2014 CARDIAC ARREST CARE

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Objectives

- Review CPR technique and sequence
- Review recent evidence & current studies in the use of ACLS medications
- Review metabolic chain of events during cardiac arrest and how it relates to oxygenation
- Review new research and methods of pre-hospital Therapeutic Hypothermia

Where would you want to collapse in V-FIB?

- Dedicated training of responders
- A confined environment.
- Numerous security cameras.
- Collapse to shock time average is 4.4 minutes.

77% discharge if shock in 4 minutes!

Cardiac Arrest by the Numbers

<table>
<thead>
<tr>
<th></th>
<th>Cardiac Arrests</th>
<th>Survival Rate</th>
<th>Mortality Rate</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Out of Hospital</td>
<td>359,400</td>
<td>9.5%</td>
<td>90.5%</td>
<td>325,357</td>
</tr>
<tr>
<td>In-Hospital</td>
<td>209,000</td>
<td>24.2%</td>
<td>75.8%</td>
<td>158,422</td>
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<tr>
<td>Total</td>
<td>568,400</td>
<td>18.8%</td>
<td>81.2%</td>
<td>483,779</td>
</tr>
</tbody>
</table>

For perspective:
Equivalent loss of life to 4 fully loaded Boeing 747s crashing everyday!
Back to Basics: Effective CPR is the key to successful resuscitation

Almost 60 years later......

Dr. Kouwenhoven and Dr. Knickerbocker invent the defibrillator in 1951, discover the benefit of closed chest compression with Dr. James Jude in 1958, and adding Dr. Peter Safars’ work with rescue breathing, create CardioPulmonary Resuscitation in 1960

THE BEGINNINGS......

CPR Technique
We need proper:
- Rate
- Depth
- Chest recoil
- Minimal pauses
- Proper ventilation

To achieve and maintain adequate coronary and cerebral blood flow and increase the likelihood of defibrillation success
Importance of Effective Compressions

- **Depth**
- **Rate**

Ventilation

Coronary Perfusion Pressure

Current study being conducted out of Univ. of Washington comparing current AHA guidelines of 30:2 with Continuous Chest Compressions with ventilation every 6-8 seconds.

Other Conditions Needed for Successful Defibrillation

- A heart that is not “overfilled”
  - Following the onset of V-fib the right ventricle continues to be filled by residual venous return but with no forward flow the chambers expand
- Adequate level of myocardial cell ATP

Up to 2 minutes of high quality chest compressions before defibrillation has been shown to eject stored blood from ventricles and increase myocardial ATP levels by up to 30-40%.
Note that as ATP decreases the V-fib amplitude decreases. Algorithms exist that predict likelihood of defibrillation success and ROSC based off the Amplitude Spectral Area (AMSA) and slope of V-fib waveform.

Myocardial Cell ATP levels and correlating waveform

Right Ventricular filling in V-fib

Note RV expansion and decrease in strength of fibrillation with time.

Defibrillation without compressions

Atria still contracting normally but no ventricular response before or after shock.

Defibrillation after Compressions

Only atria contracting prior to shock. Atrial and ventricular contraction post shock.
Peri-shock Pause
Independent Predictor of Survival

Optimal Pre-Shock Pause:
< 5 seconds, max of 10 seconds

Study showed that odds of survival were significantly lower for patients with:
1. Pre-shock pause > 20 seconds
2. Peri-shock pause > 40 seconds

Are we really helping our patients?

Do ACLS drugs improve outcomes?

Peri-shock Pause
Independent Predictor of Survival

- Resuscitation Outcomes Consortium (ROC)
- PRIMED trial 2013
- Odds of survival with good CPC:
  - pre-shock: highest in shocks < 10 seconds
  - peri-shock: highest in shocks < 20 seconds
- OR for survival:
  - decreases 6% for every 5 sec. delay

- AHA 2010 ACLS guidelines:
  - Epinephrine, Amiodarone, and Lidocaine are all Class Iib weak “may be considered” recommendations

- Unproven therapies may be:
  - Beneficial
  - Inconsequential
  - Harmful
Benefit of Each Link in the Chain of Survival
• Ontario Prehospital Advanced Life Support (OPALS) study
• 5,638 Out-of-Hospital Cardiac Arrest patients
• Assessed the benefit of each additional link in the chain of survival to hospital discharge

IV Drug Administration in Cardiac Arrest
Olasveengen TM et al. JAMA 2009; 301:2222-9
• Oslo, Norway
• Randomized trial of resuscitation with and without the use of ACLS IV medications
• 851 Out-of-hospital cardiac arrest cases
• Trial considered underpowered to address survival to discharge

Epinephrine: The Mainstay of Cardiac Arrest Care since 1974 ACLS Guidelines

Prehospital Epinephrine Use & Survival in Japan
Hagihara A et al. JAMA 2012; 307:1161-8
Retrospective study on data of 417,188 out-of-hospital cardiac arrests from 2005-2008
• Limitations to note
  • Not a randomized, placebo-controlled trial where all variables are known and controlled
  • EMS personnel in Japan didn’t carry Epinephrine until 2006 and dosage was not standardized across agencies
  • Hospital care was variable and missing data in many cases
  • Less than 4% of cases administered Epinephrine
Despite the known limitations of the study; due to trial size, the outcome of this study has opened the door for future trials.
Amiodarone vs Lidocaine In PreHospital Refractory VF

- Toronto ALIVE study
- Double-blind, randomized trial of Amiodarone vs Lidocaine
- 347 Out-of-hospital cardiac arrest cases
- No statistical difference in survival to discharge

The Answer May Lie in the ALPS Trial

- ALPS: Amiodarone, Lidocaine, or Placebo Study
- Led by University of Washington
  - 10 locations across U.S. and Canada
  - 70 EMS agencies participating
- 3,000 patients over approximately 3 year period
  - First patient enrolled in June, 2012
  - As of February, 2014 approximately 1,200 patients enrolled

ALPS design

- Persistent or recurrent VF/VT* after 1st shock
- Randomized
- Amiodarone
- Lidocaine
- Neither (placebo)
- Survival to Hospital Discharge

ALPS drug kits

<table>
<thead>
<tr>
<th>SYRINGE #</th>
<th>AMIODARONE KIT</th>
<th>LIDOCAINE KIT</th>
<th>PLACEBO KIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Amiodarone 150 mg (3 cc)</td>
<td>Lidocaine 60 mg (3 cc)</td>
<td>Placebo (3 cc)</td>
</tr>
<tr>
<td>1B</td>
<td>Amiodarone 150 mg (3 cc)</td>
<td>Lidocaine 60 mg (3 cc)</td>
<td>Placebo (3 cc)</td>
</tr>
<tr>
<td>2</td>
<td>Amiodarone 150 mg (3 cc)</td>
<td>Lidocaine 60 mg (3 cc)</td>
<td>Placebo (3 cc)</td>
</tr>
</tbody>
</table>
Oxygenation: More is Not Always Better

Metabolic Chain of Events

- Cardiac Arrest
- Decrease of Blood Flow
- Widespread Ischemia (Ischemic Cascade)
- CPR, Defibrillation, & ACLS
- Cell Damage
- ROSC
- Increased Blood Flow & O2 Reperfusion
- Oxygen Free Radicals
- Cell Death & Cerebral Injury

Hyperoxia Post-Resuscitation Survival from Cardiac Arrest
Kilgannon et al. JAMA 2010; 03(21):2165-2171

- 6,326 ICU patients from 120 hospitals
- 18% patients hyperoxic (PaO2 > 300)
- 63% patients normoxic (60 > PaO2 < 300)
- 19% patients hypoxic (PaO2 < 60)
- Mortality higher with hyperoxia than hypoxia

Therapeutic Hypothermia
Early Trials Showed Great Promise

Induced Hypothermia (32-34°C)

• Europe
• 275 VF/VT ROSC patients
• Cooled to 32-34°C for 24 hours

Induced Hypothermia (33°C)

• Australia
• 73 Out-of-hospital ROSC patients
• Cooled to 33°C for 12 hours

Improved out-of-hospital cardiac arrest survival: the Wake County experience

Comparison of Outcomes
Hypothermia vs. Baseline

* P < 0.05 when compared with baseline
Current Research Has Painted a Different Picture

Prehospital Induction of Hypothermia in OOH-CA due to VF with 4ºC Ringers Lactate
Bernard et al. Circ 2010;122:737-42

- 234 Out-of-hospital ROSC patients
- Cooling initiated immediately post-ROSC
- 2L of 4ºC Lactated Ringers
- Cooled in ED to 33ºC for 24 hours
- Study terminated early due to futility

The “Trials of Two Cities”

Randomized Trial of Prehospital Induction of Hypothermia in OOH-CA with 4ºC Saline
Kim et al. JAMA. Epub 2013 Nov 17

- 1,359 Out-of-hospital ROSC patients
  - Grouped patients by presenting rhythm (VF or not)
  - Cooling initiated immediately post-ROSC
  - Cooled in ED to 32-34ºC for 24 hours
Selective Brain Cooling: ‘RhinoChill’

- Non-invasive “preferential” brain cooling
  - Aerosolized coolant spray delivered through NC
- Very rapid cooling
  - Reaches target temperature of 34°C two hours faster than systemic cooling methods
- Can be initiated early during arrest

PRINCE : Pre-ROSC IntraNasal Cooling Effectiveness
Castren et al. Circulation 2010;122(7):729-36

- 194 Out-of-hospital cardiac arrest patients
- 15 sites, 5 European countries
- RhinoChill Intranasal cooling initiated during arrest
- Standard therapeutic hypothermia methods used after hospital arrival

This IS Working

Pit Crew Model:
- Same name…many versions
- CPR
  - Maximize compression fraction
  - Effective compression(rate/depth)
  - Provider fatigue
- Controlled ventilations
- Defib
  - Pre-charge @1:45
  - Emphasis on Shock/Don’t shock
It's a JUDGEMENT call

Termination of Efforts

30 minutes consider termination
You are a different kind of HERO
Effects of Permitting Family Members to Observe CPR

Despite data that suggest benefit to family members from allowing them to observe resuscitations (NEJM JW Emerg Med Mar 15 2013), emergency physicians may be reluctant to do so. In a prospective, cluster-randomized, controlled study involving 15 emergency medical services units in France, researchers compared psychological symptoms at 1 year between family members who were offered the chance to witness an adult resuscitation and those who were not offered the option.

Of 570 family members, 72% were evaluated at 1 year by telephone. Family members in the control group were more likely to experience major depression (31% vs. 23%), complicated grief (36% vs. 21%), and post-traumatic stress disorder-related symptoms (adjusted odds ratio, 1.5). Grief, post-traumatic stress, and depression at 1 year were reduced when family members were permitted to witness resuscitation of loved ones.

Summary
- Quality CPR is going to continue to be the foundation to successful resuscitations
- ACLS medications may not be as beneficial as previously thought, and may even be detrimental to long term outcomes
- We must take a new focus on post resuscitation oxygenation and keep SaO2 between 94-99%
- The jury is still out on the utilization of pre-hospital Therapeutic Hypothermia
- Organized cardiac arrest care DOES lead to more survivors with a good CPC score
- Remember to keep an open mind to future changes!

Questions?