

## Hypothermia Protocol for Barnes-Jewish Hospital

### Inclusion criteria:

- Cardiac arrest with return of spontaneous circulation (ROSC) in or out of the hospital,
- any gender
- Initial rhythm of ventricular fibrillation or pulseless ventricular tachycardia (note: this does **NOT** mean that these rhythms were present at *some point* during the arrest, but need to be the first recorded rhythm)
- Age  $\geq 18$
- Unresponsive after ROSC
- Head CT scan without acute intracranial process
- Systolic blood pressure can be maintained  $\geq 90$  mmHg with stability (including with pressors, fluids, meant to exclude patients in shock)

### Exclusion criteria:

- Pregnancy. All women of age  $\leq 55$  need a negative urine or serum  $\beta$ -HCG
- Another reason to be comatose (comatose at baseline, drug overdose, head trauma, stroke, status epilepticus)—consider head CT where appropriate
- Hypothermia (temperature  $<30$  °C) before cooling efforts begin
- Known coagulopathy or bleeding problem
- IVC filter—excluded from long cooling catheter (Icy) must use shorter cooling catheter (Cool-Line) via IJ or subclavian approach
- Existing DNR or DNI orders.

## Initial Management in Emergency Department

Patient arrives in ED

Initiate standard care: telemetry, non-invasive blood pressure monitoring, set up ventilator, get a set of vital signs (temperature, heart rate, blood pressure, respiration rate / ventilator settings)

Medically stabilize patient

Secondary survey: physical exam (especially for neurologic status), focused history (medical history, allergies, with eye towards hypothermia if initial rhythm was VT or VF)

Inclusion criteria

Exclusion criteria

Patients should have an endotracheal tube in place

Draw code labs: CBC, BMP, Mg, Phos, PT/PTT/INR, Troponin

If patient is female and age  $\leq 55$  years, send a urine (or serum)  $\beta$ -HCG

Order portable CXR to evaluate endotracheal tube placement, evaluate for pulmonary edema or other acute lung pathology (e.g. aspiration pneumonitis).

12 lead ECG to rule out acute myocardial ischemia/infarction as possible cause of event, rule out the need for appropriate therapy including emergent cardiac catheterization

By now, ED staff should know whether or not the patient is a suitable candidate for therapeutic hypothermia.

Contact CCU to verify that they have a bed and can accept a hypothermia protocol patient.

## Hypothermia Protocol—Brief

### Initiation Phase:

Labs: CBC, BMP, Mg, Phos, PT/PTT/INR, Troponin, ECG, CXR (if female  $\leq 55$  years, send urine or serum  $\beta$ -HCG) Replete electrolytes if needed  
Sedation with midazolam and fentanyl, goal Ramsay 5  
Turn off room thermostat  
Remove humidifier from ventilator system  
Place arterial line, temperature probe Foley  
Place “Icy” femoral vein cooling catheter (unless IVC filter, then place “Cool-Line” IJ or subclavian cooling catheter)  
Set CoolGard to goal temperature 33 °C, cooling rate ‘maximum’  
After adequate sedation, start cisatracurium paralytic, bolus 0.15 mg/kg, followed by continuous drip of 2 mcg/kg/min  
Monitor qhour with train-of-four muscle stimulator, goal 1-2 out of 4 causing twitch  
Record vital signs every hour through all three phases of this protocol  
Two hours after initiating cooling, recheck BMP, Mg, Phos, replete if needed

### Maintenance Phase: (no change needed to CoolGard unit settings)

Check ABG, BMP, CBC, PT/PTT/INR, Magnesium, Phosphorous, every nine hours (at time 0, 9 hours, and 18 hours after reaching goal temperature)  
Maintain MAP  $\sim 80$ , using fluids, pressors, inotropes as needed  
If concern for acute coronary syndrome (ACS), treat as you would any ACS  
Monitor Accu-checks every 8 hours in all patients. Give subcutaneous insulin if needed.  
Order a routine 20 minute electroencephalogram (EEG) during daylight hours.

### Rewarming Phase:

18 hours after reaching goal temperature, check ABG BMP, CBC, Mg, Phos, PT/PTT/INR (as mentioned in Maintenance Phase)  
Set CoolGard unit to 36.5 °C, rewarm slowly (0.65 °C/hour setting)  
Check BMP 2 hours into rewarming  
Stop cisatracurium paralytic when temperature  $\geq 36$  °C  
When train of four stimuli causes 4/4 twitches, begin weaning sedation  
When temperature reaches 36.5 °C, may turn off CoolGard and remove cooling catheter

## **Hypothermia Protocol: Detailed**

### **Initiation Phase:** (Mostly done in Emergency Department)

- Turn off room thermostat.
- Remove (if present) humidifier from ventilator system.
- Place temperature probe Foley
  - If anuric, place esophageal temperature probe instead
  
- Place arterial line
- Correct potassium to  $\geq 4.0$  mmol/L with IV potassium chloride
- Correct magnesium to  $\geq 2.0$  mEq/L with 2.0 grams IV magnesium sulfate
- Correct phosphate level to  $\geq 2.3$  mg/dL
  
- Record vital signs (temperature, pulse, blood pressure, respiration rate) qhour
  
- Check accu-check glucose every eight hours.
  - Give subcutaneous insulin if needed per ICU protocol.
  
- Administer sedation: intravenous midazolam & fentanyl  
  
Goal: deep sedation; e.g. Richmond Agitation Sedation Scale (RASS) of -4:  
Deep Sedation: no response to voice, but movement or eye opening to physical stimulation; This corresponds to a Ramsay Sedation Scale score of ~5 (asleep, no response to light stimulation, but response to light glabellar tap or loud auditory stimulus)
  
- Set up CoolGard 3000 cooling machine (tubing, turn machine on to pre-cool)  
~20 minutes before use on a patient
  
- Prepare to insert endovascular cooling catheter:
  - Sterile field, gloves, mask, hat, gown,  $\frac{1}{2}$  or  $\frac{3}{4}$  sterile sheet
  - Site-Rite and sterile sleeve
  - “Icy” cooling catheter (9.3 Fr, 38 cm, includes 3-IV lumens beyond its 2 cool-lines, 2x18 gauge, 1x16 gauge, latex-free)

Note: take careful notice of the **FIVE** hubs on the end of the Icy catheter. Three will access the bloodstream, like a triple lumen catheter. The other two are **ONLY** for attaching to the CoolGard 3000 machine, to circulate cold fluids through the catheter, though not into the bloodstream.

- Insert cooling catheter into femoral vein – preferably with Site-Rite or other ultrasound guidance

Note: if the patient has a known IVC filter, do not use an “Icy” catheter. Instead, place a “Cool-Line” catheter via the internal jugular or subclavian vein.

- Connect cooling catheter to CoolGard 3000 system.
- Set goal temperature to 33 °C, and cooling rate to ‘maximum’
- When patient is adequately sedated, start cisatracurium paralytic intravenous bolus of 0.15 mg/kg, followed by a continuous drip of 2 mcg/kg/minute
- Evaluate paralysis every hour by using a train-of-four muscular stimuli, aiming for goal of 1 or 2 out of 4 stimuli causing a twitch.
- Two hours after initiating cooling procedure: check BMP, Magnesium, Phosphorous

#### **Maintenance Phase:**

Be aware: patients tend to diurese during cooling, peripherally vasoconstrict, and decrease their heart rate. They also decrease their CO<sub>2</sub> production by ~30%, thus need less ventilator support than a typical patient.

Also be aware that brain recovery may be better with high blood pressure. Therefore, hypotension during cooling and maintenance should be avoided. The mean arterial pressure (MAP) should be maintained at or above 80 mmHg. The initial bolus of fluid should help, but inotropes / pressors are frequently needed. Check the CVP via the Icy catheter to consider adding IV fluids. UPenn suggests norepinephrine (Levophed) if left ventricular ejection fraction (LVEF) is normal. If LVEF is low and MAP is decreased, consider dopamine or epinephrine. Goal MAP may need to be lower in patients with acute coronary syndrome (ACS) or severe heart failure. If hypertension arises (per UPenn MAP >100) consider IV nitroglycerin infusion but verify adequate CVP before doing so.

Also be aware that some patients will have seizures after a cardiac arrest. While paralyzed, they will not show outward signs of this. We will therefore order a standard 20 minute electroencephalogram (EEG) on all hypothermia-treated patients during daylight hours.

- When goal temperature reached (33 °C):  
Check ABG, BMP, CBC, PT/PTT/INR, Magnesium, Phosphorous  
Replete electrolytes as needed

- Continue recording vital signs, including response to train-of-four every hour, as above
- Check ABG, BMP, CBC, PT/PTT/INR, Magnesium, Phosphorous, every nine hours (at time 0, 9 hours, and 18 hours after reaching goal temperature)  
Replete electrolytes as needed  
No change needed in CoolGard setting.

### **Rewarming Phase:**

18 hours after first reaching goal temperature (33 °C), the maintenance phase is complete. Be aware: rapid rewarming causes harm to the patient. Rewarming should be a slow and controlled procedure, with a goal of reaching normothermia over ~5 hours. During this phase, peripheral vascular beds will vasodilate, and blood pressure will decrease, which requires active monitoring. Usually, fluid replacement will be all that is needed to reverse this hypotension. Also, potassium levels may increase.

At the start of the rewarming phase:

- The last of the q-9-hour labs (ABG, BMP, CBC, PT/PTT/INR, Magnesium, Phosphorous) is drawn.
- Set CoolGard to rewarm slowly:  
Set goal temperature to 36.5 °C  
Set rate to 0.65 °C rise per hour (*DO NOT* rewarm quickly)
- Avoid hyperthermia. If temperature exceeds 37.5 °C during the first four hours of rewarming, treat with acetaminophen. If this does not reduce temperature, consider cooling via CoolGard to goal of normothermia.
- Continue checking vital signs and train-of-four every hour
- Check BMP 2 hours into rewarming
- Discontinue cisatracurium paralytic when temperature  $\geq 36$  °C
- When train of four stimuli causes 4/4 muscle twitches, begin weaning sedation.
- When temperature reaches 36.5 °C: Turn off CoolGard and remove Icy femoral artery catheter. This will necessitate having other IV access.