PRACTICE AREA: TARGETED TEMPERATURE MANAGEMENT (TTM) AFTER RESUSCITATED CARDIAC ARREST: The purpose of targeted temperature management after resuscitated cardiac arrest is to improve the neurologic outcomes of patients who have a return of spontaneous circulation after cardiac arrest but have suffered ischemic brain injury. The induction of mild hypothermia has proven to significantly reduce both the incidence and severity of brain injury as well as overall mortality. The exact mechanism is unknown, but it is thought that decreased temperature suppresses the generation of free radicals when tissue is reperfused after resuscitation; and thus, decreases the damage caused by free radicals.

EQUIPMENT NEEDED

  a. Arterial line kit
  b. Central venous catheter kit
  c. Two 1 liter bags of 0.9% normal saline at refrigerator temperature (e.g., 4-8 degrees C) (ICU Omnicell refrigerator, listed as cold saline or saline cold)
  d. Gaymar Medi-Therm 111 Hyper/Hypothermia machine with Rapr.Round Body Wraps (behind Bed 2 in ICU)
     • Note: Our supply is 1 box. When there is only 1 left, you must order another box.
  e. Distilled water (CSR)—will need 4 - 24 hour urine containers to fill machine
  f. Temperature probe Foley catheter or esophageal thermometre with adaptor for cooling device (or alternative temperature monitoring device) (behind Bed 2 in ICU)

NURSING ACTIONS:

EXCLUSION/INCLUSION CRITERIA

  • Assess patient to see if appropriate for initiation of TTM.

  • Exclusion Criteria: Do NOT proceed with treatment orders if any of the following criteria are met
    o Within 72 hours of a major operative procedure or trauma
- Uncontrolled bleeding
- Shock (MAP < 75 despite interventions)
- Known sepsis
- More than 12 hours have elapsed since return of spontaneous circulation (ROSC)
- Not a primary cardiac arrest (VT/VF, asystole, or PEA)
- Glasgow MOTOR score > 5
- Temperature < 32 °C
- Minimal pre-morbid cognitive status
- DNAR B or C according to FCCC Resuscitation Policy

**Inclusion Criteria:** Both criteria must be met
- ROSC for at least 30 minutes since cardiac arrest
- Patient is on mechanical ventilation

If appropriate candidate, have physician complete Targeted Temperature Management Order Set. (See attached)

- A nurse: patient ratio of 2:1 is required for the first 4-6 hours while the patient is on the protocol. Thereafter, a 1:1 ratio is required for full duration of the protocol.

**COOLING**

- Place Bard temperature-sensing Foley catheter or esophageal thermometer to monitor temperature. The Bard Foley temperature sensing catheter will work with anuric patients. The alternative is to place a temperature-sensing esophageal probe kept behind Bed 2). Consider this if you feel you are getting inaccurate temperatures with Foley.
  
  a. Connect to port on Medi-Therm III.
- The Medi-Therm III Hyper/Hypothermia machine, along with the Gaymar Hyper/Hypothermia body wrap, should be used to regulate patient temperature.
  
  a. Apply Rapr-Round® Body Wraps to patient.
    
    • Lay wraps on bed or stretcher.
    • Connect to hoses on machine per instruction manual.
    • Fill water opening and on the rear facing side of the Operator Control Panel’s sloped surface.
    • Use only distilled water, fill until green line on bopper can be seen.
- Turn machine on manual and set temperature for 4°C.
- Allow wraps to fill with water
- Apply to patient. Hoses always face down and label should be on outside.
- The 2 legs wraps should be connected to each other and then to one hose.
- Set to Automatic mode with set point of 33°C.
- Close Velcro after Mode has been selected and pads are filled with water.
- If sequential compression devices are being used, they may remain in place. Do not close lower half of leg wrap.

b. Follow instructions in the manual. Condensed version is permanently attached on the cover of the Medi-Therm III Hyper/Hypothermia machine.

c. Keep area between the patient and the blanket/body wrap dry as excessive moisture may result in skin damage.

d. The AUTO mode should be chosen. In this mode the machine constantly compares actual patient temperature with the set point value and automatically adjusts the water temperature. (MONITOR mode can be used only if therapy is not being used and temperature only needs to be monitored.)
   - Use RAPID setting rate to achieve set temperature as soon as possible within 4 hour window.
   - Press the SET POINT button to set desired patient temperature (33°C).
   - When the patient temperature stabilizes (within 0.5°C/0.9°F) of the set point, the COOLING and WARMING displays will turn off indicating that the desired patient temperature is being maintained.
   - TH should be maintained for 24 hours after the target temperature is reached.

ANTICIPATE THE FOLLOWING ISSUES DURING:

COOLING

a. Hypokalemia due to both intracellular shift and cold diuresis. Do NOT aggressively replace potassium during cooling. Replace only when potassium is < 3.2 mEq as potassium will partially correct during rewarming as extracellular ion shift will occur.

b. Magnesium, calcium and phosphate may also need frequent replacement due to cold diuresis.
c. Shivering may prevent achievement of TH in a timely manner. This is prevented by administration of neuromuscular blocking agents. **Follow NMB (Neuromuscular Blockade) SOP.**
   i. The prolonged use of meperidine (more than 2 doses at onset of therapeutic cooling) is discouraged. The metabolite normeperidine contributes to seizures. The levels of this metabolite are increased during cooling due to decreased drug clearance.

d. It may be difficult to achieve target temperature within 4 hours for patients with a large body habitus. Consult with physician as necessary.

e. Anticipate sinus tachycardia followed by bradydysrhythmias during TH. Do not treat unless symptomatic. Other arrhythmias usually decrease with TH.

f. There is an increased risk of arrhythmias at temperature less than 30 degrees C and ventricular fibrillation will occur at temperatures less than 28 degrees C.

g. Blood pressure may be elevated during TH (due to vasoconstriction), or may decrease secondary to cold diuresis.
   a. Goal is MAP > 75 <120 mm Hg and CVP > 8

h. Hyperglycemia is common during TH. Vasoconstriction my cause finger sticks to be inaccurate. Use A-line.

i. If significant bleeding ensues while hypothermic, correct coagulopathy aggressively. If bleeding cannot be controlled, stop TH and rewarm.

j. Anticipate ileus during TH. If on enteral feedings, maximum rate should be 10 ml per hour.

k. The most serious complications of TH are infection, seizures and coagulopathy. Monitor patients for signs and symptoms.
   i. A rise in patient temperature after goal is reached is usually due infection or seizures if the cooling machine is working correctly. If patient not on prophylactic antibiotics or anti seizure medications, discuss with physician.

l. Do not ignore standard ICU protocols for prevention of VAP, DVTs, and skin injury.
   i. Especially prone to injury is skin in direct contact with body wraps. The body wraps must be checked every 2 hours with position change to make sure that they are not constricting soft tissue. Velcro straps should be readjusted as necessary.
   ii. A circular pattern identical to the body wraps may be seen on the patient’s skin. This pattern typically lasts for the period of time
the body wraps are in place and resolves after the wraps have been discontinued.

m. Do not bathe patient during protocol.

n. Do not administer any subcutaneous injections except subcutaneous prophylactic anticoagulation.

o. Utilize IV medications during TH due to decreased oral absorption.
   a. Anticipate lower doses than usual for NMB drugs, narcotics, and sedatives. There is decreased activity of CYP enzymes and decreased clearance of medications. Adjust doses using regular monitoring parameters. If standard doses are given patients will experience prolonged effects (e.g. extended sedation, paralysis).
   b. If therapeutic anticoagulation is required during cooling, 50% of the usual dose should be used to start with and PT/PTT monitored as usual.

p. May need to warm hand (with external warm compresses) periodically to get a pulse oximetry reading.

q. FiO2 should not be left at 100% for more than 1 hour as this may result in cerebral edema. Titrate to maintain saturation of 94%.

r. If defibrillation is required during temperature therapy, it is not necessary to remove the vest. Simply loosen the Velcro-like closure and open the vest to expose the chest. Remove excess moisture from the chest.

REWARMING

a. To rewarm, change the set point on the Medi-Therm 111 to 36.1°C
b. Change CONTROL OPTION to MODERATE. This will increase the patient temperature at a rate of 1°C per 3 hours (0.33 degrees per hour).

c. Rapid rewarming may lead to SIRS and severe hypotension. Avoid warming more than 0.5 degrees C per hour. Do not overshoot 37°C.

d. Anticipate need for increased drug dosages during rewarming

e. Evaluate fluid volume status and electrolytes before initiating rewarming.
   • CVP goal remains > 8
   • Remove potassium from IV fluid if potassium is > 3.5 mEq

f. If shivering occurs once NMBs have been stopped, consider using meperidine.

g. Anticipate hypotension during re-warming secondary to vasodilation.

NORMOTHERMIA
a. Maintain normothermia for 48 hours after rewarming.
b. If temperature rises use acetaminophen as necessary to maintain normothermia.
c. Turn the cooling blanket back on if necessary.

References


http://www.upenn.edu/resusitation


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