

Therapeutic Hypothermia Protocol for Cardiac Arrest

Patient Selection

Patients who present to the Emergency Department (ED) or Critical Care Unit (CCU) after cardiac arrest (in or out of hospital) who have a return of spontaneous circulation (ROSC) and have the following conditions should be considered for this protocol.

1. Neurological deficits or comatose
2. Less than 8 hours from ROSC
3. Intubated and ventilated
4. Return of stable hemodynamics with or without vasopressor or mechanical hemodynamic support

Patients with life-threatening bleeding, pre existing coagulopathy, severe cardiogenic shock, infection or underlying terminal condition should be excluded from this protocol.

Phases of Therapeutic Hypothermia

Phase 1-Induction

- Initiation of cooling should begin as soon as possible after ROSC
- Rapid cooling over 1-3 hours is the goal
- Patients target core temperature for this protocol is 32-34°C
- Do not delay tests or post arrest procedures to initiate cooling
- Establish triple lumen central venous access (PICC or CVL)
- Begin sedative and pain management. Neuromuscular blocker started.
- Consider DVT prophylaxis
- Begin close blood sugar monitoring

Phase 2-Maintenance

- Maintain core body temperature at 32-34°C for 24 hours unless otherwise ordered by a physician

Phase 3-Rewarm

- Slow controlled re-warming to avoid hemodynamic fluctuations
- Goal rate for re-warming will be 0.2-0.33°C per hour until patient reaches 36.5-37.5°C (This should occur over a 17-20 hour period)

Phase 4-Normothermia Maintenance

- Fever in the first 72 hours after ROSC is associated with poor outcomes

- Maintaining normothermia, avoiding rebound hyperthermia and aggressively managing shivering should be done for 24 hours after reaching 36.5°C
- Goal core temperature for this phase is 36.5-37.5°C

Special Considerations

Electrolyte Management

- Close monitoring of Potassium, Magnesium, and Phosphate is necessary with this protocol
- Potassium replacement should be done in a conservative fashion due to potential rebound during re-warming
- All electrolyte replacement orders as outlined in this protocol will discontinue 4 hours prior to re-warming, unless otherwise specified by the physician

Implementation

Phase 1-Induction

- Initiate *Therapeutic Hypothermia Protocol for Cardiac Arrest*
- Obtain and document baseline vital signs and cardiac rhythm
- Assess and document baseline LOC and neurological status
- Insert Foley with temperature probe. Must have 4cc/hr of urine output in order for bladder probe to measure temperature accurately. May use rectal or esophageal probe if urine output is not adequate
- **Consider** cold IV fluid bolus via infusion pump to compliment Arctic Sun cooling: **Use caution in patients at risk for volume overload**
 - Infuse cooled IV fluid bolus (LR or NS 0.9% at 4°) at 30 cc/kg or a maximum of 2 liters over 30 minutes
 - Chilled fluids will be kept in the ED and CCU
 - Obtain orders for maintenance infusion fluids following bolus
- Draw and assess baseline labs (CMP, CBC, ABG's, PT/PTT, Phosphate, Magnesium, Lactate)
- Place appropriate sized Arctic Sun pads on patient. Pad sizing information is located on the outer packaging.
 - Pads should cover approximately 40% of patient body surface (BSA) in order to adequately cool patient.
 - For patients over 100kg, place an additional universal pad over center abdomen in order to facilitate coverage of appropriate BSA.
- Connect pads on temp probe to Arctic Sun.
- Turn Arctic Sun **ON** and program **target temperature to 33° C** in order to begin induction of hypothermia. Press **Auto** to begin therapy

- Refer to laminated cards on Arctic Sun for assistance with controls, troubleshooting/decision tree and pad sizing.

Patient Monitoring and Management:

- Monitor and document vital signs every 15 minutes X4, every 30 minutes X2, then every 1 hour with the exception of patient temperature, which will continue every 15 minutes until reaching target temperature of 33°C.
- Continually monitor cardiac rhythm documentation at least every 6 hours and with any rhythm changes.
- Patients will not have a Sedation Vacation while in Phase 1-2 and 3. Sedation Vacation's will resume in phase 4 (normothermia).
- Monitor and document I&O every 1 hour.
- Obtain CMP, CBC, Mg²⁺, PO₄, ABG every **4 hours** and PT/PTT every 8 hours for 48 hours and until patient is normothermic and serum electrolyte imbalances resolved.
 - ABG results will be adjusted using core temperature values. Vent management will be provided by respiratory therapy in collaboration with physician.
- Assess skin and pressure points underneath pads every 4 hours due to vasoconstriction and decrease perfusion at skin level. Consider placing patient on a specialty bed for additional pressure relief.
- Establish triple lumen central venous access:
 - **Triple Lumen Central Venous Line (CVL)**
 - or**
 - **Triple Lumen PICC**
- Begin Sedation, opioid analgesia and neuromuscular blocker (NMB):
 - Sedation**
 - **Lorazepam (Ativan) infusion-** 1-5mg/hour maintaining adequate sedation.
 - or**
 - **Midazolam (Versed) infusion-** 1-5mg/hour maintaining adequate sedation.
 - or**
 - **Propofol (Diprivan) infusion-** 5mcg/kg/minute; increase by 5-10mcg/kg/minute every 5-10 minutes until desired sedation is reached. Usual maintenance is 5-50mcg/kg/minute.
 - and**
 - Opioid Analgesia**
 - **Fentanyl-**(For pain/sedation) 100 mcg IV load, then 0.7-10mcg/kg/**hour** infusion. Must be given in conjunction with sedation medications.
 - and**
 - Neuromuscular Blocker (NMB)**-Patient must be sedated and intubated prior to initiating NMB.
 - **First choice** NMB-Vecuronium (Norcuron)-0.08-0.1 mg/kg IV bolus, followed by continuous infusion of 0.8-1.7mcg/kg/minute.
 - or**

- **Second Choice** NMB- Pancuronium (Pavulon)-0.06-0.1 mg/kg IV bolus, followed by continuous infusion of 1-2mcg/kg/minute.
- or**
- **Third Choice** NMB-Cisatracurium (Nimbex)-*(use only if severe renal impairment (est. CrCl≤15ml/min) or end stage hepatic dysfunction, or other contraindication to choice 1 or 2)*- 0.15-0.2mg/kg IV bolus, followed by continuous infusion of 0.5-7mcg/kg/minute.
 - **Clinical Pearls-** during hypothermia NMB, opioids and sedatives tend to have a longer duration of activity than in patients that are normothermic. **USE CAUTION and CONSERVATIVE DOSING.**
 - Vecuronium is drug of choice in this protocol due to its lack of adverse cardiac effects.
 - **Monitoring for NMB-**Train-of-four monitoring using a peripheral nerve stimulator should be used in all patients on a NMB. **The goal for Train-of-four monitoring in patients enrolled in the hypothermia protocol is to achieve 90% blockade (1 twitch present out of 4 impulses).** Refer to “Train of Four” protocol for details.
- Perform AccuChecks every 4 hours. Use sliding scale protocol. If FSBS≥200, place patient on insulin drip per insulin drip protocol and monitor blood glucose every 1hour.
- Protonix 40mg IVP Daily
- Choose one or more of the following DVT prophylaxis:
 - Sequential Compression Device (May cause un-wanted warming)
 - Heparin 5,000 units SQ every 8 hours
 - Lovenox (enoxaparin) 40mg SQ daily or Lovenox (enoxaparin) 30mg SQ daily if estimated CrCl ≤30ml/min.
 - Arixtra(fondaparinux) 2.5mg SQ daily

Phase 2/ Maintenance:

- This phase begins when the patient reaches 32-34°C.
- Document time patient reaches target temperature in EMR.
- Monitor and document Vital Signs at least every 1 hour and more often as patient hemodynamic status dictates. Patient temperature, Arctic Sun water temperature and shivering status will be assessed and documented at least every 1 hour and more often as situation dictates.
- **DO NOT TURN OFF SEDATION OR PARALYTIC.**
- Continue all other **Patient Monitoring and Management** as above.

Phase 3/ Re-warm:

- This phase begins 24 hours after the patient has maintained body temperature of 32-34°C.
- Adjust Arctic Sun by programming **target temperature to 37°C** with rate of re-warm at 0.2-0.33°C per hour. This should warm the patient over a 17-20 hour period.
- Monitor and document Vital Signs at least every 1 hour and more often as patient hemodynamic status dictates. Patient temperature, Arctic Sun water temperature and shivering status will be assessed and documented at least every 1 hour and more often as situation dictates.
- Document the time the patient reaches 36.5-37.5°C in the EMR.
- **DO NOT TURN OFF SEDATION OR PARALYTIC.**
- Continue all other **Patient Monitoring and Management** as above during this phase

Phase 4/ Normothermia Maintenance:

- This phase begins when the patient reaches 36.5°C and lasts for 24 hours.
- Maintain Arctic Sun at **target temperature of 37° C.**
- Monitor and document Vital Signs at least every 1 hour and more often as patient hemodynamic status dictates. Patient temperature, Arctic Sun water temperature and shivering status will be assessed and documented at least every 1 hour and more often as situation dictates.
- All TH Protocol Lab orders will D/C in this phase. Physician will order appropriate labs for further management.
- In this phase, **paralytic agent will be titrated off.** Sedation and pain management drips will continue to infuse. Stop Train of Four monitoring.
- Document time Arctic Sun is discontinued in EMR.
- DNR status should not be established and care should not be withdrawn ***based on neurologic prognosis*** before 72 hours after rewarming.

Prevention of Shivering-only used during Phase 4 (Normothermia) (choose one or more) CPOE order set: **“SHIVERING PREVENTION”**

- Acetaminophen 650 PT or PO every 4 hours on schedule (Do NOT Exceed 4000mg APAP/24 hours.
and/or
- Fentanyl 100-250mcg IV every 1 hour PRN shivering.
and/or
- Buspirone 30mg PT or PO every 8 hours on schedule.

Electrolyte Management during Hypothermia Protocol

Potassium-potassium is prone to rebounding during rewarm. **Exercise caution during repletion.**

- If $K^+ \leq 3.5$, give KCL 40 meq IVPB over 4 hours. Discontinue repletion of potassium 4 hours before re-warming phase begins.

Magnesium-normal-high magnesium levels are desired

- If $Mg^{2+} \leq 2$, give Magnesium Sulfate 2 grams IVPB over 2 hours. Discontinue repletion of magnesium 4 hours before re-warming phase begins.

Phosphorus

- If $PO_4 \leq 2.5$, give 21mMol Sodium Phosphate IVPB over 6 hours. Discontinue repletion of Phosphorus 4 hours before re-warming phase.