Cardiac Arrest and Post ROSC Care

C. Ryan Keay, MD, FACEP
North Sound Emergency Medicine
Medical Director Emergency Medicine
Providence Regional Medical Center Everett
March 18th, 2017
Goals

Ideal post-ROSC care based on current literature
Cardiac Arrest

2015

357,000 people experienced cardiac arrest
70-90% of people die from OHCA

Morbidity

Neurological deficits
Psychological impact
Cardiac Arrest

**Societal Cost:**
The estimated burden to society of death from cardiac arrest is:

- 2 million years of life lost for men
- 1.3 million years for women

*This is greater than estimates for all individual cancers and most leading causes of death.*
Cardiac Arrest for EMS

- <1% of EMS calls
- >70% occur out of hospital (OHCA)

“Stated succinctly, is ACLS care in the field cannot resuscitate the victim, ED care will not resuscitate the victim.”

2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (Part 7.2: Management of Cardiac Arrest)

• Utstein updated in 2015
  – Utstein criteria for survival
    • Witnessed by bystander
    • Found in a shockable rhythm
  – Utstein bystander criteria
    • Witnessed by bystander
    • Found in a shockable rhythm
    • Received some bystander intervention (CPR and/or AED)
Utstein National Data 2016

• Utstein survival
  – 31.6%
  – 7358

• Utstein bystander survival
  – 36.1%
  – 4349

Presumed cardiac cases only
Why is OHCA important to you?

• Time Dependent
  – STEMI
  – Stroke
  – Trauma

• Intervention Dependent
  – Cardiac arrest
  – Respiratory failure
Time-Dependent

- Require definitive intervention in the hospital
- Necessitate short scene times
- Early recognition
Intervention Dependent

- Prehospital intervention is linked to outcome
- Need to identify and intervene
- Time is not as critical
Mr. AHCA

- 65-year old male collapses at the Leavenworth Octoberfest
  - Bystander checks for a pulse and begins performing CPR while 911 is activated
  - BLS crews arrive first and rhythm analysis is performed – shock is indicated
  - BLS crews deliver 1 shock with the AED
  - ROSC is achieved
Question

What is the single best predictor of likelihood to survive OHCA in this patient?

A. Bystander CPR
B. Vfib/Vtach arrest
C. Witnessed arrest
D. ROSC
E. All of the above
Answer

E: All of the above

Meta-analysis (2010): Key Factors affecting outcomes in OHCA

1. Return of spontaneous circulation
   a. most significant predictor
2. Witnessed arrest
   a. NNT of 16-23 for EMS-witnessed cases
   b. NNT 17-71 for bystander-witnessed.
3. Bystander CPR: NNT = 24 to 36
4. Ventricular fibrillation/ventricular tachycardia
Mr. AHCA

• ALS crew arrives
  – Patient intubated
  – FiO2 of 100% delivered
  – Patient placed on capnography
Question

What is the most ideal oxygen saturation for this patient:

A. 100%
B. 94% - 98%
C. ≥ 92%
D. I don’t care – I have a 5 minute transport time!
Answer

B. 94% - 98%
Oxygen

- Cardiac arrest, and specifically ventricular fibrillation, increase myocardial oxygen demand

- Oxygen = oxygen-free radicals thru hyperoxia
Oxygen

• Current guidelines recommend patient’s oxygen saturation is 94%-98%

• Begin reducing oxygen concentration (FiO2) to the minimum amount necessary to keep the patient at 94%
Formation of oxygen free radicals

Free Radical → DNA

Oxidation

Free radical steals an electron from DNA → Damaged DNA

Stable Molecule
Effect of free radicals

- Healthy cell
- Attacked by free radicals
- Oxidative stress
Oxygen free radicals

- Hyperoxia
- Free radicals
- Apoptosis (Cell death)
- More watershed ischemia = BAD
Mr. AHCA

- EMT is bagging patient
  - Blood pressure is increasing
  - Harder to bag
  - EtCO2 is 25
Question

At what rate should you bag this patient?

A. 20-30 bpm
B. 12-15 bpm
C. 6-8 bpm
D. None of the above
Ventilation

What happens in normal ventilation?

Negative Pressure

Encouraged venous return

Cardiac fill
Ventilation

What happens in mechanical ventilation?

Positive pressure

Reduced blood return to the chest

Increased intrathoracic pressure
Mechanical ventilation
Ventilation

What happens to rate of ventilation in stressful environments?

High ventilation rates ➔

increased positive pressure time ➔

less time for blood return ➔

less time to empty cerebral blood vessels ➔

*Decreased Cerebral Perfusion*
Ventilation

What about the effects of hyperventilation on the heart?
Hyperventilation Effects

Hyperventilation $\rightarrow$ pCO$_2$

$\downarrow$O$_2$ to tissue $\rightarrow$ $\uparrow$ catechols $\rightarrow$ $\uparrow$ Intracell Ca

$\uparrow$myocardial contraction $\rightarrow$ $\uparrow$ coronary ischemia

$\uparrow$vascular tone $\rightarrow$ $\uparrow$ blood pressure
Hyperventilation

• On average, how fast is a patient ventilated in the field?
  – 30 breathes/min

• Pigs ventilated at 12/min; 20/min; 30/min
  – CPP plummeted as respiratory rate increased
  – 1mmHg decrease in PaCo2 is a decrease in cerebral blood flow of 3%
Mr. AHCA

• Our patient collapsed outside at Octoberfest. After ROSC you fastidiously obtain a body temperature of 36 degrees Celsius.
Question

• What do you do about targeted temperature management (TTM?)
  A. Crank the heat up in the rig to rewarm the patient to a normal body temperature
  B. Pump cold IV fluids in and place ice packs to get to 33 degrees
  C. Do nothing
  D. I have no idea and am ready for lunch
Answer

C. Do nothing

Primum non nocere ~ First do no harm
Hypothermia

Previous teaching:

- Hypothermia = effective in improving outcome in patients with a Vfib/Vtach
- Hypothermia for PEA/Asystole has not been shown to improve outcome
- 2015 guidelines for hospital-based care recommend that all patients who are comatose after ROSC receive hypothermia, regardless of the presenting rhythm
Hypothermia

Current guidelines:

- Hypothermia with EMS can increase re-arrest and pulmonary edema
- RCT in 2015 demonstrated no statistical significance in outcome of patients induced to 36 degrees Celsius
- *Further research is needed* on the best course of treatment for patients

*There is no role for pre-hospital induction of hypothermia with cold saline*
Mr. AHCA

• You obtain ROSC and initial blood pressure is 100/60
  – Subsequent blood pressure drops to 85/40
  – While developing your own cold pallor and diaphoresis, you try to decide how to manage the patient’s blood pressure
Question

• How do you manage blood pressure after ROSC?

A. Drive really fast
B. Start all patients on the same anti-arrhythmic you converted them with
C. Start patient on a pressor with a goal SBP of 90+ or MAP ≥ 65
D. Do nothing
C. start patient on a pressor with a goal SBP of 90+ or MAP $\geq$ n65
Blood Pressure

• In 2015, the ILCOR writing group evaluated the impact of hypotension on patient outcomes.

• Study of EMS:
  – patients who achieve ROSC after a VF/VT arrest and present to the ER with a systolic blood pressure <90 mm HG have a lower odds of survival than patients presenting with higher blood pressures.
Blood Pressure

The 2015 recommendation:

• Avoid and immediately correct hypotension
  Hypotension defined as SBP < 90 mm HG or MAP < 65 mm Hg

• How to achieve those blood pressures are left to local protocols
Mr. AHCA

• Just prior to arrival at the hospital, the patient re-arrests.
  – You initiate CPR
  – Non-shockable rhythm
  – ETCO2 = 19
Question

• At what point can you terminate efforts?
A. There’s no way I’m terminating in my rig
B. After 30 minutes of continued efforts
C. After 3 rounds of ACLS
D. After 20 minutes and ETCO2 < 10mmHg
D. After 20 minutes and ETCO2 < 10mmHg

But please follow your local protocols
ETCO2

• The consensus opinion is that the failure of an intubated patient to achieve ETCO2 of greater than 10 mmHg after 20 minutes of resuscitation is a factor that may be used to aid in the decision of when to terminate efforts.
Re-Arrest

• The most important measure to prevent re-arrest is *identifying and treating the etiology of initial arrest*.  
  – CPR  
  – Defibrillation  
  – Vasopressors  
  – Antiarrhythmic
Preventing Re-arrest

• Optimise FiO2
  – target SaO2 94-98% to avoid hyperoxia
  – decrease FiO2 as soon as possible

• protective lung ventilation via ETT (confirm placement)

• commence sedation

• ventilate to normocapnia
Summary

• Cardiac arrest is intervention-dependent
• Early high-performance CPR and defib
• Ideal oxygenation 94-98%
• Ideal ventilation rate 12-15 bpm
• Keep SBP > 90mmHg or MAP >65mmHg
• No role for TTM in EMS...for now
• ETCO2 > 20mmHg, higher chance for ROSC
• Prevent re-arrest


Questions?