

THERAPEUTIC HYPOTHERMIA PROTOCOL FOR PATIENTS IMMEDIATELY POST CARDIAC ARREST

1. Patients who meet inclusion criteria post cardiac arrest should have their core body temperature reduced to 32° - 34°C as soon as possible, ideally within 4 hours of return of spontaneous circulation (ROSC).
2. Hypothermia should not be delayed due to other lifesaving procedures, and should occur simultaneously with cardiac catheterization or other emergent procedures. Patients transferred from another hospital should not have therapeutic hypothermia delayed prior to transfer from the outside hospital.
3. If the patient is not already in an Intensive Care Unit (ICU) arrangements must be made for a transfer to the first available ICU bed. *For children, ≤18 years old, the PICU Attending should be called immediately.*
4. One to one nursing care is required for any patient receiving therapeutic hypothermia.
5. Ideally the patient's circulation must be maintained with a mean arterial pressure 80–100 mmHg (to overcome the effects of raised intracranial pressure). (For children, Systolic BP > [2 x age + 70]) O₂ saturation of 94-96% and a CO₂ level of 40mmHg. **Hyperoxia should be avoided and oxygen should be titrated down** to meet this criterion where possible.
6. The goal is to continue the therapeutic hypothermia for a period of 24 hours from initiation of cooling.
7. Once 24 hours of cooling has occurred, a slow (passive) rewarming phase will be initiated to reach the goal temperature of 36.5° Celsius. It should happen no faster than an increase of 0.25°C per hour.
8. **Attempts at prognostication should NOT be made within the first 72 hours.** Neurological signs include absent reflexes are **NOT** reliable at this time. **When hypothermia is used a longer period may be needed. Consult with neurology.**

ISSUE	INTERVENTIONS
Inclusion criteria	<ol style="list-style-type: none"> 1. All patients with cardiac arrest; in or out of the hospital within the past 24 hours who do not recover to make purposeful neurological movements (as assessed by appropriately following commands or having a motor score of 5 on GCS)
Cautions to consider	<ol style="list-style-type: none"> 1. Septic Shock as the cause of cardiac arrest (hypothermia therapy may inhibit an immune response). 2. Known pre-existing coagulopathy or active or recent bleeding. 3. Don't start as long as patient's temperature is already ≤32-34°C post arrest. Continue to monitor using cooling and heating exchange devices to maintain core temperature between 32-34°C. Hypothermia will need to be started if temperature rises above 32-34°C. 4. Intra-cerebral hemorrhage (discuss with Neurology before making final determination to use or not use hypothermia)
Consults to obtain (time measured from ROSC)	<ol style="list-style-type: none"> 1. If New ST elevation or New Left Bundle Branch Block - call a STAT code H** 2. Cardiology if EKG findings unclear or positive troponins or not obvious extracardiac cause of cardiac arrest (e.g. electrolyte abnormality, hypoxia, trauma) – call Cardiology consult for evaluation for cardiac catheterization. 3. STAT MICU consult for post arrest management, or for MICU acceptance in a non-code H patient. (For children ≤ 18, STAT PICU consult – call the Attending)

ISSUE	INTERVENTIONS
	<ol style="list-style-type: none"> 4. Order Routine EEG STAT: (indication: Encephalopathy. No Sleep Deprivation. Portable). <ul style="list-style-type: none"> • EEG technician should be paged if this occurs off-hours • Page neurology resident on call who will contact the appropriate Fellow/Attending for a STAT interpretation of the routing EEG. • Order Video EEG STAT: (Indication: Encephalopathy. No Sleep Deprivation. Portable) • Video EEG will be continued for a minimum of 72 hours. Discontinuation of EEG after 72 hours will be discussed with the Epilepsy attending. 5. Neurology consult after 72 hours or sooner if there is a specific neurologic concern noted; e.g., seizure activity, involuntary movement, abnormal EEG findings. Seizures must be avoided in this patient population and an urgent neurology consult is needed if suspected clinically or based on EEG.
Equipment needed	<ol style="list-style-type: none"> 1. Temperature probe for continuous monitoring of core body temperature (bladder & esophageal preferred, rectal if these are not possible) 2. Two liters of 4° Celsius normal saline – Keep 2 liters chilled normal saline in ICU/ED med refrigerators while running the protocol. Two liters of chilled normal saline will arrive on non-ICU floors with replacement Code cart or already available on floor/unit. Label the bag to expire in 24 hours. 3. Pressure bags. 4. Ice packs – zip lock bags from code cart, ice from ice machine 5. Therapeutic Hypothermia Cooling system or simple cooling blanket system (top and bottom sandwich) 6. Urinary catheter 7. NG tube 8. Bladder lavage (to be used only if cooling process not successful within 15-30 minutes). 9. Therapeutic Hypothermia Frequent Vital Sign sheet 10. Intraosseus access if needed for infusion medication and cold saline.
Cooling the Patient in the first 4 hours	<p>For neonatal / pediatric cases consult PICU.</p> <p>For ADULTS:</p> <ol style="list-style-type: none"> 1. Obtain a core temperature via esophageal, bladder or rectal temperature probe. If greater than 34°C, start therapeutic hypothermia. 2. Infuse two liters (bolus) – 30ml/kg of 4° Celsius Normal Saline over 30 minutes using pressure bags to aid infusion through peripheral IV's, central lines or intraosseus route. 3. Place ice packs at patient's neck, axilla and groin. (and head, for children) 4. Place patient on Therapeutic Hypothermia cooling system. If using simple cooling-blanket system, place patient between 2 cooling blankets (sandwich), with sheets between the patient and the blanket. (Cooling machines are available in CICU, SICU, MICU and the ED. Use two extension hoses on one machine) OR Use an Automated loop-- feedback external pad--cooling system

ISSUE	INTERVENTIONS
	<ol style="list-style-type: none"> 5. Use an esophageal, bladder or rectal probe to monitor body temperature. 6. Record vital signs, PERRL and whether shivering is present on the designated therapeutic hypothermia (TH) frequent vital sign sheet every 15 minutes for one hour, then every one hour. 7. Place a Foley catheter and NG tube. 8. If NG lavage required: use ice cold water – 250ml every 15-30 minutes until target temperature is reached. Watch pH. 9. Consider bladder lavage only if cooling is occurring too slowly; 200ml every 15-30 minutes. 10. Check skin surfaces every hour for cold burns, document integrity on TH frequent vital sign sheet. 11. Maintain a MAP > 80mmHg. (For children, maintain a systolic BP > [2 x age (years) + 70]) 12. Maintain continuous cardiac monitoring. 13. EKG every 8 hours x 3 then once a day.*(see note). Refractory arrhythmias will require active rewarming. (Repeat EKG's may not be necessary for children) 14. Labs: On admission: Chem 8 w/ Mg/Ca/Phos, ionized calcium, serial troponins, PT/PTT, amylase, lipase, lactic acid, ammonia, blood cultures, ABG (corrected to the temperature of the patient) (Troponins may not necessary for children Every 2 hours during cooling phase until target temperature is met: Chem 8 w/ Mg/Ca/Phos, ionized calcium during cooling phase. 15. Maintain blood glucose at target range using the Adult Rapid Acting Insulin Order-Set (For children, use the Pediatric Insulin Protocol) 16. If blood glucose > 150mg/dL use the Adult ICU Regular Insulin Infusion Orders in power plan order set. 17. Lab values: Keep serum potassium \geq 3.5mmol/L Keep Mg \geq 1.8mg/dL Maintain blood glucoses \leq 150mg/dL Keep Ionized calcium – normal (if persistently low may need a calcium drip at 1 or 2g/hr. calcium gluconate / chloride titrated to calcium level) 18. Sedate ventilated patients using the Richmond Agitation Scale (RASS) goal = (-4) Deep sedation. (For children, use the State Behavioral Scale - SBS, goal = -3) 19. Eliminate shivering through use of opiates, warming hands and feet and/or neuromuscular blocking agents. 20. Administer a paralytic ONLY if shivering is present: (or if other indication such as ventilator crisis):Do NOT paralyze a patient who is not intubated & adequately sedated

ISSUE	INTERVENTIONS
Cooling the Patient from hour 4 to 24.	<ol style="list-style-type: none"> 1. Record vital signs hourly 2. Maintain continuous cardiac monitoring – observe for refractory arrhythmias. 3. EKG every 8 hours x 3 4. Obtain Neurology Consult 5. EEG 6. Monitor I's & O's
Notes on Shivering	<ol style="list-style-type: none"> 1. Additional sedation / neuromuscular blockade may be needed to eliminate shivering. Note: Neuromuscular blockades should be avoided unless necessary due to potential abrupt drop in core temperature. 2. Shivering will generate heat and raise core temperature. 3. Shivering increases O₂ consumption by 40 -100%
Clinical Consequences and Complications to look for	<ol style="list-style-type: none"> 1. EKG: wide QRS, prolonged QT, Osborne waves, atrial fibrillation, refractory VF @ < 30°C Refractory arrhythmias – requires active rewarming. 2. Oxygen delivery to tissues: bradycardia (HR 40-45) reduces C.O. by approx 25%, impaired unloading of O₂ off hemoglobin, C.O.shunts to core, increased ANP, “cold diuresis” – hypovolemia, reduced metabolic rate, hyperlactatemia and metabolic acidosis. 3. Electrolyte imbalances – Hypo K, Mg, P, Ca (due to tubular dysfunction and intracellular sequestration) do not over correct. There may be hyperkalemia in the warming phase. 4. Hyperglycemia: Insulin resistance and reduced insulin secretion - should be treated aggressively. Keep glucose / finger sticks around 130-150. 5. Increased amylase, LFT's 6. Decreased drug clearance by liver conjugation/oxidation, esp. opiates, benzos, NM blockers 7. Incorrect ABG values: subtract 5mmHg for each 1 degree < 37°C 8. Hemorrhagic diathesis: low platelet #'s and function. Significant only in trauma patients. – may use FFP & Platelets. 9. Unrecognized sepsis – patients may not mount an immune response. 10. Bedsores 11. Resuscitative medications and defibrillation may not work at temperatures < 30°
What you may expect to see	<ol style="list-style-type: none"> 1. Induced diuresis – treat aggressively with fluid and electrolytes 2. Mg, Phos & K should be monitored closely at low normal. (They will rebound to high upon rewarming)
Rewarming the Patient	<ol style="list-style-type: none"> 1. Anticipate vasodilatation (after drop) & drop in BP with rewarming. Aggressively volume load with NaCl 6-8 hours prior to rewarming 2. Begin 24 hours after cooling is initiated 3. Rewarm body temperature passively by discontinuing cooling therapy to a goal of 36.5°C at a rate of 0.25°C / hour or 1°C every four hours. 4. Only if the goal temperature of 36.5°C is not reached within 12 hours should a warm air blanket be used.

ISSUE	INTERVENTIONS
	<ol style="list-style-type: none"> 5. Monitor for rebound hyperthermia - Avoid temperatures > 37.5°C, treat with medication or cooling blanket 6. Routine ICU vital signs. Call MD for MAP < 70-80, HR < 40, potassium \geq 5 7. Continue to monitor and notify MD for arrhythmias, abnormal coagulation lab values, signs of infection, hypotension, hyperkalemia 8. Stop neuromuscular blocking agents if initiated 9. Titrate analgesics and sedative for patient sedation – RASS (-2) (For children, SBS -2)

REFERENCES:

- Bhattacharjee, Judhutt, The University of Chicago Medical Center, *When the Heart Stops Beating*, http://www.uchospitals.edu/pdf/uch_003646.pdf
- Calver, Patty RN, BSN, Braungardt, Theresa RN, BSN The big chill: Improving the Odds After Cardiac Arrest, May 1, 2005 <http://www.modernmedicine.com/modernmedicine/article/articleDetail.jsp?id=158219>
- Hospital of the University of Pennsylvania. *Hypothermia after Cardiac Arrest Guideline of care*, 6/10/2005 <http://www.med.upenn.edu/resuscitation/hypothermia/documents/hypothermia%20protocol%20MGH%202005.pdf> .
- Nolan, J.P, FRCA; Morley, P.T. MD; Vanden Hoek, T.L. MD, Hickey R.W. MD, *Therapeutic Hypothermia After Cardiac Arrest*, 2003. <http://circ.ahajournals.org/content/108/1/118.full>

Neumar, R. W, Nolan JP, Adrie Cet al. *Post-cardiac arrest syndrome: epidemiology, pathophysiology, treatment, and prognostication. A consensus statement from the International Liaison Committee on Resuscitation (American Heart Association, Australian and New Zealand Council on Resuscitation, European Resuscitation Council, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Asia, and the Resuscitation Council of Southern Africa); the American Heart Association Emergency Cardiovascular Care Committee; the Council on Cardiovascular Surgery and Anesthesia; the Council on Cardiopulmonary, Perioperative, and Critical Care; the Council on Clinical Cardiology; and the Stroke Council.* *Circulation* 2008; 118:2452-2483
<http://circ.ahajournals.org/content/118/23/2452.full.pdf+html?sid=00c00c2b-10bd-4acb-823b-55f65f4df202>

- Taylor, Kimberly, M.D., PhD, Massachusetts General Hospital, *Hypothermia after Cardiac Arrest*, 2/22/2011, <http://www2.massgeneral.org/stopstroke/protocolHypothermia.aspx>
- McQuillan, Karen A. RN, MS,CCRN, CNRN, *Hypothermia Post Cardiac Arrest*, pp presentation, <http://www.umm.edu/imres/conf/AC-Hypothermia-0809.pdf>
- O'Connor, Robert E, Bossaert, Leo, *Part 9: Acute Coronary Syndromes: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations*, *Circulation*, 2010, 122:S422-S465 http://circ.ahajournals.org/content/122/16_suppl_2/S422.full.pdf+html
- Sayer, M., Rudolph W. *Part 5: Adult Basic Life Support: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations*, *Circulation*, 2010 http://circ.ahajournals.org/content/122/16_suppl_2/S298.full.pdf+html