**INTRODUCTION**

Patients undergoing post-cardiac arrest resuscitation (PCAR) and therapeutic hypothermia (TH) will have nursing care provided according to the following policy.

**SCOPE**

Registered Nurses (RNs) working in the Emergency Department (ED) and adult Critical Care Units (CCU, MICU, SICU) in which use of the PCAR and TH are approved by the Medical Director.

**ELIGIBILITY CRITERIA**

A. See Appendix A: Post-Cardiac Arrest Early Goal-Directed Therapy (algorithm).

B. Patient post-cardiac arrest: defined as absence of pulses requiring chest compressions, regardless of location or presenting rhythm with subsequent return of spontaneous circulation (ROSC).

C. Less than 12 hours have elapsed since ROSC (Return of Spontaneous Circulation).

D. Patient does not have an order for Do Not Attempt Resuscitation (DNR) B or C; or a Do Not Intubate (DNI).

E. Patient’s pre-arrest cognitive status is not severely impaired (Glasgow Coma Score [GCS] =15 or performed ADL independently).

F. Patient is comatose at enrollment with a Glasgow Motor Score <6 (doesn’t follow commands) pre-sedation.

G. No other obvious reasons for coma.

H. No uncontrolled bleeding.

I. No evidence of uncontrollable dysrhythmias.

J. No pre-existing multi-organ dysfunction syndrome, severe sepsis, or metabolic acidosis as a cause of arrest.

K. No comorbidities with minimal chance of meaningful survival independent of neurological status.
BACKGROUND

Brain temperature during the first 24 hours after resuscitation from cardiac arrest may have a significant effect on survival and neurological recovery. Cooling to 32-34°C for 24 hours decreases the chance of death and increases the chance of neurological recovery.

EFFECTS OF THERAPEUTIC HYPOTHERMIA

A. Hypothermia activates the sympathetic nervous system causing vasoconstriction and shivering. Shivering increases oxygen (O$_2$) consumption by 40-100%. Sedatives, opiates, and neuromuscular blockers are used to counteract these responses and enhance the effectiveness of active cooling.

NOTE: Initiating paralysis in a patient who is already hypothermic should be avoided because it can result in a precipitous drop in core body temperature. Elderly patients will cool more quickly than younger or obese patients.

B. Hypothermia shifts the oxyhemoglobin curve to the left and may result in decreased O$_2$ delivery. However, the metabolic rate is also lowered, decreasing O$_2$ consumption and carbon dioxide (CO$_2$) production. Ventilator settings may need to be adjusted due to decreased CO$_2$ production, using temperature-corrected blood gases.

C. Hypothermia initially causes sinus tachycardia, then bradycardia.
   1. Extremely important to keep temperature >30°C.
   2. Temperatures:
      a. <30°C, increased risk for arrhythmias.
      b. <28°C, increased risk for ventricular fibrillation.
   3. Severely hypothermic myocardium (<30°C) is less responsive to defibrillation and medications.

D. Hypothermia decreases cardiac output and increases systemic vascular resistance (SVR).

E. Hypothermia can induce coagulopathy which is treatable with platelets and fresh frozen plasma (FFP).

F. Hypothermia-induced diuresis is to be expected and should be treated aggressively with fluid and electrolyte repletion. Magnesium, phosphorus and potassium should be monitored closely and maintained in the normal range.

G. Decreased insulin secretion and sensitivity leads to hyperglycemia, which should be treated aggressively.

H. Re-warming must proceed slowly over 6 or more hours to prevent rapid vasodilation, hypotension, and rapid fluid and electrolyte shifts.
I. Re-warming is begun 24 hours from the time target temperature is reached. Set Gaymar III 7900 to automatic mode, gradual, with target temperature of 37°C (this will rewarm patient @ 0.17°C/hr, [1°C/6hrs]). Maintain sedation and paralysis until temperature reaches 36°C to avoid shivering and rapid rewarming.

**PROCEDURE**

A. Provide Patient and Family Education Support.
   1. Explain the purpose of hypothermia and the need for pharmacologic paralysis.
   2. Encourage the family to continue to talk to the patient.
   3. Provide emotional support and answer any questions.
   4. Offer pastoral care support to the family. Facilitate communication between the family and the physicians, nurse practitioners (NP), and physician’s assistants (PA).

B. Gather Equipment for Cooling (see Appendix B: Tip Sheet):
   1. Two one liter bags of cold (4°C) 0.9% saline (stored in participating units’ medication refrigerators).
   2. PreSep catheter and tubing set up.
   3. Arterial catheter and tubing set up.
   4. Gaymar III 7900 external cooling system with two complete sets of hoses.
      a. One Gaymar torso wrap and.
      b. Two thigh cooling leg wraps (available through Gaymar company).
      c. Choose small-medium or large wraps depending on patient size for the most effective cooling.
      d. Weight of Gaymar wraps when filled:
         1.) Large Torso: 3.0 lbs
         2.) Medium/Small Torso: 2.5 lbs
         3.) Each Leg: 2.0 lbs
   5. Temperature probe indwelling bladder catheter (consider alternative site if Urine Output is less than 4 ml/hr).
   6. 1/4-1/8” adapter for cooling device (stored with the Gaymar III).
   7. Neuromuscular blockade equipment (not required for ED).
      a. Peripheral nerve stimulator. (Refer to BCC-03-26 Neuromuscular Blocking Agent)
      b. BIS monitor and sensor. (Refer to CCC-05-05 Use of Bispectral Index (BIS) Monitoring)
   8. Ensure fluid warmer is available in case need arises after cooling.

C. Preparation for Cooling:
   1. Verify prescriber’s orders *(SCM Post-Cardiac Arrest/InducedHypothermia Orderset)*
2. Ensure arterial and central venous catheters are inserted BEFORE or SIMULTANEOUS with initiation of cooling.
   a. Once the patient is cooled to target temperature it is more difficult to place an arterial catheter because of vasoconstriction.
   b. Insertion of a Presep triple lumen catheter is ideal, however, any central venous catheter (CVC) is acceptable.

3. Obtain baseline labs per prescriber’s order:
   - ABG with Ionized Ca+ and Magnesium
   - CBC, Platelets, PT/PTT/INR, Fibrinogen
   - Electrolyte “panel 7” plus ionized calcium, magnesium, phosphate, chloride, glucose
   - Amylase, lipase
   - Liver function panel
   - Lactate, CPK-MB, CK, Troponin
   - Cortisol level
   - Pan-culture: Blood Culture, Urine culture, Urinalysis, Sputum culture (if appropriate)
   - Toxicology screen (if appropriate)
   - Co-oximetry panel (Central Venous)
   - Beta HCG on all women of childbearing age

4. Connect temperature probe indwelling bladder catheter (or alternative temper probe) to temperature monitoring port on cooling device.

5. Thorough skin assessment before applying cooling system wraps.

D. Cooling

1. Infuse intravenous (IV) fluids as per hypothermia protocol as needed.
   a. See Appendix A: Post-cardiac arrest early goal-directed therapy (see algorithm).
   b. Cold saline (4ºC) (up to 2 liters) may be used to facilitate cooling (frequently begun in the ED).

2. Administer medications per prescriber’s orders (Refer to 4A-02-05a Electronic Documentation of Medication Administration).
   a. Ensure adequate sedation use BIS monitor if available.
   b. Initiate neuromuscular blockade before cooling (cisatracurium is recommended).
   c. Refer to HUP Formulary.
   d. Ensure adequate paralysis by using peripheral nerve stimulator (Refer to BCC-03-26 Neuromuscular Blocking Agent).

3. Gaymar Cooling Device:
a. Keep device plugged in at all times during use.
b. Make sure wraps are filled before applying to the patient.
c. Apply circumferential torso pad and connect to first cooling hose.
d. Apply circumferential thigh wrap to each leg, connect leg wraps together in series, and then connect free ends to second cooling hose.
e. Connect temperature probe indwelling bladder catheter to temperature monitoring port on cooling device.
   ● If urine output is less than 4 mL/hr switch to an esophageal probe (CDR # 100158), placed by physician.
   ● Protect indwelling bladder catheter and temperature probe from coming in contact with cooling blanket wraps.
f. Ensure cooling blanket in- and out-flow tracts are unobstructed and that fluid is filling wraps when machine is turned on. You may need to add more water to device until plunger in tank rises to point where green line is seen.
g. Settings:
   ● Set to rapid cooling automatic mode with target temperature of 33°C.
h. Assess and document cooling blanket settings and patient's temperature in °C.
i. Document patient temperature and blanket temperature on flowsheet in °C.

4. Cooling is maintained for 24 hours from time target temperature is reached.

E. Monitoring

1. Goal is to maintain patient's core temperature between 32° and 34°C for 24 hours.
2. Maintain blanket temp at 33°C in “gradual” automatic mode, follow patient temperature hourly.
   a. If temp < 31° C, consider infusing 250 ml boluses of warm 40°C IV NSS or Lactated Ringers (LR) until temperature > 32°C.
   b. Monitor closely for arrhythmias when temperature < 32°C.
3. Hemodynamic Assessment:
   a. Continuous venous oxygen saturation (ScvO2) with PreSEP™ catheter.
   b. Central venous oxygen saturation (ScvO2) every 6 hours if PreSEP™ catheter is not used.
   c. Maintain MAP 65-120 mmHg with IV fluids, vasopressors, or nitrates as ordered.
4. Obtain laboratory values per prescriber’s orders:
   a. Arterial blood gas (ABG) every 6-8 hours and as needed.
   b. Glucose, potassium (K+) and lactate every 6 hours x2 days (may require intensive glucose control and more frequent monitoring while cooled).
   c. Repeat Creatine phosphokinase-MB (CPK-MB), Troponin at 6 hours.
d. Complete blood count (CBC)/platelets/prothrombin time (PT)/partial thromboplastin time (PTT), electrolytes/blood urea nitrogen (BUN)/Creatine, Calcium/Magnesium/Phosphate every 12 hours x 4.

5. Urine output every 2 hours and more frequently if needed.
   a. Hypothermia-induced diuresis is common.
   b. Aggressive IV fluid repletion may be required.
   c. Confirm decreased urine output with bladder scanner if acute decrease in urine output noted.

F. Re-Warming

1. Begin re-warming 24 hours after target temperature reached.
2. Re-warming too rapidly can cause vasodilatation, hypotension, and rapid electrolyte shifts.
3. Prior to rewarming:
   a. Volume load aggressively with Normal Saline to compensate for reductions in BP, ScvO2, and central venous pressure (CVP).
   b. K+ shifts to extracellular compartment during re-warming.
      ● STOP all K+ containing fluids
      ● However, always correct hypokalemia, and other electrolytes, to the normal range.
4. Re-warm gradually:
   a. Maintain paralysis until patient reaches 36°C.
   b. Program cooling unit to re-warm patient by increasing set point to 37°C.
   c. Set in automatic mode, gradual, with target temperature of 37°C (this will re-warm patient @ 0.17°C/hr, [1°C/6hrs]).
5. Assess vital signs with CVP every 1 hour until temperature reaches 36°C.
6. Monitor K+ every 6 hours and more frequently if needed.
7. Monitor serum glucose levels closely because as insulin resistance resolves there is increased risk of hypoglycemia.
8. Follow ABGs as needed. Adjust ventilator settings accordingly with Respiratory Therapy and physician/Nurse Practitioner (NP)/physician assistant (PA) collaboration.
9. Anticipate reduction in venous return (cardiac output) and BP (with ↓ CVP) as cooler blood shifts from core to extremities. Follow CVP closely; aggressive IV fluids may be necessary to maintain adequate volume status during re-warming.
10. Maintain paralysis until patient temperature > 36°C. Once temperature > 36°C, paralysis can be stopped, BIS monitoring discontinued when train of four (TOF) is 4/4. Titrate sedation to comfort and ventilator synchrony. (Refer to HUP Policy 1-12-22 Pain Assessment).
DOCUMENTATION

A. Nursing Flowsheet for Inpatient Units/Emtrac for ED patients:

2. Hemodynamics:
   a. CVP
   b. ScvO2
3. Baseline and ongoing neurological exam, pain assessment and level of sedation/agitation.
4. Administration of analgesia, sedation and NMB agents.
5. Cooling blanket settings in °C with each change (use separate column).
6. Patient’s temperature in °C.
7. Eye care.
8. Skin care and repositioning.

B. Interdisciplinary Progress Notes:

1. Patient’s tolerance to the procedure.
2. Ongoing assessments.
3. Family updates.

C. Sunrise Clinical Manager (SCM): Medication Administration Record (MAR) (Refer to 4A-02-05a Electronic Documentation of Medication Administration)

1. Time infusion begun.
2. Dose administered.
3. Time infusion discontinued.

D. SCM Post-Cardiac Arrest/Induced Hypothermia Orderset

REFERENCES

Hypothermia after Cardiac Arrest Study Group. Mild Therapeutic Hypothermia to Improve the Neurologic Outcome After Cardiac Arrest. New England Journal of Medicine, 2002; 346(8):549-556.


**REVIEWS/APPROVALS**

Critical Care Practice Committee
Emergency Department Leadership
MICU Medical Director
Co-Director, Clinical Center for Resuscitation

**Supersedes:** November 30, 2007  
**Effective Date:** May 29, 2009
Appendix A - Post-Cardiac Arrest Early Goal-Directed Therapy

Who needs this?
Resuscitated patients with:
- Pulseless < 60 min
- GCS Motor score < 6
- No other reason for coma
- Not DNR or DNI status
- If pregnant consult Ob/Gyn

Getting Started
- Stat ECG, echocardiogram, and cardiology consult
- Stat head CT
- Insert arterial pressure monitoring line in radial or femoral artery
- Initiate therapeutic hypothermia if indicated (after arterial line)
- Insert Presep® CVC in subclavian or internal jugular vein
- Notify Bed Coordinator for ICU bed and EEG fellow for EEG

MAP

- < 80
- > 100

CVP

- > 8
- < 8

80-100
(Consider lower goal if ACS*, CHF, Shock)

ScvO₂ ≥ 65%

No

Yes

MAP, CVP, ScvO₂ goals achieved

Monitor serial lactate to rule out inadequate organ perfusion

If evidence of shock is present:
- Optimize CVP if not already done (up to 20)
- Transfuse PRBC’s if hemoglobin ≤ 10 mg/dl
- Dobutamine if not already initiated
- Consider PA Cath if CVP>15 or escalating vasopressors

ScvO₂<65%

w/ shock?

No

Yes

If NOREPI
- If EF, start DOBUT (2.5-20 mcg/min).
- If MAP<, add DOPA or EPI
- If severe hypotension → IABP

If evidence of shock is present:
- Optimize CVP if not already done (up to 20)
- Transfuse PRBC’s if hemoglobin ≤ 10 mg/dl
- Dobutamine if not already initiated
- Consider PA Cath if CVP>15 or escalating vasopressors

MAP, CVP, ScvO₂ goals achieved

Monitor serial lactate to rule out inadequate organ perfusion

* ACS=Acute coronary syndrome

Updated 5/16/06
Appendix B - Tip Sheet

**EQUIPMENT CHECKLIST**

1. Arterial line kits (both radial and femoral)
2. Presep central venous catheter
3. Two one liter bags of 4°C 0.9% saline (stored in ED and ICU refrigerators)
4. Gaymar III external cooling device
   a. Gaymar III with 1 torso and 2 thigh pads
5. Temperature probe foley catheter or esophageal temp probe
6. 1/8 inch to 1/4 inch adapter needed for Gaymar device
7. Connect temperature monitoring foley to temperature monitoring port on cooling device. If urine output less than 4 cc/hr switch to esophageal probe
8. Neuromuscular blockade monitoring equipment (not required for ED)
   a. Twitch monitor
   b. BIS monitor and sensor
9. Rapid access to warmed IV fluid

**Gaymar III Cooling Unit**

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**Initial Cooling**

- Infuse 2 liters of 4°C saline IV (peripheral IV preferred) over 30 minutes.
- Apply circumferential torso pad to chest and connect to first cooling hose
- Apply circumferential thigh cooling pads to both thighs. Connect the two thigh pads in series and then connect free ends to second cooling hose.
- Connect temperature monitoring foley to temperature monitoring port on cooling device. If urine output less than 4 cc/hr switch to esophageal probe

**Maintenance of Hypothermia**

- Initially set device on rapid cooling automatic mode with target temp of 34°C. Once patient reaches 34°C, set on gradual cooling automatic mode at 33°C.

**Rewarming (0.25 °C/hour)**

- In the gradual automatic mode, increase the patient target temperature setting by 0.5°C every 2 hours until patient temperature reaches 36°C, then discontinue cooling system.