Management of Cardiac Arrest

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Objectives

• Identify causes of cardiac arrest
• Identify the four ECG presentations of cardiac arrest
• Review high quality CPR
• Discuss “best practices” in cardiac arrest management
• Review use of induced hypothermia for ROSC patients
What’s the definition of cardiac arrest?

Cardiac Arrest
A medical emergency with absent or inadequate contraction of the left ventricle of the heart that immediately causes body wide circulatory failure.

- Acute myocardial infarction
- Ischemia without infarction
- Structural alterations such as scar formation or ventricular dilation secondary to prior infarction
Incidence....

• Each year, 424,000 people experience non-traumatic OHCA
• Approximately 60 percent of OHCA victims are treated by EMS
• Twenty-five percent of OHCA victims treated by EMS have no symptoms before the onset of arrest
• For EMS-treated OHCA cases, 23 percent have an initial rhythm of VF or VT
  • May respond well to treatment with AED
Initial Rhythm Presentation

- Initial rhythm in primary cardiac arrest

<table>
<thead>
<tr>
<th>Initial Rhythm</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>VF</td>
<td>50%</td>
</tr>
<tr>
<td>Asystole</td>
<td>30%</td>
</tr>
<tr>
<td>PEA</td>
<td>18%</td>
</tr>
<tr>
<td>VT</td>
<td>2%</td>
</tr>
</tbody>
</table>

- Out of hospital cardiac arrests (OHCA) 20% reach the ED and 8% survive past discharge
Risk

• Age-adjusted incidence of OHCA is higher among blacks and Hispanics than among whites

• Prior heart disease (myocardial infarction or heart failure) is a major risk factor for cardiac arrest

• A family history of cardiac arrest in a parent, sibling, or offspring is associated with a two-fold increase in risk of cardiac arrest.
Sports: Rising Number of Cardiac Arrests

- Physical activity/exercise can reduce the risk of cardiac arrest
  - When coupled with undiscovered congenital factors
- Media attention is being given to student athletes with pre-existing cardiac conditions
  - Helps raise awareness for early cardiac screenings
Outcomes

- Outcomes are rhythm dependent
- VT – 80% reach hospital and 70% survive
- VF - 40% reach hospital and 20% survive
- PEA -10% reach hospital and 1% survive
- Asystole – 5% reach the hospital and 1% survive

Sudden Cardiac Arrest Survival

• Survival to hospital discharge after EMS-treated non-traumatic cardiac arrest with any first recorded rhythm is 10.4 percent.

• Survival after bystander-witnessed VF is 31.7 percent.

• Among people who survive to hospital discharge, five-year survival is better among those who received angioplasty compared with their counterparts (78.7 vs. 54.4 percent).

• Among those who receive therapeutic hypothermia compared with their counterparts (77.5 vs. 60 percent).

• Survival rates are higher among those who receive chest compressions alone (10.2 percent) vs. chest compressions and rescue breathing (8.5 percent).

• Rates of survival to 30 days after hospital discharge are more than twice as poor for blacks as for whites. Survival among Hispanics are also lower than among whites.
Risk Factors Associated with Cardiac Arrest

- Age
- HTN
- Heart Disease
- Diabetes Mellitus
- Obesity
- Renal Failure
- Genetic predisposition
- Social factors
  - Smoking
  - Alcohol
Physiological/Disease Specific Risk Factors

Common
• Coronary Artery Disease
• Cardiomyopathies

Uncommon
• Aortic Stenosis
• Congenital heart disease
• Wolf Parkinson-White
• Prolonged QT
• Brugada Syndrome
Risk Factors of Cardiac Arrest

A Confluence Of Risk Factors Act Together To Produce Sudden Cardiac Death

• Transient risk factors
• Ischemia
• Hypoxia
• Hypotension
• Acidosis
• Electrolyte imbalances
• Drug effects
• SCD
Risk

• Etiology
  • CAD ~ 80%
  • Cardiomyopathies ~ 15%
  • WPW syndrome < 5%
  • Genetic factors < 5%
  • Long-term medical problems (coronary artery disease and cardiomyopathies) produce structural pathology in the myocardium on which transient factors act and trigger ventricular tachycardia and ventricular fibrillation.
Four Initial ECG Rhythms of Cardiac Arrest

• Ventricular Fibrillation (VF)
• Pulseless Ventricular Tachycardia (VT)
• Pulse-less Electrical Activities (PEA)
• Asystole
Pathology of Cardiac Arrest

- General progression through several cardiac rhythm disturbances prior to an arrest...

- **V-Tach**
  - With pulse
  - Without pulse

- **V-Fib**
  - Course: early in onset
  - High survival potential!

- **PEA**
  - Poor prognosis for survival
  - Same as Asystole

- **Asystole**
  - Poor prognosis for survival
  - Same as PEA
Ventricular Tachycardia – V Tach

- Organized Chaos of a ventricular origin
- No perfusion
- Treat with defibrillation and medication
V Tach
Torsade's

“Twisting around a point”
Usually kicked off by a PVC

- Consider cause
- Consider magnesium
Ventricular Fibrillation
Ventricular Fibrillation

- Chaotic rhythm
- No perfusion
- Treat with defibrillation and medication
V Fib

Fine V Fib

Course V Fib
Pulseless Electrical Activity – PEA

• Search for the underlying causes
  • Hypovolemia
  • Hypoxia
  • Hypoglycemia
  • Hydrogen ions (acidosis)
  • Hypothermia
  • Hypo-/hyperkalemia
  • Tension pneumothorax
  • Tamponade
  • Thrombosis
  • Toxins

• CPR and Epinephrine. But also try a fluid bolus or a warm blanket. In the case of PEA, sometimes simple is better.
Asystole

Cardiac Standstill
• Treatment includes medications and continuous High Quality CPR
Treatment for Presenting Dysrhythmias

• It is always

High Quality CPR
CPR “Chain of Survival”

- Immediate recognition of cardiac arrest and activation of EMS
- Early CPR with emphasis on chest compression
- Rapid defibrillation
- Effective advanced life support
- Integrated post-cardiac arrest care
AHA Out of Hospital Cardiac Arrest Reports...

• More than 1,000 people suffer non-traumatic cardiac arrest outside hospitals—including about 26 children—each day in the U.S.

• Overall survival rates are approximately 10 percent.

• Among young victims, the survival rate is about five percent.
## Incidence and Outcome of Out-of-Hospital Cardiac Arrest in the U.S.

<table>
<thead>
<tr>
<th></th>
<th>Annual number of cases</th>
<th>Annual number of fatalities</th>
<th>Survival, (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMS assessed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>424,000</td>
<td>401,000</td>
<td>5.2</td>
</tr>
<tr>
<td>Children</td>
<td>9,500</td>
<td>8,800</td>
<td>4.4</td>
</tr>
<tr>
<td><strong>EMS treated</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>211,000</td>
<td>187,000</td>
<td>10.4</td>
</tr>
<tr>
<td>Children</td>
<td>7,700</td>
<td>7,000</td>
<td>5.4</td>
</tr>
<tr>
<td><strong>Shockable rhythm</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>42,000</td>
<td>30,000</td>
<td>28.3</td>
</tr>
<tr>
<td>Children</td>
<td>560</td>
<td>370</td>
<td>26.7</td>
</tr>
<tr>
<td><strong>Bystander-witnessed, shockable rhythm</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>24,000</td>
<td>16,000</td>
<td>31.7</td>
</tr>
<tr>
<td>Children</td>
<td>240</td>
<td>160</td>
<td>26.7</td>
</tr>
</tbody>
</table>

*Summary by Sudden Cardiac Arrest Foundation. Figures are point estimates.*


*Reference: American Heart Association Heart Disease and Stroke Statistics—2014 Update,*

[http://circ.ahajournals.org/content/129/3/e28](http://circ.ahajournals.org/content/129/3/e28)
The Differential

Sudden cardiac death occurs in the setting of an acute insult acting most commonly on a pathological structural substrate

- Acidosis
- Acute myocardial infarction
- Cardiac tamponade, Tension pneumothorax
- Hypoxia, hypovolemia, hyperkalemia, hypokalemia hypoglycemia, hypothermia
- Pulmonary embolism
- Toxins or drugs
Differential....

Bedside Sonography

• Increasingly used by trained emergency physicians
• Check for cardiac activity in PEA/asystole
  • Pericardial effusion
  • Suspected aortic catastrophe
Differential......

• Hypoxia, hypovolemic, and hypoglycemia rapidly assessed
  • Treat with adequate ventilation, fluid resuscitation, and a finger
    stick test and dextrose water

• Hyperkalemia can cause bradycardic arrest, may or may not
  produce the typical ECG features of prolonged PR intervals
  and peaked T waves
  • Treat with 10 units of regular insulin with glucose in normoglycemic patients
    If hyperkalemia is detected prior to cardiac arrest, calcium gluconate, 10 mL in
    10% solution over 10 to 20 minutes, should be given to stabilize electrical
    effects on cardiac myocytes
Certain drugs can prolong the QT interval in genetically predisposed individuals. These medications include:19

- tricyclic antidepressants
- neuroleptics
- macrolide and quinolone antibiotics
- antifungal agents
- Procainamide
- quinidine
- sotalol
Cardiac tamponade
- Symptoms and signs prior to cardiac arrest (e.g. pulses paradoxus, elevated jugular venous pulsation, distant heart sounds)
  - Emergent pericardiocentesis should be performed

Tension pneumothorax
- Immediate decompression
Take the Time to Save a Life:

“...implementation of guidelines increasing the time devoted to chest compression during resuscitation.”

- Minimum 100 compressions per minute
- Maximum 120 compressions per minute
- Compression IS important
- Allow FULL RECOIL of the chest to allow the heart to refill with blood to circulate on the next compression
- Take your weight off your hands....this requires practice
Did You Know?

“...implementation of guidelines increasing the time devoted to chest compression during resuscitation.”

• It takes 16 seconds worth of compressions to obtain enough vascular pressure for oxygen exchange to occur within the cells of vital organs
• It only takes 3 seconds of no compressions to reduce that pressure back to “0”!!!
• Maintain your compressions while you ventilate
Changes: Ventilation

“These changes include reducing the number of back-to-back rhythm analyses/shocks, eliminating rhythm and pulse checks after each shock, and increasing the ratio of chest compressions to ventilations.”

• Get on the chest and STAY ON THE CHEST even after defibrillation!
• If rhythm converts to a “viable” rhythm after defibrillation STAY ON THE CHEST for one minute before assessing a pulse
• When using an AED only stop compressions when the machine tells you to
• Ventilate once every 5-6 seconds, or once every 20 compressions...NO MORE
Reality Check...

Hospital personnel are less proficient at CPR than we are at ACLS

• Why?
  • We worry about the “next” intervention
  • We do too much ALS before BLS
  • We spend to much time on ET/IV/IO insertions
  • We think we “already know this”!
Frequency of Use

How many of you could be experts at anything you only practice 15.6% of the time?
Improving CPR outcomes

Best Practices
• The goal is to save lives
• If the rhythm is shockable – Stay and Play
• If the rhythm is not-shockable – Continue High Quality CPR
Are you still going to halt definitive resuscitation to:

- Move them onto a board
- Onto the stretcher
- Pile the equipment up
- Move through the hallway
- Get down/up the stairs
- Out to the ambulance
- Into the ambulance
- Restage your equipment

And finally resume quality CPR!!
Treatment Recommendations

The AHA Classification Of Recommendations And Level Of Evidence

• **Class I**  Conditions for which there is evidence and/or general agreement that a given procedure or treatment is useful and effective.

• **Class II** Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment.
  
  • **IIa.** Weight of evidence/opinion is in favor of usefulness/efficacy
  
  • **IIb.** Usefulness/efficacy is less well established by evidence/opinion

• **Class III** Conditions for which there is evidence and/or general agreement that the procedure/treatment is not useful/effective and in some cases may be harmful.

• **Class Indeterminate** Conditions for which there is Insufficient research, continuing area of research, or no recommendation until further research.
Return of Spontaneous Circulation

• Patient support continues
  • Intubated with ventilator support
  • Sedated for comfort
  • Pressors
  • Admission to Intensive Care Unit
  • Consider PCI therapy based on suspected etiology
ROSC

Initial Manual Cooling Algorithm

- Return of spontaneous circulation
- Initial temp > 34 degrees Celsius
- ET in place
- Confirm not responsive to verbal stimuli
- Expose patient. Perform 12-lead EKG
- Apply ice packs to groin and axilla
- Cold saline bolus: 30ml/kg, max 2L
- Versed 0.15 mg/kg slow IV push, max 10 mg (for sedation/shivering) with repeat B/P
Therapeutic Hypothermia

• American Heart Association
  • 2010 Updates
    • Therapeutic hypothermia in adult cardiac arrest patients shows improved neurological outcome for those that are discharged from the hospital

• Induced Therapeutic Hypothermia (ROSC)
  • Region VII ALS SMO’s, Code 11
  • Key points
    • Cardiac arrest not related to trauma, hemorrhage, or infection
    • Age >18
    • Not currently pregnant
    • Patient is intubated and unresponsive
    • Initial temperature > 34 degrees C (93.2 F)
ROSC

• What current science says...
  • “A new study found that contrary to conventional belief, pre-hospital hypothermia had no effect on the rate of survival to hospital discharge or on neurological outcome among surviving cardiac arrest patients, either among patients with ventricular fibrillation (VF) or non-VF arrest.”
  • “trial established....not simply that field cooling offered no advantage to patients. Instead, those patients randomized to prehospital cooling experienced re-arrest on the way to the hospital more often – 26 percent versus 21 percent – as well as increased pulmonary edema and use of diuretics.”
Conclusion

• High quality post-resuscitative care is an important component of management of cardiac arrest with emphasis on treatment of reversible causes and metabolic conditions.

• Therapeutic hypothermia is effective in a select subset of cardiac arrest patients but is still being studied for its effectiveness

• Back to the basics...high quality CPR, early defibrillation and YOU are your patients best chance for survival and good outcomes