Case conference

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Discussion

Therapeutic hypothermia after ROSC

Induced Hypothermia

- Permissive hypothermia often develops spontaneously after arrest
- Active induction hypothermia may also be good:
  - Reported almost 50 years ago
  - Cooling within minutes to hours after ROSC
  - Initial rhythm: Ventricular fibrillation (VF)
    - Also in PEA and asystole

Benefit and risk

- Benefit:
  - Decreased cellular metabolic demand
  - Decreased cerebral metabolic demands
- Risk/complication:
  - Resource-limited
  - May increased coagulopathy, arrhythmia, hyperglycemia, pneumonia, sepsis
    - Prolonged hypothermia -> decrease immune function

Question of hypothermia

- To whom?
- When?
- How?

Who should be cooled?

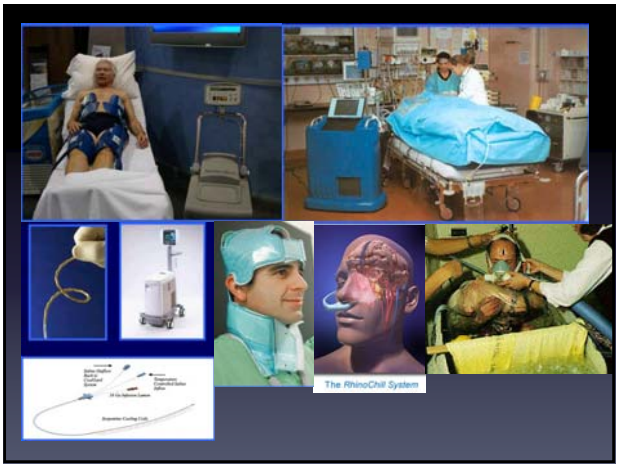
- Out-of-hospital ventricular fibrillation (VF)
- May also be effective to in-hospital cardiac arrest, non-VF initial rhythms

Timing

- Not completely understood
  - The sooner, the better?
  - The faster, the better?
- It WOULD be better only if hypothermia is applied!

The way to cool

- Multiple methods
  - Surface cooling device
    - Cooling blanket
    - Frequent application of ice bags
  - Cooling caps/helmets
  - Endovascular cooling
  - Iced isotonic fluid infusion: 500 ml to 30 ml/kg of saline or Ringer's lactate
  - Cardiopulmonary bypass



Duration

- At least 12 hours
- May be >24 hours
- In most case series of adult patients: 24 hr
- In newborns: 72 hours

Monitor the body temperature

- Core temperature
- Esophageal thermometer
- Bladder catheter: for nonanuric patients
- Pulmonary artery catheter
- Axillary, oral temperature: inadequate
- True tympanic temperature probe: rarely available

Rewarming

- Optimal duration: unknown
- Mostly: 12 to 24 hours
- 1 ℃/hr
- Heated air blanket, warm IV fluids
- Suppression of shivering

Summary from AHA

- for comatose adult patients with ROSC after OHCA with VF
  - 32-34 ℃ (89.6-93.2 ℉)
  - For 12-24 hours
  - Class I
- For comatose adult patients with ROSC after OHCA and IHCA with ANY rhythm
  - Induced hypothermia was considered
  - Class IIb
- If spontaneous mild hypothermia after ROSC within 48 hours
  - Do NOT actively rewarm patients
  - Class III

Circulation 2010;122;S768-S786

Complication of hypothermia

- In stage I (induction of hypothermia)
  - Over-cooling
  - Hypokalemia
  - Hyperglycemia
  - shivering
- In stage II
  - Changes in pharmacokinetics, hemodynamics, susceptibility to infection
- In stage III
  - Hyperkalemia
  - Fever
  - Especially if BT increases more than 1 °C every 3-5 hours

Korean J Anesthesiol. 2010 Nov; 59(5): 299-304

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Other complications of hypothermia

- During hypothermia, animal studies report extravasation in several organs, including brain.
  Scandinavian Journal of Trauma, Resuscitation and Emergency Medi- cine 2010, 18:29
- The activity of important enzymes, such as those of the coagulation pathway, is simultaneously down regulated. Unfallchirurg. 2009 Dec; 112(12): 1055-61

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The application of hypothermia

- Cardiac arrest
- Brain trauma
- Neonates
- Stroke: including ischemic and hemorrhagic
- Spinal cord injury
- Hepatic encephalopathy

Ageing Res Rev. 2010 January; 9(1): 61

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Hypothermia is good for the brain!

- 3 phases of cerebral injury after brain hypoxia caused by cardiac arrest
  - The first stage:
    - Cardiac arrest, no cerebral blood flow
    - Brain keeps using oxygen, ATP, glucose
    - Hypothermia: decrease energy utilization
  - The second stage:
    - Brain releases the excitatory amino acids and glutamate
    - To activate cytotoxic free radicals and NO
    - Hypothermia: decreases the release of AA, NO, delayed the peak of NO
  - The third stage:
    - Up to 24h after cardiac arrest
    - BBB breaks down, cerebral edema worsens, seizures and neuron death might occur
    - Hypothermia: slow the deterioration of the BBB, decrease cerebral edema

Circ J 2009; 73: 1877-1880

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To protect the brain

- Hypothermia could improve the neurological outcome following cardiac arrest.
- Therapeutic hypothermia to reduce intracranial hypertension may improved patient outcome, but the key issues are length of hypothermia treatment and speed of re-warming.
  - 48 hours to 5 days
  - Re-warm slowly: 1°C/4 hours
  - Measure the ICP to monitor the brain edema

Trials 2011, 12:8

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To protect the brain

- Prolonged cooling (24-48 h) is essential for long term and robust protection.
- Hypothermia in combination with a second potential neuroprotective agent
  - Mg, xenon, anti-oxidants, trophic factors
  - Triple therapy: with Mg and tirilazad; with caffeine, ethanol

Ageing Res Rev. 2010 January; 9(1): 61

Take home message

- Hypothermia has cytoprotective and neuroprotective function in patient of HOCA after ROSC
- The early, maybe the better
- Be careful about the protocol of hypothermia
  - No to cool too over, no to re-warm too early and too fast
- Be ware of the complication of hypothermia

Thanks you for your listening!