The Therapeutic Role of Hypothermia

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Objectives:

• Hypothermia
• Therapeutic benefits of Hypothermia
• The role of Neurodiagnostics in Hypothermia Monitoring
Hypothermia

• Definitions:
  – A medical emergency that occurs when your body loses heat faster than it can produce heat, causing a dangerously low body temperature. (Mayo Clinic, 2002)
  – The artificial reduction of body temperature to slow metabolic processes, as for facilitating heart surgery. (Dictionary.reference.com, 2014)
  – Any body temperature below 35.0°C (95.0°F) (Wikipedia.org, 2014)
Hypothermia Facts

- Moderate hypothermia (28° C to 32° C) before cardiac arrest has been used successfully since the 1950s to protect the brain against global ischemia during some open heart surgeries. Success in post cardiac arrest was done in 1950s but abandoned due to difficulties.

- 2008 IU Health Methodist began using “Hypothermia Protocol”.

- 2011 NT Monitoring became standard for all Hypothermia patients at Methodist.
What is Therapeutic Hypothermia?

- Controlled cooling of the body down to 33°C for 12-24 hours with a controlled re-warming period of 24 hours

- Can be done via: ice packs to head and torso, cold air mattress or blanket, cold IV saline, and cooling gel pads with water tubing (Arctic Sun)
Arctic Sun Energy Transfer Pads

Used in our Institution and considered the current “Gold Standard”


Bobrow, 2010
Therapeutic Hypothermia Benefits

• Could a cold heart save your brain?

• Since 2003, the American Heart Association advises the use of hypothermia in patients who remain unconscious following cardiac arrest.

Journal of the American Heart Association Circulation 2003
Neuroprotection

• Goal is to cool vital organs (Brain) to a point where metabolism is slower and requires less oxygen and reduction of risk by ischemic injury

• Decrease in cerebral metabolism
  – 6% reduction for every 1°C drop in temperature
  – 32-34°C = 18% – 30% decrease in cerebral metabolism

• Decreases speed of neuronal transmission
Neuroprotection

• Suppression of reperfusion injury
  - Reduction in excitatory neurotransmitters
  - Suppression of Ca+2 mediated cell death
  - Reduce apoptosis (programmed cell death due to biochemical negative fluctuations)
  - This specific function can be welcomed (Tadpole – Frog) however not in Neuronal Death
  - Anti-inflammatory effects

Nolan et al. (2003) Circulation
Froehler and Geocadin (2007) J of Neuro Sci
NCSE and Growing Evidence that NCSE and Seizure are Harmful

• Seizure can increase glutamate to neurotoxic levels

• Non Convulsive Status Epilepticus and Periodic Discharges have been independent predictors of declining outcomes in multiple patient populations

• Prolonged NCSE can lead to permanent neurological injury (Vespa, 2007)

• NCSE has been independently related to death in cardiac arrest victims (Koenig, 2006)

• NT can detect NCSE with real-time intervention to eliminate or lessen seizures to improve patient outcomes
Evidence of The Theory

Mild Therapeutic Hypothermia to Improve the Neurologic Outcome after Cardiac Arrest: The Hypothermia after Cardiac Arrest Study Group

Treatment of Comatose Survivors of Out-of-Hospital Cardiac Arrest with Induced Hypothermia: S.A. Bernard and Others
Hypothermia and Cardiac Arrest

Outcomes (at 6 mo):

• 55% of the hypothermia group had a “favorable outcome” compared to 39% in the non hypothermia group, \( p = 0.009 \)

• mortality was 41% in the hypothermia group compared to 55% in the non hypothermia group, \( p = 0.02 \)

Favorable Outcome = “Good Recovery or Moderate Disability”

(Holzer & Sterz, 2002)
Hypothermia in Cardiac Arrest

• Outcomes:
  – 49% of the hypothermia group had a “good outcome” compared with 26% in the non hypothermia group, (p<0.05)
  – mortality was 51% in the hypothermia group and 68% in the non hypothermia group, (p=NS)

• Good Outcome Defined =
  “Discharged to home or rehab facility.”
Therapeutic Hypothermia Benefits

“In patients who have been successfully resuscitated after cardiac arrest due to ventricular fibrillation, therapeutic mild hypothermia increased the rate of a favorable neurologic outcome and reduced mortality.”

Holzer & Sterz, 2002

“…treatment with moderate hypothermia appears to improve outcomes in patients with coma after resuscitation from out-of-hospital cardiac arrest.”

Bernard et al., 2002

Modified from Bobrow, 2010
Therapeutic Hypothermia Benefits

Induced Hypothermia as a Neuroprotectant in Post-Cardiac Arrest

“Hypothermia is currently the only neuroprotectant with proven benefits in the prevention of PCA anoxic brain injury and is currently recommended for out-of-hospital cardiac arrest victims with VF or VT as the initial rhythm. Guidelines also recommend consideration of hypothermia for other types of cardiac arrest and recommendations for hypothermia for in-hospital cardiac arrest are likely to follow soon…

….As further data surface from future clinical trials, evidence for broader application of hypothermia for a variety of disease entities is likely.”

The Ochsner Journal 9:278-281, 2009
Mohi E. Alkadri, MD, Paul McMullan, MD
Department of Cardiology, Ochsner Clinic Foundation, New Orleans, LA
Neurodiagnostics Role

NT control room with 22 Review/Monitoring Stations

Nicolet ICU/LTM Monitor
Neurodiagnostics Role

• Hypothermia hookup is completed using Ambu disposable electrodes or MRI compatible electrodes collodion glue

• Impedance of 5 K ohm or below achieved on all cortical leads, EOG and EKG 10 K ohm or below

• Baseline NT EEG (30 minutes) completed with integrity test, activation procedures

• Notations of patient state, medications, temperature and history are documented on report and in I/O flow sheet
Neurodiagnostics Role

• Communication with nursing staff every 6 hours (at a minimum), physicians and NT control staff for best patient care and safe handoffs

• NT Control technologist (R. EEG T. or CLTM) technologist monitor the patients live EEG and video 24/7

• Report events (?seizures) and changes in background to NT reading physician and nursing staff

• Write reports in the patient chart describing EEG (6am, 2pm, 10pm) and in significant events
Neurodiagnostics Roles

- Maintain technical integrity of the study without compromise of skin breakdown
- Monitor “burst suppression ratio” via trending
- Monitor medication changes, (neuromuscular blockade, AED’s, sedation, and shivering due to drop in body temperature (1°C drop shiver occurs))
Neurodiagnostics Role

- Patients assigned to hypothermia have target temp of 33°C
- Hypothermia is maintained for 24 hours followed by passive rewarming over 24 hours
- Normothermia patients have target temperature of 36.5°C
- The Neurotelemetry is discontinued by physician order
- Electrodes are removed and head is cleaned
- Study data is pruned, labeled and transferred to server
Neurotelemetry Monitoring

- **Seizures**
- **Status**
- **Sedation**
- **Subclinical Seizures or no clinical signs (NCSE)**
- ALOC or mental status change
- **Burst-Suppression Monitoring vs BIS**
- Cerebral Metabolism (ischemic events)
- Detection of reversible abnormalities
- Ability to sometimes tell the effectiveness of interventions or no intervention
- Characterize unknown movements or behavior changes

*Vespa, Nenov, Nuwer, J. Clin Neurophys 1999*
Neurotelemetry
The Rich Admixture of EEG Activity

- Probably Not Ictal
- Interictal
- Ictal

- FIRDA
- Monomorphic Delta
- PLEDS
- GPEDS

- TIRDA
- Triphasics
- IEDS
- Rhythmic Spikes

- OIRDA
- GIRDA
- SIRPIIDS

- PDA
- BiPLEDS

- Burst-Suppression
- Intermittent Spikes

Modified from S. LaRoche PPT
Neurotelemetry Techs do more than monitor we:

- Build and develop relationships with patient’s, family members and co-workers
- Seize opportunities to encourage and serve others while performing our daily work
- Use each case as a learning tool to gain knowledge and increase our skill level
- Continue to work to improve our process with organized committee meetings
- Grieve when our patient’s health and lives deteriorate
- Celebrate the success and recovery of our patients!
Case Review

• Hx: 28 yr old patient collapsed at home. No prior cardiac condition. Husband started CPR and was taken to IUH West and then IU Methodist Hospital.
Day 1 Baseline
Case Review

- Day 2: Pt being re-warmed.
- Posterior Dominant Rhythm: 5-6 Hz
- EEG Background Description: GPEDs seen, more posteriorly dominant, occurring approximately once per second.
Day 3 – Myoclonic Spike and Wave Discharges
Case Review

• Day 4: Sedated/Normothermic, continue ativan

• Day 5: Fentanyl increased due to tremors
Day 5 – Decreased Spike and Wave but con’t myoclonus
Case Review

- Day 6: No changes

- Day 7 & 8: Decreased myoclonus and Pt started making purposeful movement to lifts arms.
Day 8 – Much improved EEG
Case Review Outcome

- Several days following NT D/C, pt became aware and was noted to initially be blind however 3 days later could tell the physician the color of his tie
- Cardiac defibrillator was implanted
- MRI done showed evolving infarcts and no acute intracranial abnormality
- Discharged fully oriented with follow up
Questions?
Reference


- Vespa, MD, P. M., Milller,MD, C., PhD, D. M., & BS, M. E. Nonconvulsive electrographic seizures after traumatic brain injury resulting in a delayed, prolonged increase in intracranial pressure and metabolic crisis. Crit Care Med, 35.
