MSSM ED Critical Care
Induced Hypothermia Protocol

Date: ___________  Time of Screening: ___________  Your Name: ___________

### Inclusion Criteria (Must have All)
- ☐ Post Cardiac Arrest (Any rhythm as cause of arrest is eligible)
- ☐ ROSC < 30 min from EMS/Code Team Arrival
- ☐ Time now <6 hrs from ROSC
- ☐ Comatose (Does not follow commands)
- ☐ MAP > 65 on no more than one vasopressor

### Exclusion Criteria
- ☐ Pt has DNR, MOLST, poor baseline status, or terminal disease
- ☐ Active or Intracranial Bleeding
- ☐ Traumatic etiology for arrest
- ☐ Cryoglobulinemia
- ☐ Pregnancy (Relative-Consider OB/Gyn consult)
- ☐ Recent Major Surgery (Relative)
- ☐ Severe Sepsis/Septic Shock as cause of Arrest (Relative)

### Neurologic Exam

<table>
<thead>
<tr>
<th>Eye Opening</th>
<th>Verbal</th>
<th>Motor</th>
<th>Brainstem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous</td>
<td>Oriented</td>
<td>Obey</td>
<td>Pupils React</td>
</tr>
<tr>
<td>Voice</td>
<td>Confused</td>
<td>Localizes</td>
<td>Corneal</td>
</tr>
<tr>
<td>Pain</td>
<td>Inappropriate</td>
<td>Withdraws</td>
<td>Spont. Resp.</td>
</tr>
<tr>
<td>None</td>
<td>Sounds</td>
<td>Decorticate</td>
<td>Doll’s Eyes</td>
</tr>
<tr>
<td></td>
<td>Intubated</td>
<td>Decerebrate</td>
<td>None</td>
</tr>
</tbody>
</table>

**DTRs:**

<table>
<thead>
<tr>
<th>Bicep</th>
<th>Knee</th>
<th>Toes</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>L</td>
<td>L</td>
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<tr>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
</tbody>
</table>

**If any Starred (*) Item is checked off on the neuro exam, the patient is ineligible for the protocol.**

### Protocol

- If there is a question regarding eligibility, discuss Case with the ICU Fellow or Attending.
- Time of Discussion: ___________  If pt is deemed ineligible by ICU, list reason: ___________
- List Initial Arrest Rhythm: ___________  List Number of Minutes from Start of CPR to ROSC: ___________
- Send blood for: CMP, LFTs, Superstat I, Lactate, CBC, PT/PTT, CK/MB/Troponin, Lipase/Amylase
- Completely expose patient and place cooling blanket above and below with nothing between blanket & skin.
- Place temp probe in *mid-esophagus* (~4 cm above xiphoid via oral/nasal); if unable to place in esophagus, probe can be placed rectally (5 cm)
- Hook both cooling blankets and the probe to the same blanketrol machine.
- Set temperature to 33º C and Set the machine to “Auto Control”.
- List time Now (Starting Protocol): ___________  List Initial Patient Temperature: ___________º C
- If initial temperature is < 33º C, allow patient to warm to 33º C.
- Begin opioids & sedation protocol (See page 3). Titrate to RASS Score -3/-4 (Ramsay Score 4/5 in the ICU).
- Infuse refrigerated crystalloid, preferably through large bore, peripheral IV.

Administer at ~100 ml per minute using pressure bag (evacuate air first). Maximum initial infusion is 30 cc/kg; if patient not < 34º C after this amount, wait 15 minutes before giving further 250 cc boluses Q 10 minutes.
- Administer Tylenol 650 mg GT Q 6 hours unless pt has allergy.
- If during induction, pt has shivering unrelieved by the above meds, Vecuronium 0.1 mg/kg x 1 can be used
- Total Cold Crystalloid Infused: ___________  Time that Pt reaches 34º C: ___________
- If patient’s temperature rises above 34º C, infuse 250 cc boluses of cold crystalloid Q 10 min until <34º C.
- Assess for shivering Q 15 minutes. If any signs of shivering, see the protocol on page 5.
- Maintain temperature 32-34º C for 24 hours (ideal temperature is 33º C).
- If significant bleeding or severe hemodynamic instability, consider rewarming. See ehced.org for protocol.
- Time of Rewarming: ___________  Reason Necessary: ___________
- Maintain MAP>80: Multiple Pressors and/or Dobutamine may be used during protocol, if fluid loading ineffective.

4/3/09

Scan this worksheet when pt’s bed is ready and Give Original to ICU Resident
Induction of Hypothermia

See First Page

Procedures

- Full sterile neck line with CVP monitoring
- Full sterile femoral arterial line (Axillary if femoral contraindicated/unsuccessful)
- Foley Catheter with hourly urine monitoring
- Orogastric Tube on suction

Ventilation

- Place patient on AC Mode
- Set Vt to 8 ml/kg Ideal Body Weight (see last page)
- Set IFR to 60 lpm
- Set Initial rate to 18 bpm
- Set Initial O2 to 50%
- Titrate FiO2/PEEP to achieve corrected ABG Saturation 94-96%.
- Often pulse ox will not read well due to peripheral vasoconstriction
- Send an ABG, **DO NOT INDICATE THE PATIENT’S TEMPERATURE ON THE ABG ORDER**

Hemodynamic Goals

- **Ensure Adequate Preload**
  Assess by passive leg raise, pulse pressure variation, and echo. CVP may provide some indication if very low. Use normal saline, lactated ringers, or isolyte boluses. Use room temperature fluid if patient at goal temperature. Replace patient’s urine losses 1:1
- **MAP > 65** at all times, MAP > 80 is preferred to augment cerebral perfusion
  Preferred initial pressor is norepinephrine, may add vasopressin if necessary
  If MAP is < 80 and CVP > 10 perform passive straight leg raise to assess fluid responsiveness.
  If MAP > 100, start nitroglycerin infusion
- **Corrected ScvO2 > 70**
  Can be measured by PreSEP catheter or central venous O2 saturation (send blood gas as mixed venous)
  If ScvO2 < 70 and HB < 7 (some would advocate <10 as trigger), transfuse patient
  If HB > 7, evaluate echocardiogram and consider inotropes vs. balloon pump/revascularization
- **Lactate**
  Hypothermia will raise lactate levels and post-arrest patients will have high lactate. Send a baseline level after the patient achieves goal temperature. From this point on, the lactate should stay the same or drop. If lactate is increasing, the patient is under-resuscitated or seizing

Cardiac Testing

- Get EKG immediately upon arrival; at the start of hypothermia induction; and Q 1 hour for the first 4 hours
- If possible, get a bedside transthoracic echo at the start of induction. In the ED, this should be performed by the emergency physician or cardiology. Look specifically for qualitative LV function, RV function, pericardial effusion/tamponade, & gross valve function
Sedation & Pain Control
- To gain the full benefits of hypothermia, it is imperative that the patient is adequately sedated
- Optimize fentanyl infusion rate first
- Add on propofol or dexmedetomidine if necessary
- Titrate to RASS Score -3/-4 (Ramsay Score of 4/5 if in the ICU)

Richmond Agitation Sedation Scale (RASS)

<table>
<thead>
<tr>
<th>Score</th>
<th>Term</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>+4</td>
<td>Combative</td>
<td>Overtly combative, violent, immediate danger to staff</td>
</tr>
<tr>
<td>+3</td>
<td>Very agitated</td>
<td>Pulls or removes tube(s) or catheter(s); aggressive</td>
</tr>
<tr>
<td>+2</td>
<td>Agitated</td>
<td>Frequent non-purposeful movement, fights ventilator</td>
</tr>
<tr>
<td>+1</td>
<td>Restless</td>
<td>Anxious but movements not aggressive vigorous</td>
</tr>
<tr>
<td>0</td>
<td>Alert and calm</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td>Drowsy</td>
<td>Not fully alert, but has sustained awakening (eye-opening/eye contact) to voice (&gt;10 seconds)</td>
</tr>
<tr>
<td>-2</td>
<td>Light sedation</td>
<td>Briefly awakens with eye contact to voice (&lt;10 seconds)</td>
</tr>
<tr>
<td>-3</td>
<td>Moderate sedation</td>
<td>Movement or eye opening to voice (but no eye contact)</td>
</tr>
<tr>
<td>-4</td>
<td>Deep sedation</td>
<td>No response to voice, but movement or eye opening to physical stimulation</td>
</tr>
<tr>
<td>-5</td>
<td>Unarousable</td>
<td>No response to voice or physical stimulation</td>
</tr>
</tbody>
</table>

Labs & Electrolytes
- Send Superstat I (ABG with Electrolytes) and Lactate Q 1 hour for first 4 hours, then Q 4 hours
- On arrival, send CMP, CBC, Lytes, PT/PTT, Lipase, Cardiac Enzymes, Type and Hold, & Pan-Cultures
- Send CMP (complete metabolic panel) and CBC Q 4 hours
- Send Cardiac Enzymes Q 6 hours
- Keep Magnesium at high-normal at all times with aggressive IV repletion
- Replete Potassium if < 3.4 with IV KCl
- Keep iCal at high normal at all times
- Keep Sodium at least 140 at all times, 150 is preferable
- Keep Glucose < 150 with Insulin Drip (preferred) or Subcutaneous Regular Insulin

DVT Prophylaxis
- If no contraindication, Heparin 5000 units subcutaneous Q 8 hours

Stress Ulcer Prophylaxis
- Nexium 40 mg IVSS x 1

VAP Prophylaxis
- Head of bed to 30°
- Place in-line closed suction and perform aggressive pulmonary toilet
Additional Testing

- Consider Head CT if possible neurologic cause to arrest. Note: even an intracranial bleed is not a contra-indication to continuation of induced hypothermia. Consider letting the patient drift to 34°C and administration of dDAVP.
- If there is a question of brain death, consider a CTA of the brain to assess for flow.
- Consider CTA Chest if there is a strong suspicion of PE as the cause of arrest. Bedside dopplers by EP or sono technician may be a good first step
- EEG if seizures (convulsive or non-convulsive) are suspected

Revascularization for STEMI

- PCI is preferred, consult with CPORT fellow/attending and CCU fellow. Hypothermia does not need to be discontinued for PCI.
- If PCI is not available or will be delayed, thrombolysis should be administered. Thrombolysis can be given during hypothermia. CPR performed prior to ROSC should not stop reperfusion therapy. Use standard doses of Retevase. Consult with CPORT fellow/attending.

Transport to radiology or ICU

- Disconnect the hypothermia machine and leave the blankets and temperature probe in place.
- If the patient returns to the ED, hook the machine back up.
- If the patient’s temperature is >34.5, infuse 250 cc boluses of cold crystalloid Q 10 min until <34°C
Shivering Protocol After Induction

Bedside Shivering Assessment (BSAS) (Neurocrit Care 2007;6:213)

0-None, no shivering. Must not have shivering on EKG or palpation.
1-Mild-localized to neck/thorax. May only be noticed on palpation or EKG.
2-Moderate-intermittent involvement of upper extremities +/- thorax
3-Severe-generalized shivering or sustained upper extremity shivering

• All patients receive: Acetaminophen 650 mg GT Q 6 hours unless allergic

• If BSAS > 1, add Fentanyl Drip (titrate as per EHCED drip sheet)
• If BSAS still > 1, add Propofol Drip or Dexmedetomidine Drip (titrate as per EHCED drip sheet)
• If BSAS still > 1, add Bair Hugger Device on both of patient’s arms
• If BSAS still > 1, administer MgSO4 2 grams IVSS, then 0.5-1 gram/hr for target serum Mg 3 mg/dl
• If BSAS still > 1, administer Ketamine 0.5 mg/kg IVP, may start drip at same dose per hour
• If BSAS still > 1 after titration of above meds, add Nimbex 0.15 mg/kg IV Q 1 hour PRN

Paralysis should only be necessary under extraordinary circumstances!

MSSM ED Critical Care
ARDSNet Vent Protocol

OXYGENATION GOAL: PaO₂ 55-80 mmHg or SpO₂ 88-95%
Use incremental FIO₂/PEEP combinations below to achieve goal

<table>
<thead>
<tr>
<th>FIO₂</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
<th>0.5</th>
<th>0.6</th>
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<tbody>
<tr>
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<td>5</td>
<td>8</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>12</td>
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<table>
<thead>
<tr>
<th>FIO₂</th>
<th>0.7</th>
<th>0.8</th>
<th>0.9</th>
<th>0.9</th>
<th>0.9</th>
<th>1.0</th>
<th>1.0</th>
<th>1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>16</td>
<td>18</td>
<td>20</td>
<td>22</td>
<td>24</td>
</tr>
</tbody>
</table>

PLATEAU PRESSURE GOAL: ≤ 30 cm H₂O
Check Pplat (0.5 second inspiratory pause), SpO₂, Total RR, TV and pH (if available) at least q 4h and after each change in PEEP or TV.

If Pplat > 30 cm H₂O: decrease TV by 1 ml/kg steps (minimum = 4 ml/kg).
If Pplat < 25 cm H₂O: TV < 6 ml/kg, increase TV by 1 ml/kg until Pplat > 25 cm H₂O or TV = 6 ml/kg.
If Pplat < 30 and breath stacking occurs: may increase TV in 1 ml/kg increments (maximum = 8 ml/kg).

pH GOAL: 7.30-7.45
Acidosis Management: (pH < 7.30)
  If pH 7.15-7.30: Increase RR until pH > 7.30 or PaCO₂ < 25 (Maximum RR = 35).
  If RR = 35 and PaCO₂ < 25, may give NaHCO₃.
If pH < 7.15: Increase RR to 35.
  If pH remains < 7.15 and NaHCO₃ considered or infused, TV may be increased in 1 ml/kg steps until pH > 7.15 (Pplat target may be exceeded).
Alkalosis Management: (pH > 7.45) Decrease vent rate if possible.

This package outlines suggestions for the care of the Post-Arrest patient. It does not set a standard of care and individual patient circumstances should always be taken into account when making treatment decisions.