TARGETED TEMPERATURE MANAGEMENT AFTER CARDIAC ARREST: SAVING THE NEURONS

MARY ANN BAUTISTA, DNP, RN, AGCNS-BC, AGACNP-BC

DISCLOSURE

Financial Support: Attune Medical

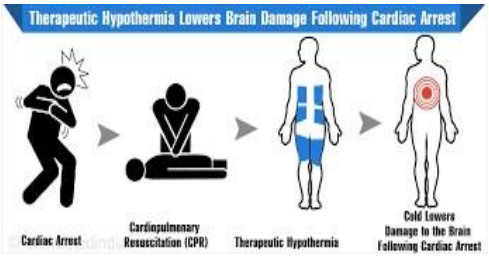
COURSE OBJECTIVES

1. Review the mechanisms of injury after cardiac arrest.
2. Review how Targeted Temperature Management (TTM) mitigates injuries after cardiac arrest.
3. Discuss the stages of TTM.
4. Discuss shivering and prevention strategies.

STATISTICS

- Cardiac arrest 3rd leading cause of death in the US.
- 395,000 out-of-hospital cardiac arrests (OHCAs) /year
- 200,000 in-hospital cardiac arrests/year
- Survival rate for OHCAs = 7.6%

POST- CARDIAC ARREST CARE

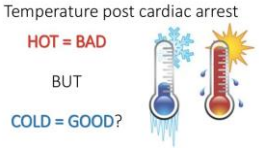


Google images, 2018

DEFINITION

Targeted Temperature Management (TTM):

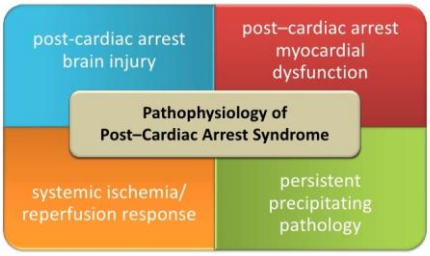
- induced hypothermia
- active control of temperature at any target



GOALS OF TTM

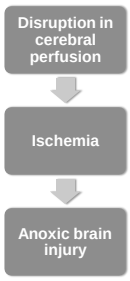
- Temper the post- cardiac arrest inflammatory cascade
- To reduce cerebral oxygen consumption, blood flow and edema
- Improve oxygen supply and demand mismatch
- Improve neurologic outcomes

MECHANISMS OF INJURY POST- CARDIAC ARREST



Google Images 2018

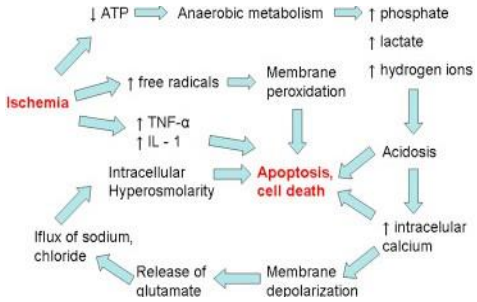
POST-CARDIAC ARREST BRAIN INJURY



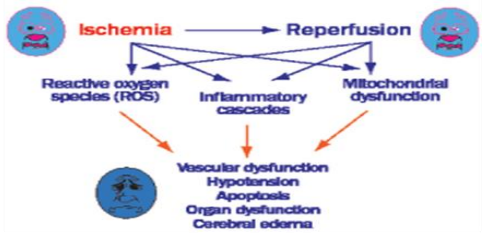
MYOCARDIAL DYSFUNCTION

- LV dysfunction
- Myocardial stunning
- Cardiogenic shock

MECHANISMS OF INJURY AFTER CARDIAC ARREST: ISCHEMIA



REPERFUSION INJURY WITH ROSC

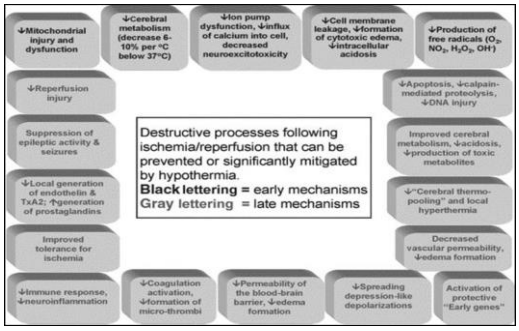


Google images University of Ottawa Heart Institute, 2011

PERSISTENT PRECIPITATING PATHOLOGY

- **STEMI**
- **Toxic ingestion**
- **Hypoxia**
- **Hemorrhage**

MECHANISMS MITIGATED BY HYPOTHERMIA



Polderman, 2009

EVIDENCE

In 2005, International Liaison Committee on Resuscitation (ILCOR) and the American Heart Association (AHA) endorsed:

- Unconscious adult patients w/ ROSC after OHCA should be cooled to 32-34 degrees X12-24 hours with initial rhythm Vfib (Class lla).
- Similar therapy may benefit patients w/ non-V-Fib or in-hospital arrest (Class llb).

EVIDENCE: TTM AT 33° VERSUS 36° AFTER CARDIAC ARREST

- 950 unconscious adults out of hospital cardiac arrest presumed from cardiac origin
- Randomized to 33 ° C vs 36 ° C for 28 hours
- Followed by 72 hours of fever control (<37.5 °C)

Result – targeted 33°C conferred no benefit

- Mortality: 50% in 33°C group vs 48% in 36°C group
- At 180 days 54% died or had poor neuro status per Cerebral Performance Category in 33°C group vs 52% in 36°C group
- Using Modified Rankin scale both groups 52%

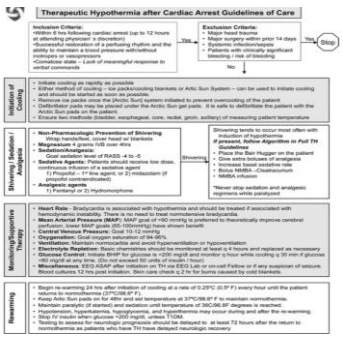
Nielsen, et al NEJM (2013)

EVIDENCE: 2015 AHA POST CARDIAC ARREST CARE GUIDELINES UPDATE

- Comatose adult patients with ROSC after cardiac arrest should have TTM
- Maintain constant temperature between 32°C – 36°C
- After achieving target temperature, maintain for at least 24 hours (Class IIa)
- Higher temperatures preferred in some patients where lower temperatures increase risk (e.g. bleeding)
- Lower temps preferred when patient has clinical finding worse at higher temps (e.g., seizures, cerebral edema)

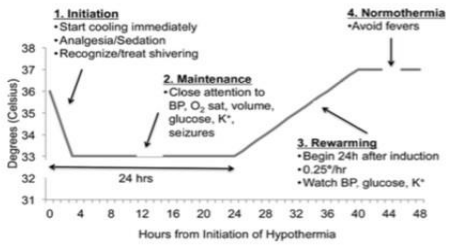
AHA, 2015

PROTOCOL EXAMPLE



Scirica, Circulation 2013

PHASES OF TTM



Scirica, Circulation (2018)

INITIATION PHASE

AIM: Rapidly cool

- Initiate within 6 hours of cardiac arrest
- Insert continuous temp monitoring device (PA/ Bladder/Esophageal)
- Insert A line/central line
- Labs/EKG prior to induction but don't delay
- Administer anti-shivering medications (sedation/ analgesia/paralytic)

TEMPERATURE MODULATING DEVICES

- Cold saline intravenous
- Ice packs- groin, axilla
- Surface cooling
  - Torso and leg wraps
- Esophageal Cooling Device
- Intravascular

PHYSIOLOGIC EFFECTS OF HYPOTHERMIA

Cardiovascular

- Initially HR, CO & BP followed by a HR, CO, BP
- **EKG Changes**
  - Prolonged PR interval
  - Widening QRS complex
  - Increased QT interval
  - Bradycardia
  - Osborne wave

Hematologic

- Thrombocytopenia
- Impaired clotting cascade
- Impaired platelet function
- Decreased WBC Count

PHYSIOLOGIC EFFECTS OF HYPOTHERMIA

GI

- Impaired bowel function/motility
- Increased liver enzymes

Renal

- Diuresis
- Fluid/electrolyte imbalance

Endocrine

- Hyperglycemia
- Decreased insulin secretion

PHYSIOLOGIC EFFECTS OF HYPOTHERMIA

Systemic

- ↓ O2 Consumption
- Left shift on the oxyhemoglobin curve
- ↓ CO2 production
- ↑ Lactate levels

Immune system

- ↓Neutrophil and macrophage function
- ↑risk of infection (wound infections and pneumonia)

MAINTENANCE PHASE

AIM: Tightly control core temperature with minimal fluctuations

- Monitor VS continuously
- Minimize temperature fluctuations
- Assess for shivering hourly using Bedside Shivering Assessment Scale (BSAS)
- Assess water cooling device temperature
- Monitor labs- K, glucose

REWARMING PHASE

AIM: Slow and controlled

- Begins 24 hours after goal temperature reached
- Avoid hyPERthermia
- Gradually rewarm at 0.25 degrees
- May consider rewarm at 0.1 degrees if concern with elevated intracranial pressure
- Maintain sedation/paralytic until temperature reached 36 degrees

Closely monitor for:

- Shivering
- Hypotension
- Hyperkalemia

NORMOTHERMIA PHASE

- Avoid fevers
- Maintain normothermia for next 48-72 hours
- Monitor for shifts in electrolytes
- Monitor for s/s of infection (ex. Increased WBC/ difficulty maintaining temp)
- **NO** prognostication before 72 hours of ROSC

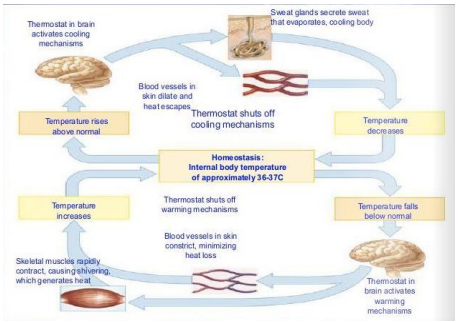
SHIVERING

Why prevent shivering?

Increases:

- O2 consumption
- Energy expenditure
- CO2 production
- Core temperature

SHIVERING MECHANISM



SHIVERING ASSESSMENT

Place hands over the patient's temples, masseters neck and upper thorax, pectoralis muscles to assess.

Goal: BSAS ≤ 1

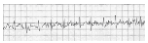
Score	Definition
0	None: no shivering noted on palpation of the masseter, neck or chest wall
1	Mild: shivering localized to the neck and/or thorax only
2	Moderate: shivering involves gross movement of the upper extremities in addition to the neck and thorax
3	Shivering involves gross movements of the trunk and upper and lower extremities

Badjatia, N, et al. 2008

OTHER WAYS TO ASSESS SHIVERING

- Monitor trend indicators in cooling device

- EKG artifacts/irregularity



- Difficulty reaching /maintaining temperature goal

SHIVERING PREVENTION

- Use skin counter warming
  - Bair Hugger
  - Hand/feet warmer
- Anti-shivering regimen
  - Buspar
  - Magnesium
  - Meperidine
  - Fentanyl
  - Dexmedetomidine
  - Propofol
  - Paralytics

TAKE AWAY

- Time is brain
- Cool between 32-36 degrees
- After rewarming, maintain normothermia for 48-72 hours
- Prevent shivering
- No prognostication before 72 hours of ROSC

REFERENCES

American Heart Association (2015). Highlights of the 2015 American Heart Association Guidelines Update for CPR and ECC

Badjatia, et al. (2008). Metabolic Impact of Shivering During Therapeutic Temperature Modulation. The Bedside Shivering Assessment Scale. *Stroke*. 39:3242-3247

Carwell, M. (2018). Targeted Temperature Management for Improved Outcomes. Are we there yet?. Critical Care Nurse. 11(2);102-108.

Nielsen, N. et al (2013). Targeted Temperature Management at 33° C versus 36 ° C after Cardiac Arrest. *New England Journal of Medicine.* 369;2197-2206

Polderman, 2009. Mechanisms of action, physiological effects, and complications of hypothermia. Critical Care Medicine 37(7).
Doi: 10.1097.CCM.0b012e3181aa5241

Scirica, B. (2013). Therapeutic Hypothermia After Cardiac Arrest. *Circulation*. 127: 244-250.