Induced Hypothermia Protocol for Resuscitated Arrest Patients

Emergency department procedures

- Assess eligibility for therapeutic hypothermia
- Assess baseline LOC and neuro status using Glasgow-Coma scale
- Establish airway and mechanical positive pressure ventilation
- 12 lead ECG
- Establish IV access
- Place bladder temperature probe
- Place arterial line
- Place Arctic Sun pads for patients being transported to the Cath Lab for coronary angiography; Intravascular Alsius catheter should be placed for patients being transferred directly to the MICU
- Baseline labs: electrolytes, Mg, glucose, ABG, coagulation labs, lactate, Troponin I, CBC, LFT’s

Notify all of the following:
- MICU nursing
- Senior medical resident
- Cardiology fellow for primary cardiac arrests; the cardiology fellow will be responsible for contacting the cardiology attending physician.
- Critical care fellow (MICU) for primary respiratory arrests; the critical care fellow will be responsible for contacting the pulmonary attending physician.

Location of patient (Cath lab or MICU)

Direct to Cath lab for STEMI, will be transferred to MICU after Cath lab
- Arctic Sun pads should be placed but cooling should not be initiated until after revascularization is complete.

MICU if not STEMI
- Place Alsius Catheter in the ED (Reserve Arctic Sun for STEMI pts) • Cooling should be resumed or initiated immediately on arrival to the MICU—do not wait for additional IV access, sedation or paralytics
- If patient has no pulmonary edema and normal or mildly depressed cardiac function on ED ultrasound, may infuse up to 2 liters of iced saline

Cooling device
- Arctic Sun is default cooling device for STEMI patients
- Alsius cooling catheter is default device for:
  - Direct MICU patients (Reserve Arctic Sun for STEMI patients)
  - All patients > 300 pounds (136kg)
Oversight

- Cardiology fellow must call the appropriate cardiology staff physician to approve the continuation of the hypothermia protocol for primary cardiac arrest patients.
- Critical Care fellow must call the appropriate staff physician for the MICU to approve the continuation of the hypothermia protocol for primary respiratory arrest patients.
- Data on all cardiac arrests will be kept by the ED. Compliance with the protocol will be audited. If eligible patients are not being cooled, decisions will be made to facilitate better application of hypothermia.
- Neurology consultation must be requested for the next day.
- Fellow on call (Cardiology fellow for primary cardiac arrest patients and critical care fellow for non-cardiac arrest patients) to be notified by ED of patient admission - fellow is expected to evaluate the patient in person ASAP.

Inclusion criteria

1. Resuscitated cardiopulmonary arrest
   - Primary cardiac
   - Respiratory arrest
     - Hanging
     - Airway obstruction
     - Asphyxiation
     - Asthma/COPD
   Drug overdose (overdoses involving cardiovascular active agents should be discussed with MICU staff prior to initiating cooling – e.g. calcium channel blockers and beta-blockers or tricyclic antidepressants)
2. CPR initiated within 15 minutes from the time of arrest by EMS
3. Time to return of spontaneous circulation of less than 30 minutes is preferred; however there is not a strict limit on duration of resuscitation efforts given individual patient circumstances.
4. Unresponsive after return of spontaneous circulation
5. Endotracheal intubation and mechanical ventilation

Exclusions

1. Mean arterial pressure < 60 mmHg for \( \geq \) 30 minutes after return of spontaneous circulation while receiving high dose vasopressors to maintain BP
2. Persistent pulse oximetry < 85% for more than 15 minutes after return of spontaneous circulation, despite supplemental oxygen and intubation with positive pressure ventilation
3. Coagulopathy such as DIC (treatment with warfarin or heparin is permissible)
4. Active bleeding
5. DNR/DNI status, terminal illness, comatose or vegetative state before cardiac arrest
6. Pregnancy
7. Refractory ventricular arrhythmias/electrical storm
8. Pre-existing multisystem organ failure, sepsis, ARDS
9. History of cold agglutinin disease, Reynaud’s disease, sickle cell disease
10. QTc > 550msec

MICU procedures

Baseline:
- Confirm accurate measurement of core temperature with 2 temperature probes (any two of the following - bladder probe, central line, rectal probe)
- Obtain baseline vital signs
- Monitor cardiac rhythm with continuous telemetry.
- All patients will require ventilator support according to MICU standard practices.
**Active Cooling:**
- Initiate cooling according to device specifications with Arctic Sun or Alsius catheter
- Further data collection and procedures after cooling initiated:
  - Paralysis and sedation per protocol (see appendix).
  - Obtain hemodynamic values (if using pulmonary artery catheter)
  - Maintain target temperature of 33.5 degrees C for 24 hours from the time cooling began
  - Record temperature every 15 minutes during cooling phase.
  - Check vital signs every 15 minutes during cooling phase.
  - Call senior resident responsible for patient if unable to achieve target temperature within 8 hours, MAP < 60 mmHg, heart rate < 45, ventricular ectopy, urine output < 30cc/hr, core temperature falls to ≤ 32 degrees C

**Maintenance Phase:**
- Maintain core temperature of 33.5 degrees C for 24 hours from the beginning of cooling
- Record vitals and temperature every 30 minutes during the first 2 hours of maintenance, then every hour
  - ABGs q4 hours
  - Blood tests every 8 hours for 3 draws to include: CBC, BMP, Mg, PT/PTT, INR, Troponin I, LFTs, lactate
  - 500cc NS bolus to be given 2 hours before rewarming
  - Potassium and magnesium replacement should be performed to maintain values >4.0 mg/dL and 2.0 mg/dL, respectively. Replacement protocols are acceptable for potassium, but must be discontinued at the start of rewarming. After the rewarming process has begun, potassium replacement should be performed as needed only if k<3.5 mg/dL. The potassium replacement protocol should not be used. Single dose replacements with potassium checks after each replacement should be performed due to possible intracellular shift that may occur with rewarming

**Rewarming:**
- Check temperature and vital signs every 1 hour during rewarming.
  - Initiate rewarming according device specifications
  - Stop neuromuscular blockade and sedation when core temperature of 35 degrees C is reached
  - Remove thermal transfer pads (Arctic Sun) and cooling catheter (Alsius) when temperature of 37 degrees C is reached

**Overcooling**
In the event of cooling ≤ 32 C
- Double-check temperature with both thermometers
- Notify senior resident and staff cardiologist/critical care attending
- Initiate warming procedure as outlined above until temperature of 33.5 C is achieved – maintain this temperature for the duration of the 24 hour treatment period
If temperature is ≤ 30 degrees C., call the general surgery chief resident and the CCL/MICU attending
Appendix - Sedation and Neuromuscular Blockade Protocol

All patients must be intubated/ventilated prior to initiation of protocol.

Medications (in sequence)

Patient weight for drug dosing: ____________ kg.
If weight >100kg, use 100kg for calculation.

**Sedative:** Either midazolam or propofol may be administered for sedation at the discretion of the admitting team. In the absence of hemodynamic instability, propofol is the preferred drug since it allows more rapid awakening to assess neurologic status. The purpose of sedative is twofold: 1) to provide amnesia in the event the patient were to awaken while paralyzed, 2) in absence of paralysis, to manage restlessness/agitation, to provide better synchrony with the ventilator, and to prevent muscle activity (including shivering) that would impede cooling.

**A. Propofol**

No Load

Maintenance:
- A minimal dose of 40 mcg/kg/min should be used for paralyzed patients.

  - If hypotension precludes dosing of at minimum 40 mcg/kg/min, hypotension should be corrected with a fluid bolus or vasopressor (or both) or sedation should change to midazolam infusion.
  - If paralysis not used, the dose of propofol can be reduced to 20-30 mcg/kg/min as long as there is no restlessness/agitation, muscle activity, or worsening of tachycardia or hypertension that might indicate inadequate sedation.

**B. Midazolam**

Bolus:

0.05mg/kg = ________mg (max: 5 mg) IV over 1 min q 5 min x 2 doses, slower if patient experiences hypotension. Hold for SBP < ____100___ mmHg.

**Maintenance:**

Initial infusion rate 0.05mg/kg/h = __________ mg/hr (max: 5 mg/hr) IV Rescue (break through):

0.05mg/kg = __________mg (max: 5mg) q10 min prn for under sedation

- Target dose for paralyzed patients is 5 mg/hr.
- Dose for non-paralyzed patients can be reduced to 1-2 mg/hr as long as there is no restlessness/agitation, muscle activity, or worsening of tachycardia or hypertension that might indicate inadequate sedation.

**Narcotic:** All patients should be given fentanyl while undergoing hypothermia. Narcotics help reduce shivering and restlessness/agitation, give better patient-ventilator synchrony, and decrease the likelihood of pain or discomfort.

**Fentanyl**

**Load:**

1 mcg/kg = __________ mcg (max: 100 mcg) IV x 1

**Maintenance:**

50mcg/h IV continuous infusion

Breakthrough agitation:

1 mcg/kg IV x 1 (not to exceed 100mg)
**Paralysis:** The purpose of paralysis is:
1) to eliminate shivering or other muscle activity that may limit the ability to reach the target temperature during induced hypothermia, and
2) to enhance patient-ventilator synchrony.

- All patients must have adequate sedation with propofol or midazolam (see above) to ensure amnesia in the event of awakening while paralyzed.
- Paralysis may only be needed when temperature is being lowered (since shivering occurs most often during this time).
- Once the target temperature is reached paralysis is often unnecessary and should only be used to control shivering (or other muscle activity) or patient-ventilator dyssynchrony that is not adequately controlled by sedation/analgesia.

**Atracurium**
Paralysis must be achieved during the induction of hypothermia to prevent shivering by administering repeated boluses of atracurium. After the patient has achieved the desired level of hypothermia, it is the discretion of the physician team whether maintenance infusion of atracurium will be administered. In most cases continued paralysis is not necessary.

**Load:**
0.5mg/kg = _____________mg IV (max: 50mg) x repeated doses until desired level of cooling achieved. Repeat doses as necessary to maintain muscle inactivity to prevent shivering.

**Maintenance (optional):**
10 mcg/kg/min
Titrate infusion as necessary to prevent shivering through muscle inactivity. A bolus of 0.5mg/kg should be given whenever an increase in the maintenance rate is needed.

**Discontinuation of paralysis and sedation:**
When rewarming has been initiated and core temperature reaches 35 degrees:
- Stop atracurium first (downward titration unnecessary);
- Continue midazolam and fentanyl titrate for 30 minutes, then discontinue.

**Regulatory Statute/ Standard Reference:** None

**Related Policies:** None

**References:**