

- a. Cooling should be initiated **as soon as possible after ROSC**, preferably within 4 hours. It can be initiated in the Emergency Department, Cardiac Cath Lab or ICU.
- b. Obtain Neurocritical care consult after ROSC for those undergoing TTM.
- c. Patients should be cooled as quickly as possible to achieve the target goal of 33 or 36 degrees Celsius within 4 hours of initiation of hypothermia. The choice of the targeted temperature will be made by the **attending physician** by taking into account factors such as: the mechanism of cardiac arrest, comorbidities such as severe hypotension with use of multiple vasopressors, presence of arrhythmias, and coagulopathies. Once goal temperature is attained, it should be maintained for 24 hours (from the time target temperature is reached). All patients who are eligible should be considered for TTM. Most patients will likely be candidates for 36 degrees Celsius.

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- d. Factors to consider **to target 36 degrees Celsius** rather than 33 degrees Celsius
 - i. Pregnancy
 - ii. Severe shock requiring multiple vasopressors
 - iii. Severe bradycardia
 - iv. Major surgery within 2 weeks
 - v. Severe coagulopathy
 - vi. Severe head trauma or intracranial hemorrhage
 - vii. Multi-trauma

- III. TTM 33 degrees Celsius
 - a. Initiation
 - i. Confirm that the ventilator's heated humidifier is off.
 - ii. Confirm that the patient has been sedated.
 - iii. 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. Titrate neuromuscular blockade by using train of four to maintain 1-2/4 twitches.

 - b. External Cooling Methods
 - i. For patients not yet in the ICU (i.e. ED / Cath Lab), who have no evidence of pulmonary edema, begin cooling by infusing 1-2 liters refrigerator chilled 0.9% normal saline over 30 to 60 minutes through a **peripheral or femoral venous line**, (Safety of chilled IV fluids via IJ or subclavian sites is unclear.)
 - ii. Apply ice packs to sides of neck and head and bilateral axilla and groin if needed.
 - iii. Ensure core temperature monitoring/insertion.
 - iv. Transfer patient to ICU or Cardiac Cath Lab as expeditiously as possible.
 - v. Once patient is in ICU, continue temperature management using the Arctic Sun temperature management system.
 - 1. Follow manufacturer instructions for applying ArcticGel Pads.
 - 2. Select target temperature on Arctic therapy screen per practitioner order. The standard therapy is set to a target of 33 degrees Celsius. Once target temperature is achieved, the machine will maintain target temperature for 24 hours, then rewarm to 37 degrees over 16 hours.

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- vi. If the Arctic Sun is not available, Blanketrol cooling blankets may be used. Apply blankets both 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.
 - 1. Set cooling blanket temperature on manual mode to achieve desired patient temperature. (Recommended initial cooling blanket temperature setting is 10-15 degrees Celsius).
 - vii. Remove ice packs once target temperature is reached.
- c. Patient monitoring at induction, maintenance
- i. Obtain baseline troponin, CPK MB, lactate, electrolytes, glucose, magnesium, ionized calcium, ABG, PT/PTT, CBC.
 - ii. Continuously monitor the patient's core body temperature. Document core temperature **every 15 minutes during the initial cooling phase**, and at least **hourly after the goal core temperature of 33 degrees Celsius is reached**.
 - iii. Monitor **vital signs at least every 30 minutes until transported to the ICU or Cardiac Cath Lab, then 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.
 - iv. **Shivering** may be first controlled by using counter-warming of the hands and feet. Continued shivering may be controlled with continuous infusions of sedatives such as propofol, midazolam, and dexmedetomidine. Analgesia with opiates may also be used. Although meperidine has been used effectively for the treatment of shivering, it may lower the seizure threshold in this population. Alternatively, buspirone and/or magnesium sulfate may also be used.
 - v. Maintain cerebral perfusion pressures (CPP) of at least 60 mmHg. If intracranial pressure monitoring is not able to be obtained, the MAP goal should be adequate for an estimation of optimal CPP.
 - vi. Monitor and document **initial QTc interval** with an EKG; monitor **QT at least hourly until target temperature is reached, then every 2 hours**. If QT / QTc > 500 ms, notify

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practitioner immediately. QT/QTc > 500 ms is associated with Torsades de pointes, and is a relative contraindication to continued therapeutic hypothermia.

- vii. Monitor **blood glucose hourly**. Insulin resistance, sometimes severe, may develop with hypothermia. If hyperglycemia develops, continue monitor blood glucose every hour and use an insulin infusion to maintain blood glucose < 180. **DO NOT** use standard insulin protocol while the patient is hypothermic.
 - viii. During the 24 hour period of active cooling, there is no indication for sedation holidays. Train of four should be used to monitor the level of neuromuscular blockade if necessary. Neurological checks should include assessment of pupillary reflex and observing spontaneous neurological activity such as signs of cognition, motor movements, and other brainstem functions.
 - ix. Observe for intravascular volume depletion due to hypothermia-induced diuresis which may be accompanied by hypokalemia. This shift reverses when the patient is re-warmed and may result in hyperkalemia. If K⁺ is ≥ 3.5, discontinue potassium administration eight hours before re-warming.
 - x. Continue standard supportive care for mechanically ventilated, chemically paralyzed patients, including DVT prophylaxis, head of bed elevated >30 degrees and attentive skin care.
 - xi. If time permits before transfer to ICU or Cardiac Cath Lab, insert Salem sump tube via orogastric route and check for ileus; consider intermittent low suction if present. Limit medications via OG tube during cooling.
 - xii. Monitor for potential complications, including hyperglycemia, hypoglycemia, coagulopathy, pneumonia, sepsis, and rhabdomyolysis.
 - xiii. Patients should be on continuous EEG monitoring until pharmacologic paralysis is discontinued. Continuous EEG should be used to assess for brain activity and seizures.
- d. Re-warming
- i. At 24 hours after achieving target temperature, the patient should be re-warmed to a goal of 37 degrees Celsius.
 - ii. If the Arctic Sun is in use: once the cooling period is over, an alert will sound & display “Cool Patient End” – hit “Start” to initiate rewarming. Post-rewarming, the “Normothermia” setting may be used up to 48 hours.

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- iii. If the Blanketrol was used for cooling, remove cooling blankets and allow passive re-warming. May use regular blankets. Optimally, re-warming should occur no faster than 1 degree Celsius/hour. If not normothermic at six hours, add Bair Hugger Warmer.
- iv. Neuromuscular blockade, if used solely to prevent shivering, should be stopped when the cooling is discontinued at 24 hours.
- v. Sedation should be weaned during re-warming. Attempt to have a sedation holiday once the patient temperature reaches 36 degrees Celsius.
- vi. Monitor during re-warming for hyperkalemia, hypoglycemia, seizures, hypotension due to vasodilatation and fluid volume shifts, and recurrent ventricular fibrillation.
- vii. Contact physician if patient becomes febrile, > 38.0 degrees Celsius, as hyperthermia is harmful to the recovering brain.

IV. TTM 36 degrees Celsius

- a. Patients being maintained at 36 degrees Celsius may use conservative methods such as reduction in blankets, decreasing ambient room temperature. More aggressive temperature management can include cooling blanket and Arctic Sun set at 36 degrees.
- b. Sedation and medications/methods for shivering may be used as described above as needed.
- c. Maintain targeted temperature of 36 degrees for 24 hours. Temperatures should be documented every 1-2 hours. Core temperatures are more accurate than peripheral temperatures.
- d. Maintain cerebral perfusion pressures (CPP) of at least 60 mmHg. If intracranial pressure monitoring is not able to be obtained, the MAP goal should be adequate for an estimation of optimal CPP.
- e. After TTM of 36 degrees for 24 hours, rewarming to 37.0 - 37.5 degrees can be done over 4 hours if using Arctic Sun. Maintain euthermia (under 37.5 degrees) for at least 48 hours post rewarming.
- f. Normal monitoring of blood glucose and electrolytes can be done during TTM of 36 degrees.
- g. Continuous EEG should be used to assess for brain activity and seizures.

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