

# THERAPEUTIC HYPOTHERMIA

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# OVERVIEW

It is estimated that there are 35.7-128.3 cases per 100,000 of cardiac arrest cases per year.

Therapeutic hypothermia was demonstrated as far back as 1959 by Benson et al

It is now included in the American heart association, the international liaison committee on resuscitation as well as the European resuscitation council guidelines for post cardiac arrest management.

# APPLICATIONS

- Post cardiac arrest
- Haemorrhagic shock
- Brain injury

# PHYSIOLOGY OF THE NORMAL BRAIN

- The normal temperature in man is  $37^{\circ}\text{C} \pm 1^{\circ}\text{C}$ .
- Core temperature covers cranial, thoracic, abdominal and pelvic contents.
- Temperature is lowest at night and highest at mid afternoon, it also varies with menstrual cycle in females.
- Tight temperature control is important for optimal ENZYMATIC activity
- Denaturation of proteins occur at  $42^{\circ}\text{C}$  and loss of consciousness occurs at  $30^{\circ}\text{C}$

# ANATOMY OF THE NORMAL BRAIN

There are temperature sensitive cells in the hypothalamus of the brain, this is considered the most important site for temperature control.

There are also peripheral temperature receptors in the skin and nerves which carry cold sensation to the brain.

The brain then sends signals back to the to the muscles and skin to cause shivering and “goose pimples” in order to raise core temperature.

# WHAT HAPPENS DURING A CARDIAC ARREST

- There is whole body ischemia- a reduction in blood flow and oxygen and a subsequent reperfusion injury which follows resuscitation. There will have been a build up of metabolites which in themselves are harmful.
- Harmful metabolites include high carbon dioxide – acid build up, free radicals, excitatory neurotransmitters, calcium and other electrolytes

# THE EFFECTS OF HYPOTHERMIA

- The response to hypothermia depends on the rate and duration of cooling
- Temperatures above 33 degree Celsius preserve physiological functions
- 33-30 degree Celsius lead to arrhythmias, confusion
- Less than 30 degree Celsius there is ventricular arrhythmias
- 27-28 degree Celsius would mimic death
- Extreme hypothermia 24-26 degree is usually incompatible with life.

# THE EFFECTS OF HYPOTHERMIA

## BRAIN

- A reduction in in cerebral metabolism, for every 1° celsius drop in temperature there is a 6-8% reduction in metabolism
- Electrolyte, Ph and water redistribution and stabilization of the blood brain barrier
- A reduction in free radicals
- A reduction in apoptic [cell death] signaling and cell wall breakdown
- A restoration of protein synthesis and gene expression
- Attenuation of platelet activation factors
- There is cessation of electrical activity below 18 degrees

# THE EFFECTS OF HYPOTHERMIA

## HEART

- An initial increase cardiac output then it falls
- A reduction in cardiac output up to 30% at 30 degree Celsius
- A reduction in the area of injury
- Promote epicardial reflow
- Reduction in myocardial metabolic demand
- Preserves intracellular high energy phosphate stores

# EFFECTS OF HYPOTHERMIA

## RESPIRATION

- Apnea at 24 degree Celsius
- Reduction in tissue oxygen delivery due to reduced cardiac output
- Reduction in oxygen demand and carbon dioxide production

# EFFECTS OF HYPOTHERMIA

## METABOLIC RESPONSES

- Initially metabolic rate increases
- Shivering to maintain temperature
- Oxygen consumption falls
- Increase in blood glucose
- Increase in potassium
- Increase in fat utilization

# EFFECTS OF HYPOTHERMIA

## KIDNEYS

- Diuresis due to inability to reabsorb water and sodium
- Metabolic acidosis

# DOWNSIDE TO COOLING

- An increase in blood viscosity
- An increase in haematocrit less than 30 degree
- A reduction in platelets due to sequestration- mainly hepatic but splenic
- Chest infections,
- Rebound hyperthermia
- Status epilepticus
- Difficulty of oxygen release to the tissues
- Shivering; not desirable in the critically ill

# Rewarming

Rewarming needs to be passive as a sudden increase in temperature will lead to vasodilatation and a sudden shift in body fluids leading to hemodynamic instability.

# MONITORING

Temperature should be measured using a temperature sensing foley catheter, nasopharyngeal probe or a PA catheter if present. A tympanic probe can be used but is not reliable.

# Nursing care

- **University of Chicago: Cooling after Cardiac Arrest Nursing Orders**
- **Diagnosis:**
- **Pregnancy Test**-send BHCG serum test to the lab for all women of
- childbearing age and document in chart (do not cool patient if pregnant)
- **Vitals:**
- Record Temperature Q30 minutes
- Goal Temp 32-34° call House officer (HO) if temperature <32°C
- or if 34°C not achieved within 4 hours
- **Cooling Monitors**
- Foley with temperature Probe (preferred)
- Rectal Temperature Probe
- Tympanic Temperature Probe
- Other \_\_\_\_\_
- **Cooling Method**
- **Sedation/Paralysis**
- **Patient Comfort:**
- **Fentanyl**
- Loading dose: \_\_\_\_\_mcg IVP (suggested 1-2 mcg/kg)
- Continuous dose: \_\_\_\_\_mcg /hr (suggested 1-4 mcg/ kg/ hour)
- **Morphine**
- Start at \_\_\_\_\_mg/hr (suggested 1-2mg/hr) then titrate to comfort
- **Sedation:**
- Use the attached Richmond Agitation Sedation Scale (RASS)
- goal of deep sedation -4
- **Midazolam**
- Loading dose \_\_\_\_\_ mg IVP (suggested 2-6 mg IV push)
- Continuous \_\_\_\_\_ mg/hr (suggested 1-2 mg/hr)
- **Propofol**
- Start at 5 mcg/kg/min then titrate to comfort (max 80mcg/kg/min)

# NURSING CARE

- **Paralysis: Do not paralyze a patient who is not adequately sedated!**
- Once sedation has been achieved, initiate train of four (TOF).
- Mark electrode placement for ongoing assessment. Monitor paralysis
- using TOF with goal of therapy 1 of 4
- **Cisatracurium** 0.15-0.2 mg/kg IV \_\_\_\_\_
- 3mcg/kg/min infusion after the initial dose and then decrease to 1-2mcg/kg/min as needed
- **Other** \_\_\_\_\_
- **Shivering**
- Pethidine or propofol 25mg IV Q4 hours prn shivering
- **Rewarming:**
- Begin rewarming 12-24 hours after the target temperature is reached (or 24 hours of total cooling)
- **External Cooling Method:** only use warm air blanket if temperature is not 36° C after 12 hrs of passive rewarming
- **Labs:**
- Labs post arrest: CBC, U&E, Clotting, Cardiac enzymes, ABG, ECG
- Then Q8 (for the next 24 hours):CBC, BMP, ABG,
- **Sedation Score**



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