VT/VF Hypothermia Guidelines for BMC-CCU

I. INDICATIONS:
   A. Status post VT/VF arrest with the following:
      i. Should be initiated within a 6 hour post cardiac arrest time window
      ii. Estimated interval of 5-15 min from collapse to onset of resuscitation
      iii. Estimated interval less than 60 minutes from collapse to restoration of circulation

II. EXCLUSION CRITERIA:
   A. Trauma
   B. Recent surgery [<14 days]
   C. Respiratory arrest
   D. Systemic infection/sepsis
   E. Conditions predisposing to major bleeding
   F. Pregnancy
   G. Core temperature < 30 degrees Celsius on admission
   H. Comatose state prior to the arrest secondary to CNS depressant drugs
   I. Positive response to verbal commands after resumption of spontaneous circulation
   J. Hypotension [MAP < 60 mm Hg for > 30minutes after the return of spontaneous circulation OR SBP < 90 mm Hg despite pressors]
   K. Terminal illness preceding the arrest
   L. Pre-existing coagulopathy

III. EQUIPMENT:
   A. Cooling device
      1. Alsius Coolgard 3000 cooling device
   B. Two continuous temperature monitoring devices
      1. Foley catheter with thermistor CDC # 11664 to plug into T1 temperature outlet
      2. Esophageal/rectal probe with thermistor to plug into T2 temperature outlet
   C. Coolgard 3000 Start Up Kit [tubing]
   D. ICY Kit for percutaneous introduction
   E. 500 cc Normal Saline Bag
   F. Physiometric PSA 4000 monitor for sedation
      1. PSA Array#2 EEG electrode set
   G. Venous access for fluids/ meds/ and blood draws
   H. Optional - arterial line for BP monitoring if hemodynamically unstable
      Arterial line is recommended if hypotension persists post resuscitation despite pressors. Arterial access should be secured in a timely fashion before instituting hypothermia by the MD or anesthesia. HOWEVER, HYPOTHERMIA SHOULD NOT BE DELAYED OR CANCELLED SECONDARY TO THE INABILITY TO OBTAIN AN ARTERIAL LINE.

IV. COOLGARD 3000 SET UP:

A. Obtain Cardiology consent
B. Support respiratory function with an artificial airway and ventilatory support.
C. PRE-HYPOTHERMIA:
    1. Check coolant level
        a. If the level is below the minimum line add sterile water to raise the fluid level between the maximum and minimum line
    2. Plug in the power cord and power up the console
    3. The console will ask you SYSTEM PRE-COOL?
        a. Select YES and press the large knob once to enter your selection
    4. SELECT CATHETER [Pump Rate] will appear next
        a. Select the catheter you are planning to use. In the CCU for VT/VF arrest we use the ICY CATHETER
        b. Press the large knob to enter your selection
    5. OVERRIDE SECONDARY TEMPERATURE PROBE [T2] ? will be displayed next
        a. Select NO & press the large knob once if you are attaching two temperature probes to the console. THIS IS WHAT WE SELECT IN THE CCU. IT IS STANDARD PRACTICE TO MONITOR THE PATIENT'S TEMPERATURE BY TWO PROBES.
        b. Select YES if you are only attaching one temperature probe to the console & press the large knob once to enter your selection. Remember you must monitor a second temperature source also.
    6. An informational message will be displayed and ask if you wish to continue?
        a. Select CONTINUE and press the large knob once
    7. SET TARGET TEMPERATURE will appear
        a. Turn the large knob to the desired temperature and press it once to enter the selection. For hypothermia for VT/VF the desired temperature is between 32 and 34 degrees Celcius. Our goal is a patient temperature of 33 degrees Celcius. For the first couple of patients we will set it at 34 degrees initially. The nurse will monitor it for one hour after the target temp of 34 is reached to insure we do not have patient temperature drift. After we are sure there is no temperature drift, reset the target temperature to 33 degrees Celcius. The patient is cooled at the target temp of 33 degrees Celcius for 24 hours.
    8. MAX POWER or CONTROLLED RATE will appear
        a. For initial cooling select MAX POWER and press the large knob
        b. CONTROLLED RATE is used upon rewarming

9. Install the start up kit tubing set:
    a. Insert the heat exchange coil into the coolant well
    b. Insert the air trap into the air trap holder
    c. Load the wider tubing into the roller pump. Note the flang fits into the slot on the right hand side of the roller pump. Carefully thread the tubing while turning the roller pump with the crank handle provided. Firmly close the top cover of the roller pump. Refer to diagram on the inside of lid of the console.
    d. Using aseptic techinique, spike the tubing into a bag of 500 cc Normal Saline. Use the 500cc Saline bag manufactured by Braun located on the shelf above the Coolgard console in the locked CCU equipment room. Remove the rubber stopper from the shorter additive port and insert the spike from the tubing kit. This Normal Saline bag is made with a stiffer plastic and is better suited for the large spike on the tubing kit. Insert the saline bag into the insulated jacket and hang on the hook in the back of the console
    e. Remove the air trap from the holder and hold it upside down
    f. Press and hold the PRIME switch. The pump will slowly rotate. Watch the movement of saline through the tubing. Wait until it fills the air trap, tap the air trap to dislodge any bubbles, when satisfied replace it into the air trap holder.
    g. Continue to prime the entire length of tubing. You will not see any more air return to the saline bag when priming is complete. When priming is complete, release the PRIME switch. During the prime if you continue to see air in the line, check to insure that the lumen of the tubing spike has advanced well into the saline bag.
    h. Route the tubing out of the machine through notches in the front of the console and through the channel at the side of the console.
    i. Close the cover.
    j. Lock console wheels
9. Connect the two patient temperature sensors
    a. T1 is the foley
    b. T2 is the esophageal/rectal tube
10. Aseptically connect the ICY catheter to the saline tubing from the Coolgard 3000
    a. Make sure the system is in the STANDBY mode
    b. Disconnect Luer fittings on the tubing set
    c. Connect tubing fittings to Luer fittings of the IN and OUT balloon ports of the ICY catheter
11. Turn on the Coolgard 3000
    a. Press the RUN/STANDBY button

b. The screen changes from the standby screen to the main operating screen
c. The roller pump will begin to turn
d. The red windmill in the tubing will rotate

D. TO INSTITUTE REWARMING VIA THE COOLGARD 3000:

1. Press the STANDBY/RUN BUTTON.
2. Press the TARGET TEMP button. It will be displaying MAX
3. Turn the large knob to change the temperature setting from MAX to the desired temperature you wish to rewarm [36.7 degrees Celcius].
4. Press the large knob once to enter the desired temperature.
4. Press the RATE DEGREE/HR button
5. Turn the large knob until you select 0.5 degrees Celcius [the insures the machine will not warm your patient faster than 0.5 degrees Celcius] [You never want to warm a patient quickly or you risk hypotension, arrhythmias, and a recooling phenomenon as cool peripheral blood is quickly circulated centrally.]
6. Press the large knob once to enter your selection.
7. Press the STANDBY/RUN button to restart the pump. [Note the pump may not begin rotating the solution right away. It first rewarms the solution in the coolant bath so that rewarming can occur. It will begin rotating the pump when the coolant bath reaches the appropriate temperature to do so.]
8. Monitor the pump and red windmill once the console starts rewarming.

E. TO TEMPORARY DISCONNECT THE PATIENT FROM THE COOLGARD 3000:

1. Press the STANDBY/RUN button to place the CoolGard 3000 in the standby mode.
2. Disconnect the temperature probes from the Coolgard 3000 cables. Leaving the temperature probes in the patient.
3. Using aseptic technique, disconnect the IN and OUT balloon port on the ICY Catheter from the saline line.
4. Connect the IN and OUT balloon ports to each other and then connect the ends of the saline line from the Coolgard 3000 to each other.

F. TO RECONNECT AFTER A TEMPORARY DISCONNECTION FROM THE COOLGARD 3000:

1. Using aseptic technique, reconnect the saline line from the Coolgard 3000 tubing to the IN and OUT balloon ports of the ICY catheter.
2. Reconnect the temperature probes to the cables from the Coolgard 3000.
3. Restart treatment by pressing the STANDBY/RUN button.

G. TO END TREATMENT WITH THE COOLGARD 3000:

1. Press the STANDBY/RUN button.
2. To end treatment and remove the ICY catheter, the MD must first disconnect the IN and OUT balloon ports from the Coolgard cooling line.
    a. Uncap or leave uncapped the inflow and outflow balloon lumens of the cooling circuit.

b. Aspirate each balloon lumen separately to remove any residual saline from the balloons. When aspirating from one balloon port, the other balloon port should be open to air. Repeat on the remaining balloon port.
c. Do not reconnect the balloon ports to each other to allow residue saline within the circuit to be expressed during withdrawal. As catheter is withdrawn, the balloons are further compressed. Saline within the balloons must be free to pass out of the balloon or the balloon will not deflate making the catheter difficult to remove.

3. If the ICY catheter is to remain in place for IV access, aseptically disconnect the IN and OUT ports of the balloon lumen from the Coolgard cooling line and immediately connect them to each other. This keeps the balloons maximally inflated and will minimize clot formation. The ICY catheter may be used for up to 4 days maximum, however, per usual CCU practice femoral lines should be removed as soon as possible to minimize the risk of infection.
    a. The balloon lumens should be disconnected and aspirated as outlined above in Step #2, Section G of this guideline at the time of removal.
4. Disconnect the primary & secondary patient temperature probes from the Coolgard 3000 cables.
5. Press the knob once. A menu is displayed. Turn the large knob to highlight SELECT END PROCEDURE and press the knob once.
6. Turn off the Coolguard 3000.

IX. NURSING CARE OF THE PATIENT RECEIVING HYPOTHERMIA:

A. Pre-hypothermia perform a complete neurological exam
B. If the patient's clinical condition allows, assess and mark sites for TO4 monitoring prior to giving NMBA.
C. Monitor hourly and PRN the following:
    1. VS including temperature, cardiac rhythm, hemodynamics, respiratory status, neurological status, & urine output
    2. Maintain MAP 90-100 mg Hg
    3. Level of sedation
    4. Level of neuromuscular blockade
    5. Pulse distal to the extremity that has the ICY catheter inserted
    6. The site of the ICY catheter and integrity of connections
    7. The red windmill of the Coolgard 3000 is turning
    8. The level of saline in the 500 cc Normal Saline bag connected Coolgard tubing remains constant.

D. Additional nursing care:
    1. NO bathing is done during the cooling and re-warming phase of treatment to prevent temperature fluctuations.
    2. Minimal patient movement is performed when the patient's temperature is less than or equal to 34 degrees Celsius to avoid dysrhythmias.
    3 . Utilize heel relief mode on bed to protect the heels, which are the a very vulnerable area for breakdown.

4. ASSESS FLUID STATUS & INSURE ADEQUATE HYDRATION BEFORE INSTITUTING REWARMING TO AVOID HYPOTENSION. Try to maintain I&O equal.
5. DO **NOT** REWARM THE PATIENT FASTER THAT 0.5 DEGREES CELCIUS PER HOUR.
6. Due to the circulatory risk a percutaneous catheter creates, continued monitoring of circulation to the limb distal to the ICY catheter is recommended for the first 24 hours after catheter removal.

E. Draw labs on admission then q 6 hours:
1. Every 6 hour lab studies include: electrolytes, glucose, cardiac enzymes, blood gas analysis [arterial or central venous].
2. Admission and daily labs add BUN, Cr, liver profile, serum amylase, lipase, CBC with differential, INR.
3. Blood cultures are drawn 12 hours after initiating cooling as infection will be masked during the cooling phase.
4. Lactate levels should be monitored if acidosis is suspected from results of blood gas or electrolytes [low bicarbonate or high anion gap].

D. Administer sedation:
1. Maintain until the patient is re-warmed & approaches normothermia.
2. Versed may be used to obtain immediate sedation upon initiation and for breakthrough sedation.
3. Ativan infusion is recommended for continuous sedation.
4. The Physiometric PSA 4000 is another tool to use to monitor sedation level. Monitoring sedation in patients receiving a NMBA is made more difficult due to hypothermia since they will not raise their BP or HR as sedation wears off. Current recommendations are to sedate according to clinical assessment and a PSA score of 50 to 80. Further experience with this device in these patients is warranted.

E. Administer neuromuscular blockade:
1. Utilized to prevent shivering and the resultant increase in oxygen demands and metabolic rate.
2. Intermittent dosing is preferable until the patient is re-warmed & approaches normothermia to prevent shivering.
   a. Vecuronium is the preferred agent unless dosage titration is precluded by severe kidney failure.
   b. In patients with severe renal failure, cistracurim should be utilized.
3. Target goal for NMBA is 1 to 2 twitches out of 4 with the TO4 along with clinical parameters.

F. Be aware that:
1. Hypothermia can cause arrhythmias VT/VF as well as bradycardia.

2. Remember a hypothermic patient requires a reduced dosage of medication compared with a normothemic patient so use the lowest dose possible for treating arrhythmias.
3. Maintain MAP 90 - 100 mm HG
4. A percutaneous catheter poses a risk to the circulation of a limb distal to it's insertion. This risk prevails for the duration of the catheter use but may manifest in the first 24 hours after a catheter is removed necessitating close monitoring/documentation of distal pulses in the affected limb throughout the duration of catheter use and for 24 hours after removal.
5. Maintain a neutral head and body position to minimize any ICP elevation
6. Complications of hypothermia include infection, pancreatitis, coagulopathies, liver failure

X. CLINICAL INFORMATION:

A. Induced moderated hypothermia has been shown to afford some degree of protective value to the brain following cardiac arrest in animals and a few published studies in humans. This results from a number of reasons:
   - a reduction in cerebral oxygen consumption,
   - suppression of free radical reactions,
   - protection of lipoprotein membranes, reduction of intracellular acidosis,
   - reduction of intercerebral pressure,
   - inhibition of biosynthesis, release and uptake of excitatory neurotransmitters.

B. Complications of hypothermia
   - Cardiac arrhythmias, infection, & coagulopathies may increase if core temperature falls below 32 degrees Celcius.
   - Hypothermia was associated with a reduction in CI, increase in SVR, and hyperglycermia [Bernard et al: 2002].
   - Status epilepticus was noted in 4/9 patient in one study and was attributed to hypoxic-ischemic brain injury in all cases [Felberg et al: 2001]. During rewarming myoclonic movements were first noted in these patients, begining in the face and arms, and progressing to seizures.

XI. RESOURCES:

Bernard SA, Gray TW, Buist MD, et al. Treatment of comatose survivors of out of hospital cardiac arrest with induced hypothermia. NEJM 2002: 346: 557-563.

Felberg, RA, Krieger, DW, Chuang, R, et al. Hypothermia After Cardiac Arrest . Circulation. 2001; 104: 1799-1804.

The Hypothermia after Cardiac Arrest Study Group. Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest. NEJM 2002; 346: 549-556.

Nolan, JP, Morley, PT, Vanden Hoek, TL, et al. Therapeutic Hypothermia After Cardiac Arrest. Circulation 2003; 108: 118-121.

XII. Authors:

George Philipides MD
Janet S. Eagan RN