Hypothermia Post Cardiac Arrest

Case Study and Protocol

July 2008

Outline

- Case study
- Therapeutic Hypothermia
  - History
  - Inclusion/exclusion criteria
- Plan of care
  - Assessment guidelines
  - How to cool, maintain and rewarm
  - Rationale
  - Education
- Outcomes
- Conclusions

Case Presentation

- 48 year old male ,Mr. C.
- History of hypertension, positive family history for CAD, hypercholesterolemia
- Witnessed cardiac arrest at home
- Daughter called 911 and initiated CPR
- EMS arrived within 5 min---initial rhythm ventricular tachycardia
- Defibrillated x 2 with return of spontaneous circulation

Case continues

- Intubated on site
- Total down time 15 min
- Transport to local ER
- GCS 6T
- MAP 65, O2 sats 94%
- Sinus tachycardia at 106—EKG shows inferior lateral ST changes

Sudden Cardiac Death (SCD)

- Brief interval between onset of symptoms leading to collapse and death (1 hour)
- Unexpected
  - 80% at home
  - 40% unwitnessed
- Poor survival rates for out of hospital cardiac arrests
- 40% never regain consciousness, and of those who do – 30% have profound neurologic deficits

Epidemiology

- Out-of-hospital cardiac arrests: 10,000 - 40,000 annually in Canada (70% cardiac in origin)
- SCD is responsible for 50 - 60% of all mortality from CV disease
- SCD is the first symptom of coronary disease in approximately 10% of patients
- Average age: 65 years (70-80 % men)

What is Therapeutic Hypothermia?

Deliberate reduction of core body temperature to 32 – 34 degrees Centigrade

- Implemented during the first 12 to 24 hours post cardiac arrest
- Hypothermia results in a ↓ in metabolic activity, leading to a reduction in oxygen consumption
- Thought to provide protection from chemical reactions that occur with reperfusion injury (free radical production, apoptosis)

A brief history

- Since 1950's, moderate and deep hypothermia have been used for certain surgical procedures
- 2002 two separate multicenter trials in Europe and Australia were published in the New England Journal of Medicine regarding induced hypothermia post cardiac arrest
- Adoption of therapeutic hypothermia by the International Liaison Committee on Resuscitation and subsequently the American Heart Association

Pathophysiology of anoxic brain injury

PHASE 1: NO FLOW

- Cardiac arrest causes immediate cessation of blood flow, leading to a rapid depletion of cerebral oxygen and ATP stores and depressed cerebral function
- Damage occurs to neurons in the CNS during cardiac arrest

Pathophysiology of anoxic brain injury

PHASE 2: LOW FLOW

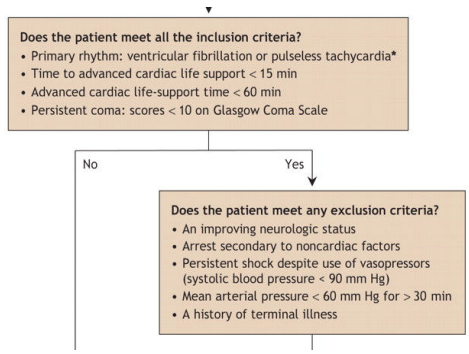
- Return of spontaneous circulation
- The viability of neurons depends on type, location and duration of global anoxia
- Neurons in the cerebral cortex, hippocampus, basal ganglia are the most vulnerable

Pathophysiology of anoxic brain injury

- After return to spontaneous circulation, initially there are supranormal levels of cerebral blood flow, this drops below normal after several hours
- Cerebral vasospasm occurs and there is a reduction in cerebral perfusion pressure
- Cerebral blood flow is compromised due to coagulation issues
- There is a deterioration of the blood brain barrier

How does induced hypothermia diminish anoxic brain injury?

- Decreases energy utilization and oxygen consumption
- Decreases nitric oxide production and lessens the release of other neurotoxin and diminished the loss of brain cells
- Stabilizes the blood brain barrier and decrease cerebral edema



Green and Howes CMAJ March 13, 2007

To cool or not to cool

- Does this patient meet the criteria for Induced Hypothermia Post Cardiac Arrest??????
- Yes

PreInduction

- Baseline blood work
- Baseline VS, including TOF
- Line insertion-arterial, central access,
- Others--foley, orogastric tube
- VAP and CLI bundles
- Temperature monitoring
- Family centered care re process and potential outcomes

Induction/Initiation Phase

- paralyze to maintain TOF of 1 to 2
- Sedate and ? sedation monitoring with BIS
- Pain control using a drip
- Patients require adequate paralysis and sedation to eliminate shivering
  - Shivering ↑ metabolic and oxygen demands
  - Choice of paralytic and sedation agents

Temperature Monitoring

- rectal probe set between 32-34 °C.
- urinary catheters
- PA catheter
- esophageal probe

Goal Temperature

- Temperature measurements must be accurate
  - Goal Temp of 32 °C achieved within 6 hours of initiation
  - Core temperatures below 32 ° C are associated with ↑ adverse events such as arrhythmias, infections and bleeding

Methods of Cooling

- Ambient air
- fan-ice (safety issue)
- Cooling blanket/mattress
- Ice Packs—where, how, skin protection
- Ice saline- central cooling(4°C.)

Maintenance

- Patient parameters must be closely monitored hourly or more frequently
  - Neuro assessment and train of four
    - Train of four works best using facial nerve
  - Peripheral vasoconstriction associated with cooling
  - Heart rhythm, Blood Pressure, CVP
  - Electrolytes, glucose, INR, Ptt, ABG"s
  - Urine output (cold diuresis)

Maintenance

- Guidelines for ACLS applicable
- Duration of cooling 12 to 24 hours
- Ongoing family support
- Routine care –extra care considerations of the unconscious, ventilated, paralyzed, cooled patient

Maintenance

- If hemodynamically unstable---fluids first followed by inotrope/pressor
- Potassium supplements
- Insulin drips to maintain CS 4.4 to 6.1mmol/L
- Any other required drips ---i.e. guidelines for ACS
- Stress ulcer prophylaxis

Rewarming

- Rewarming is passive over 6 hours
- Surface rewarming if temperature fails to rise after 6 hours
- Vasodilatation occurs with rewarming
  - Fluid/Inotropes may be required
- Continue to monitor blood levels(Ptt,INR,CBC, ABG's, glucose, and electrolytes)
- Target rewarming temp is 36 °C
  - Stop paralytic when warm
  - Train of four – 4/4 – stop sedation

Mr. C. Progress report

- cooling initiated in Emergency dept,sedated,paralyzed,pain control initiated,
- Lines/tubes inserted
- Hemodynamics– target temp achieved within 3 hrs, HR after cooling in 40, sinus bradycardia
- Fluid bolus's and maintenance fluids to maintain MAP

Progress Report Continued

- CK and troponin positive
- EKG continued inferior lateral changes
- K down as low as 3.2 requiring K bolus's
- Glucose kept within normal limits
- Passively rewarmed after 24 hrs
- Paralyzing agent stopped
- Followed by sedation/Extubated
- GCS 14
- Successful
- Taken to Cath lab 3 days post admission—referred for CABG-diffuse 3 vessel disease

Table 1. Categories of Cerebral Performance.*

Category	Classification	Description
1	Good cerebral performance	Patient is conscious, alert, and able to work and lead a normal life. Patient may have minor psychological or neurologic deficits (e.g., mild dysphasia, hemiparesis that is not incapacitating, or minor cranial-nerve abnormalities).
2	Moderate cerebral disability	Patient is conscious and has sufficient cerebral function to be able to work part time in a sheltered environment or perform activities of daily living (e.g., dress, travel by public transportation, or prepare meals) independently. Patient may have hemiplegia, seizures, ataxia, dysarthria, dysphasia, or permanent changes in memory or mental status.
3	Severe cerebral disability	Patient is conscious, dependent on others for daily support (in an institution or at home with an exceptional effort made by the family), and has at least limited cognitive ability. A wide range of cerebral abnormalities may be present, ranging from the ability to walk but with severe memory disturbance or dementia precluding independent living to paralysis and the ability to communicate only with the eyes (as in the locked-in syndrome).
4	Coma or vegetative state	Patient is unconscious, unaware of surroundings, and without cognitive ability; no verbal or psychological interaction with the environment.
5	Death	Patient is certified as brain dead or dead.

* Data are adapted from Safar and Bircher[22] and the Brain Resuscitation Clinical Trial II.[23]

What have we learned ?

- Induced therapeutic hypothermia is a low tech intervention that does not necessarily require a substantial increase in resources. However, caring for these patients is labor intensive and requires a team approach
- Sometimes difficult to maintain patient within the narrow limits of induced hypothermia (32-34 degrees Celsius)
- Having a protocol/ppo in place allows nurses to plan and prepare (mixing drips, anticipating interventions) before patient actually arrives on the unit
- Education must continue to be ongoing (for new staff and other areas within district)

National Data

- Kennedy,J., Green,R.S., & Stenstrom,R., (2008)
- Only one half of CEP reported having induced hypothermia for cardiac arrest victims
- Hospital policies/protocols were more commonly present at academic centers
- Resource and labor intensive process

It's a lot of work but

- "This is the only effective therapeutic tool for the amelioration of neurologic damage after cardiac arrest"

» Rincon, 2008

Summary – quantitative (continued)

- "*Arrest to target temperature*" time (ATT) generally exceeds target of 4-6 hours, though not statistically significant between groups.
- Trend towards earlier cooling if started in ED (potential for education)
- High incidence of inotrope use (may be correlated with high doses of sedation)

Summary-quantitative

- Of all patients treated with induced hypothermia, 11/20 (55%) survived with CPC 1.
- Of those patients meeting inclusion criteria (including witnessed arrest), 11/16 (69%) survived
- Individual inclusion criteria (time to ACLS, time to ROSC) did also show significance as stand-alone variables
- Survivors had excellent neurological outcomes
- Significant co-morbid disease did portend a poor outcome

Qualitative review

- No gross complications of cooling identified
- Generally excepted practice
- "Off-label" cooling not necessarily advocated, but does sometimes occur as all data not necessarily available at time of decision to cool.
- Careful documentation of specific times related to arrest and resuscitation needs to accompany patient to CCU.
- If arrest truly unwitnessed, timeline criteria difficult to establish for inclusion/exclusion

Conclusions

- With an impressive multidisciplinary effort, therapeutic hypothermia has been implemented in the CCU at the QEII
- Based on the assessment of the first 20 cases treated with therapeutic hypothermia, our results seem to be consistent with the outcomes in the major trials
- An excellent PPO/protocol form is now in use
- Ongoing education and coordination efforts with CDHA emergency departments as well as other health care facilities will be required in order to meet timeline targets
- Acute MI ? – Check with on call interventionalist at HI QEII before initiating therapeutic hypothermia