Noon conference 9/25

Josh Newman
Case

• John Doe just arrived to the emergency department following cardiac arrest. He appears to be a middle aged man. According to EMS, he was walking around the local mall when he collapsed. Bystanders immediately ran to him and noted he did not have a pulse and began CPR. EMS arrived and took over compressions and transported him to your hospital. He was intubated in the field. On arrival, he was noted to be in pulseless VT. After about 5 minutes, he was shocked and achieved ROSC (total down time ~20 minutes).
Case, continued

• Initial vital signs are notable for T 99.4, P 135, R 20 (AC/VC 16/500/100/5), BP 93/56 on 0.06 of levophed.

• Exam
  • General: intubated, not responding to commands, no purposeful movements noted
  • HEENT: +ETT, otherwise unremarkable
  • CV: tachycardic, regular. No MRG
  • Lungs: coarse b/l
  • Abd: soft, non-distended, no HSM
  • Ext: no lower extremity edema
  • Skin: unremarkable
Case, continued

• Labs are notable for a white count of 18.2 w/ 83% segs, Hgb of 11.3, Plt 257. Na 142, K 4.9, Cl 107, HCO3 14, BUN 19, Cr 1.7, Glucose 107. LFTs are normal. ABG immediately after ROSC is 7.20/190/65/13. Troponin is 1.2, BNP 465.

• EKG shows sinus tachycardia, no ST/T wave changes. QTc is 510.

• Arterial and central lines are placed. MAPs are maintaining above 65 on relatively low doses of levophed.
What is your next move?

• Please write down what you think should be done next on the sheet of paper provided and pass it to the center.

• Now, for the real title page....
Therapeutic hypothermia after cardiac arrest
See, it’s right there!
Learning objectives

1. Understand the data supporting the use of therapeutic hypothermia.
2. Know ongoing areas of debate in the field
3. Understand current guidelines on therapeutic hypothermia
4. Learn possible adverse effects of hypothermia.
5. Know how and when to activate the therapeutic hypothermia protocol at Loyola
6. Use the protocol when appropriate!
The history of cooling

• The first use of cooling as a therapy was described 5000 years ago (written on papyrus!)

• When do you think hypothermia was first used for resuscitation purposes?

  a. 1803
  b. 1882
  c. 1913
  d. 1947
  e. 1983
How many times do you think we have cooled people at Loyola since 2015?

A. 0
B. 5
C. 12
D. 25
E. 63
F. 87
G. 106
Why do we cool?

TREATMENT OF COMATOSE SURVIVORS OF OUT-OF-HOSPITAL CARDIAC ARREST WITH INDUCED HYPOTHERMIA

Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia

• Up until this point, treatment of out-of-hospital (OOH) cardiac arrest was largely supportive, though the thought of therapeutic hypothermia to reduce negative sequelae of cerebral ischemia had been proposed and supported in animal models.

• This was a prospective, controlled trial comparing hypothermia to normothermia in comatose survivors of OOH cardiac arrest.
  • Inclusion criteria: initial rhythm at time of arrival of ambulance was VF, patient achieved ROSC and had persistent coma.
  • Exclusion criteria: age less than 18 for men or less than 50 for women (possibility of pregnancy), cardiogenic shock (SBP <90 in spite of epi infusion), possible cause of coma other than cardiac arrest.
Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia

• Patients were randomly assigned to hypothermia or normothermia. Hypothermia was initiated by EMS in the field. Target temperature in the intervention group was 33 degrees C.

• Patients were kept at 33°C for 12 hours. At 18 hours, active rewarming began for the next 6 hours

• Normothermia group target temperature was 37°C.
Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia

• Results
  • Total of 77 patients; 43 to hypothermia, 34 to normothermia
  • 49% of hypothermia group had a good outcome (discharged to home or to a rehab facility) compared to 26% in the normothermia group (p=0.046)
  • OR for good outcome 5.25 favoring hypothermia
Why do we cool?

MILD THERAPEUTIC HYPOTHERMIA TO IMPROVE THE NEUROLOGIC OUTCOME AFTER CARDIAC ARREST

THE HYPOTHERMIA AFTER CARDIAC ARREST STUDY GROUP*
Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest

• Compared mild hypothermia to standard care in patients with cardiac arrest due to VF
  • Inclusion criteria: witnessed cardiac arrest secondary to VF or pulseless VT, a presumed cardiac origin of the arrest, age 18-75, an estimated 5-15 minutes from collapse to first attempt at resuscitation by EMS, and no more than 60 minutes from collapse to ROSC
  • Exclusion: initial temp <30°C, comatose before the arrest due to drugs, pregnancy, response to commands after ROSC, hypotension >30 minutes after ROSC, evidence of hypoxemia for more than 15 minutes after ROSC, terminal illness, cardiac arrest after arrival of EMS, pre-existing coagulopathy, questionable likelihood to follow up.
Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest

- This was a randomized control trial with blinded assessment of outcome.
- Treatment group was cooled to 32°C-34°C for 24 hours from the start of cooling followed by passive rewarming.
- Primary outcome was a favorable neurologic outcome within 6 months (defined as Pittsburgh cerebral performance category of 1 or 2; aka good recovery or moderate disability).
Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest

• Results
  • 275 patients were enrolled; 137 assigned to hypothermia, 138 assigned to normothermia.
  • Normothermia group at baseline was more likely to have received bystander BLS.
  • At 6 months, 55% of patients in the hypothermia group had a favorable neurological outcome vs 39% in the normothermia group (RR 1.40).
    • Number needed to treat: 6
  • Rate of death 6 months after cardiac arrest was 14% lower in the hypothermia group (RR 0.74)
Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest
Is it the hypothermia that is beneficial, or the prevention of fever?
Targeted Temperature Management at 33°C versus 36°C after Cardiac Arrest

Targeted temperature management at 33°C versus 36°C after cardiac arrest

• Aim of this study was to determine whether therapeutic hypothermia was beneficial, or if avoidance of fever was what was most important.
  • Inclusion criteria: 18 years or older with GCS of <8 following OOH cardiac arrest 2/2 presumed cardiac arrest, irrespective of initial rhythm; >20 minutes of spontaneous circulation after ROSC
  • Exclusion criteria: interval from ROSC to screening of >240 minutes, unwitnessed arrest with asystole as the initial rhythm, possible or known ICH/stroke, body temperature of <30°C at randomization.
• Patients were randomized 1:1 to target temperature of 33°C versus 36°C.
• Primary outcome: all cause mortality.
Targeted temperature management at 33°C versus 36°C after cardiac arrest

• Results
  • 476 patients were assigned to the 33 °C group, 474 to the 36 °C group.
  • Temperature was controlled in both groups; fever was avoided for 72 hours post-arrest.

Figure 1. Body Temperature during the Intervention Period.
Shown are body-temperature curves in the 33°C and 36°C groups for the 960 patients in whom a bladder temperature was recorded. In the remaining 79 patients, the temperature was recorded with an intravascular or esophageal probe, with a similar temperature profile (data not shown). Rewarming was commenced at 28 hours after randomization. The temperature curves display the means, and the I bars indicate ±2 SD (95% of the observations are within the error bars).
Targeted temperature management at 33°C versus 36°C after cardiac arrest

Table 2. Outcomes.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>33°C Group</th>
<th>36°C Group</th>
<th>Hazard Ratio or Risk Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary outcome: deaths at end of trial</td>
<td>235/473 (50)</td>
<td>225/466 (48)</td>
<td>1.06 (0.89–1.28)</td>
<td>0.51</td>
</tr>
<tr>
<td>Secondary outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurologic function at follow-up†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPC of 3–5</td>
<td>251/469 (54)</td>
<td>242/464 (52)</td>
<td>1.02 (0.88–1.16)</td>
<td>0.78</td>
</tr>
<tr>
<td>Modified Rankin scale of 4–6</td>
<td>245/469 (52)</td>
<td>239/464 (52)</td>
<td>1.01 (0.89–1.14)</td>
<td>0.87</td>
</tr>
<tr>
<td>Deaths at 180 days</td>
<td>226/473 (48)</td>
<td>220/466 (47)</td>
<td>1.01 (0.87–1.15)</td>
<td>0.92</td>
</tr>
</tbody>
</table>

Figure 2. Probability of Survival through the End of the Trial. Shown are Kaplan–Meier estimates of the probability of survival for patients assigned to a target temperature of either 33°C or 36°C and the number of patients at risk at each time point. The P value was calculated by means of Cox regression, with the effect of the intervention adjusted for the stratification variable of study site.
Should PEA/asystole be cooled? What about non-witnessed arrest?

- The original studies including only VF or pulseless VT, but on the basis of those successes and the assumption that cooling would probably help in most situations, guidelines expanded to include other rhythms as reasonable for inclusion.

- Cochrane review: Hypothermia for neuroprotection in adults after cardiopulmonary resuscitation
Hypothermia for neuroprotection in adults after cardiopulmonary resuscitation
Hypothermia for neuroprotection in adults after cardiopulmonary resuscitation

- Examined the influence of cardiac arrest conditions by creating the following subgroups:
  - Cardiac arrest 2/2 cardiac vs. non-cardiac etiology
  - Witnessed versus non-witnessed
  - Initial EKG shows VT/VF versus other

<table>
<thead>
<tr>
<th>Outcome or subgroup</th>
<th>Studies</th>
<th>Participants</th>
<th>Risk ratio (M-H, fixed, 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good neurological outcome by cardiac cause vs non-cardiac</td>
<td>3</td>
<td>383</td>
<td>1.54 (1.22 to 1.95)</td>
</tr>
<tr>
<td>cardiac etiology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac cause</td>
<td>3</td>
<td>372</td>
<td>1.51 (1.19 to 1.91)</td>
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<tr>
<td>Non-cardiac cause</td>
<td>2</td>
<td>11</td>
<td>3.80 (0.55 to 26.29)</td>
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<tr>
<td>Good neurological outcome by location of cardiac arrest</td>
<td>3</td>
<td>382</td>
<td>1.56 (1.23 to 1.98)</td>
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<tr>
<td>In-hospital</td>
<td>1</td>
<td>17</td>
<td>1.64 (0.47 to 5.73)</td>
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<tr>
<td>Out-of-hospital</td>
<td>3</td>
<td>365</td>
<td>1.56 (1.23 to 1.95)</td>
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<tr>
<td>Good neurological outcome by witnessed cardiac arrest</td>
<td>3</td>
<td>382</td>
<td>1.49 (1.18 to 1.88)</td>
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<tr>
<td>Witnessed cardiac arrest</td>
<td>3</td>
<td>360</td>
<td>1.43 (1.13 to 1.81)</td>
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<tr>
<td>Non-witnessed cardiac arrest</td>
<td>3</td>
<td>22</td>
<td>5.31 (1.40 to 20.21)</td>
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<tr>
<td>Good neurological outcome by primary EKG rhythm</td>
<td>3</td>
<td>382</td>
<td>1.51 (1.19 to 1.91)</td>
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<tr>
<td>VF/VF rhythm</td>
<td>2</td>
<td>330</td>
<td>1.47 (1.15 to 1.88)</td>
</tr>
<tr>
<td>Non-VF/VF rhythm</td>
<td>2</td>
<td>52</td>
<td>2.17 (0.98 to 6.93)</td>
</tr>
</tbody>
</table>

ECG = electrocardiogram
VF/VT = ventricular fibrillation/ventricular tachycardia
Why do we cool?

• “Therapeutic hypothermia after cardiac arrest: a systematic review and analysis exploring the impact of expanded criteria and targeted temperature”. *Resuscitation, 2016.*
  • Meta-analysis of 12 studies which incorporated 1381 patients
  • OR for death: 0.51
  • OR for improved neurologic outcomes: 2.48
Therapeutic hypothermia after cardiac arrest: a systematic review and analysis exploring the impact of expanded criteria and targeted temperature
Therapeutic hypothermia after cardiac arrest: a systematic review and analysis exploring the impact of expanded criteria and targeted temperature

• This review included comatose survivors of OOH cardiac arrest with any initial rhythm, flexible downtimes, and both witness/unwitnessed arrests.
Therapeutic hypothermia after cardiac arrest: a systematic review and analysis exploring the impact of expanded criteria and targeted temperature
Therapeutic hypothermia after cardiac arrest: a systematic review and analysis exploring the impact of expanded criteria and targeted temperature

<table>
<thead>
<tr>
<th>Author(s) and Year</th>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Control 1</th>
<th>Control 2</th>
<th>Odds Ratio (95% CI)</th>
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<tbody>
<tr>
<td>Bomard 1997</td>
<td>11</td>
<td>11</td>
<td>3</td>
<td>19</td>
<td>6.23 (1.46, 27.73)</td>
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<tr>
<td>Bernard 2000</td>
<td>21</td>
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<td>9</td>
<td>25</td>
<td>2.65 (1.01, 6.98)</td>
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<td>HACA 2002</td>
<td>64</td>
<td>73</td>
<td>61</td>
<td>92</td>
<td>2.07 (1.36, 3.41)</td>
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<td>Cudde 2006 Shock</td>
<td>19</td>
<td>24</td>
<td>11</td>
<td>32</td>
<td>2.30 (0.93, 5.72)</td>
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<td>Brilliant 2007</td>
<td>23</td>
<td>9</td>
<td>17</td>
<td>19</td>
<td>2.06 (1.04, 7.86)</td>
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<tr>
<td>Donwfell 2000</td>
<td>21</td>
<td>16</td>
<td>14</td>
<td>17</td>
<td>1.59 (0.61, 4.17)</td>
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<td>Fenters 2009</td>
<td>25</td>
<td>26</td>
<td>5</td>
<td>21</td>
<td>4.38 (2.42, 13.47)</td>
</tr>
<tr>
<td>Don 2009 Shock</td>
<td>28</td>
<td>63</td>
<td>14</td>
<td>79</td>
<td>2.08 (1.44, 6.19)</td>
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<tr>
<td>Don 2009 Non-Shock</td>
<td>14</td>
<td>158</td>
<td>17</td>
<td>174</td>
<td>1.39 (0.03, 2.80)</td>
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<tr>
<td>Petrovic 2011</td>
<td>26</td>
<td>19</td>
<td>7</td>
<td>30</td>
<td>5.86 (2.13, 16.16)</td>
</tr>
<tr>
<td>Webers 2014</td>
<td>9</td>
<td>20</td>
<td>3</td>
<td>23</td>
<td>5.45 (0.82, 34.53)</td>
</tr>
</tbody>
</table>

**B. Good neurological outcome at hospital discharge**

**Random effect model Test for heterogeneity**

- TH worse
- TH better

- 0.05
- 0.25
- 1.00
- 4.00

- Odds Ratio (log scale)
Therapeutic hypothermia after cardiac arrest: a systematic review and analysis exploring the impact of expanded criteria and targeted temperature

• In spite of expanded inclusion criteria, therapeutic hypothermia continued to show a mortality benefit and increased chance of survival with a good neurologic outcome.

• No difference when comparing 33°C to 34°C. They found no evidence to support one temperature level over another between 32°C and 36°C.
Summary so far

• Early studies: hypothermia reduces mortality and improves outcomes in OOH cardiac arrest due to VT/VF
• Nielsen: included any initial rhythm in randomization; found that cooling to a lower temperature was no different than maintaining normothermia (aka, avoiding fever)
• Cochrane review: Hypothermia is beneficial regardless of initial rhythm, regardless of witnessed versus non-witnessed
• Schenone et al: Hypothermia is good regardless of initial rhythm, flexible downtimes, witness versus unwitnessed arrests. Any temperature 32°C-36°C is good without any good evidence for one specific target.
Temperature Management After Cardiac Arrest
An Advisory Statement by the Advanced Life Support Task Force of the International Liaison Committee on Resuscitation and the American Heart Association Emergency Cardiovascular Care Committee and the Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation

What do the guidelines say?
Temperature management after cardiac arrest: an advisor statement by the advanced life support task force and international liaison committee on resuscitation

• Three main questions addressed in this statement:
  1. Should mild induced hypothermia be used in comatose post-cardiac arrest patients?
  2. If used, what is the ideal timing of intervention?
  3. If used, what is the ideal duration of intervention?

• This statement came out in response to the study by Nielsen showing no difference in outcomes when 33°C was compared to 36°C.
Temperature management after cardiac arrest: an advisor statement by the advanced life support task force and international liaison committee on resuscitation

• Should mild induced hypothermia be used in comatose post-cardiac arrest patients?
  • OOH Cardiac arrest with an initial shockable rhythm
  • OOH cardiac arrest with an initial non-shockable rhythm
  • In-hospital cardiac arrest
Temperature management after cardiac arrest: an advisor statement by the advanced life support task force and international liaison committee on resuscitation

• Should mild induced hypothermia be used in comatose post-cardiac arrest patients?
  
  ➢ **OOH cardiac arrest with an initial shockable rhythm**
  
  ➢ “We recommend targeted temperature management as opposed to no targeted temperature management for adults with OOH cardiac arrest with an initial shockable rhythm who remain unresponsive after ROSC; strong recommendation, low-quality evidence)

• OOH cardiac arrest with an initial non-shockable rhythm
• In-hospital cardiac arrest
Temperature management after cardiac arrest: an advisor statement by the advanced life support task force and international liaison committee on resuscitation

• Should mild induced hypothermia be used in comatose post-cardiac arrest patients?
  • OOH Cardiac arrest with an initial shockable rhythm
    ➢ **OOH cardiac arrest with an initial non-shockable rhythm**
      ➢ “We suggest targeted temperature management as opposed to no targeted temperature management for adults with OOH cardiac arrest with an initial nonshockable rhythm who remain unresponsive after ROSC” (weak recommendation, very low-quality evidence)
  • In-hospital cardiac arrest
Temperature management after cardiac arrest: an advisor statement by the advanced life support task force and international liaison committee on resuscitation

• Should mild induced hypothermia be used in comatose post-cardiac arrest patients?
  • OOH Cardiac arrest with an initial shockable rhythm
  • OOH cardiac arrest with an initial non-shockable rhythm

➢ **In-hospital cardiac arrest**
  ➢ “We suggest targeted temperature management as opposed to no targeted temperature management for adults with IHCA with any initial rhythm who remain unresponsive after ROSC” (weak recommendation, very low-quality evidence).
  ➢ This is based on one retrospective study of 8,316 patients with IHA with any initial rhythm that found no difference in morality at hospital discharge (OR 1.11; 0.81-1.54) or poor neurological outcome (OR 1.08, 0.76-1.54).
Temperature management after cardiac arrest: an advisor statement by the advanced life support task force and international liaison committee on resuscitation

• Target temperature
  • “We recommend selecting and maintaining a constant target temperature between 32°C and 36°C for those patients in whom temperature control is used (strong recommendation, moderate-quality evidence). Whether certain populations of cardiac arrest patients may benefit from lower (32°C-34°C) or higher (36°C) temperatures remains unknown.”
Temperature management after cardiac arrest: an advisor statement by the advanced life support task force and international liaison committee on resuscitation

• If used, what is the ideal timing of intervention?
  • Based on data from 7 randomized controlled trials providing moderate-quality evidence, pre-hospital induction of mild hypothermia did not reduce poor neurologic outcomes or mortality and the largest of these studies found an increased risk of pulmonary edema and re-arrest.
  • “We recommend against routine use of prehospital cooling with rapid infusion of large volumes of cold intravenous fluid immediately after ROSC (strong recommendations, moderate-quality evidence). Other cooling strategies and cooling during cardiopulmonary resuscitation in the prehospital setting have not been studied adequately…”
Temperature management after cardiac arrest: an advisor statement by the advanced life support task force and international liaison committee on resuscitation

• If used, what is the ideal duration of intervention?
  • No interventional studies compared durations of targeted temperature management
  • “We suggest that if targeted temperature management is used, duration should be at least 24 hours, as in the 2 largest previous RCTs (weak recommendation, very low-quality evidence)”
Gaps in knowledge

• Is 33°C better than 36°C?
  • Nielsen suggested no, but these patients had higher rates of bystander CPR than prior trials (73% versus 43-49%) and patients in this trial had a relatively short period of no-flow time.
  • Do some subgroups benefit from lower temperature?
  • Does it matter if the temperature is at a constant level, as they suggest?
    • Perhaps those with bleeding complications at lower temperatures should be warmed up to normothermia and maintained there?

• What is optimal way to cool?
  • Rapid infusion of cold fluid? Ice packs? Cooling machines (Arctic sun)?

• How long should someone be cooled?
  • Data on this endpoint is lacking
Possible adverse effects of hypothermia
What are negative effects of therapeutic hypothermia?

• The lower body temperature leads clotting enzymes to function more slowly and platelets to work less effectively which results in bleeding.
  • No data has shown an increased incidence of bleeding among patients treated with TH, but this remains a concern.
  • In the case of a major bleed, you should stop cooling.
• Reduced leukocyte function
  • Some data has shown increased risk of infection, but this was not associated with increased mortality.
  • Randomized trials have found no difference in rate of infection.
What are negative effects of therapeutic hypothermia?

• Arrhythmias
  • Bradycardia, QT prolongation
  • HR in the 40’s, what do you do?
    • Nothing! ...assuming BP and such isn’t being impacted by the slow HR

• Hyperglycemia
  • Hypothermia can induce insulin resistance.

• Diuresis
  • Patients diurese when they are very cold, leading to hypovolemia, hypokalemia, hypomagnesemia, and hypophosphatemia.
    • K even lower because the cold sends the K into the cells. Check BMP frequently!
What are negative effects of therapeutic hypothermia?

• Rewarming
  • Rate of temperature increase should be no greater than 0.5°C per hour as rapid rewarming can lead to big problems:
    • Hyperkalemia, cerebral edema (the very thing you cooled them to avoid), seizures.
Therapeutic hypothermia at Loyola
Who do we cool?

- In-hospital cardiac arrest of any causes
- Out-of-hospital cardiac arrest presenting to the ED with a witnessed arrest due to VT/VF
Loyola protocol

- Cooling should be started within 1 hour of arrest and ideally it should be initiated in the ED if it was not already initiated by EMS.
- These patients can go to CCU, MICU, or 2 ICU (these are the only units trained in therapeutic hypothermia).
  - But they can go to cath lab or IR as deemed necessary by primary team.
- Target temperature at Loyola is 32°-34°C (89.6°-93.2° F).
- All patients must have continuous EEG monitoring.
- Though our protocol doesn’t require patients to get a CT head…probably should…..
- Neuromuscular blockade should be initiated only if the patient is shivering.
- The duration of treatment should last no more than 24 hours following initiation of cooling.
Our inclusion criteria

• Age ≥ 18
• Out of hospital- witnessed VT/VF arrest with resuscitation initiated within 15-20 minutes of arrest
• In hospital cardiac arrest (VT/VF, PEA, asystole) with resuscitation initiated within 15-20 minutes of arrest
• Time from arrest to ROSC ≤60 minutes
• Persistence of altered mental status/coma (failure to follow commands or GCS ≤ 8) after ROSC
• Maintenance of SBP ≥ 90 mmHg with or without fluids and/or pressors
• Functional status of patient prior to resuscitation should score a modified Rankin Scale score less than 3
Our Exclusion criteria

• Outpatient PEA arrest or unwitnessed arrest
• DNR/DNI
• Arrest from trauma, head injury, drug OD, hemorrhage, or sepsis
• Known severe coagulopathy or active pathological bleeding
• They are already less than 32 degrees C
• Refractory hypotension despite resuscitation
• Pregnancy
• Pre-arrest terminal illness
Awesome! I want to cool someone! What do I do?

1. Page the cardiology fellow!
2. Page the neuro and tell them to come do an assessment ASAP.
   • Neuro resident should order and assess continuous EEG
   • Do not delay initiation of hypothermia or other cardiac interventions for the neuro resident
3. Connect patient to continuous cardiac monitoring
4. Record baseline temperature via esophageal or rectal temperature probe or PA catheter
5. Apply cooling system per device instructions and set to 32°-34°C.
   • Monitoring of device should only be done through the cooling device probe
   • Temperature must be independently verified by separate temperature source (esophageal, rectal, or PA catheter) to confirm accuracy.
Awesome! I want to cool someone! What do I do?

• Lab monitoring
  • Prior to cooling
    • BMP, Mag, CBC, PT/PTT, two sets of blood cultures, random cortisol
    • Additional labs as appropriate
Awesome! I want to cool someone! What do I do?

• Lab monitoring
  • During cooling
    • CMP, Mag within one hour of hypothermia initiation and then every 6 hours for duration of hypothermia
      • Keep serum K between 3.5 and 4 mEq/dL; maximum single dose of KCl is 40 mEq IV
      • Keep serum mag 2-3 mEq/dL
    • CBC every 6 hours for duration of hypothermia
    • Platelets, PT/INR, and aPTT every 6 hours for duration of hypothermia
    • Hourly blood glucose monitoring: accucheck via arterial line
      • Glucose to be kept between 100 and 180 mg/dL
      • If blood glucose is > 180 mg/dL, start insulin drip
      • Do not administer subcutaneous insulin during cooling or rewarming phases due to unreliable absorption and response
Awesome! I want to cool someone! What do I do?

• Vitals
  • Recorded hourly
  • Maintain SBP ≥90 mmHg using fluids and/or vasopressors as appropriate

• Medication administration
  • Use the ICU Adult Analgesia and Sedation for Patients Receiving Mechanical Ventilation
  • Administer neuromuscular blockade as needed per adult neuromuscular blockade in the ICU order set
    • Goal for paralysis is train of four 2/4
  • Stress ulcer PPX with Protonix 40 mg IV daily
  • Glycemic control per adult IV insulin drip algorithm 1-5
  • Therapeutic anticoagulation
    • Max initial infusion rate of 8 U/kg/hr, bolus only in the setting of submassive PE; maximum bolus of 40 units/kg x1 dose
  • DVT PPX: sequential compression devices during cooling
Time to rewarm

1. Rewarming should begin 24 hours from time of initiation of hypothermia protocol
2. If paralytic was started for shivering, discontinue it. Discontinue the cooling system
3. Initiate passive rewarming for 8 hours with maximum warming rate of 1 degree per hour
4. If after 8 hours the temperature is below 32°C, start active rewarming using the Gaymar Unit
5. Sedation and analgesia infusions should be weaned as tolerated for patient comfort once rewarming is started
6. Conservative electrolyte repletion: continue to target goal serum K of 3.5 to 4 mEq/dL until the patient is normothermic.
References


Questions