Improving Survival from Sudden Cardiac Arrest

Vincent N Mosesso, Jr, MD
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University of Pittsburgh School of Medicine

Disclosures

- Employer: University of Pittsburgh/UPMC
- Advisory Board, OxySure Systems, Inc, Frisco, TX
- Research grant, Zoll Lifecor Corp, Pittsburgh, PA
- Medical Director, Sudden Cardiac Arrest Association, Washington, DC
Greetings From Pittsburgh!

City of Bridges

The Golden Triangle
John Vincent Calipari
(born in Pittsburgh, PA)

Objectives

- Epidemiology
- Preparedness
- Acute resuscitation
- Post Cardiac Arrest Care
Out of Hospital Cardiac Arrest - A Common Disease

- 0.5-1.0 per thousand per year
- High morbidity and mortality
  ~50% never make it to the hospital

Sudden cardiac death: a public health crisis
Overall survival = 7.9 %

**Table 4. Incidence and Outcome of EMS-Treated Out-of-Hospital Cardiac Arrest**

<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>60</td>
<td>1972</td>
</tr>
<tr>
<td>1974</td>
<td>77</td>
<td>1976</td>
</tr>
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<td>1978</td>
<td>74</td>
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<td>1982</td>
<td>62</td>
<td>1984</td>
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<td>1986</td>
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<td>1990</td>
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<td>1992</td>
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<tr>
<td>1994</td>
<td>46</td>
<td>1996</td>
</tr>
<tr>
<td>1998</td>
<td>50</td>
<td>2000</td>
</tr>
</tbody>
</table>

Presenting rhythm

EMS studies report decreasing incidence/frequency VF

Public access defibrillation trials show higher rate

-PAD Trial – 60%
ROC EMS treated arrests 2006-2010

Table 1
Overall patient, event, and EMS characteristics over time.

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated episodes, n</td>
<td>2,025</td>
<td>2,275</td>
<td>2,025</td>
<td>2,075</td>
<td>2,125</td>
</tr>
<tr>
<td>Median age (IQR), y</td>
<td>67 (60)</td>
<td>67 (60)</td>
<td>67 (60)</td>
<td>67 (60)</td>
<td>67 (60)</td>
</tr>
<tr>
<td>Male, %</td>
<td>63.8</td>
<td>63.1</td>
<td>63.9</td>
<td>63.0</td>
<td>63.4</td>
</tr>
<tr>
<td>Public location, %</td>
<td>16.1</td>
<td>16.2</td>
<td>15.8</td>
<td>14.4</td>
<td>13.7</td>
</tr>
<tr>
<td>AED applied, %</td>
<td>25</td>
<td>26</td>
<td>35</td>
<td>33</td>
<td>32</td>
</tr>
<tr>
<td>AED shock, %</td>
<td>2.4</td>
<td>3.4</td>
<td>2.0</td>
<td>1.6</td>
<td>1.7</td>
</tr>
<tr>
<td>Witness status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMS, %</td>
<td>9.2</td>
<td>8.9</td>
<td>9.0</td>
<td>11.3</td>
<td>11.7</td>
</tr>
<tr>
<td>Bystander, %</td>
<td>39.7</td>
<td>37.8</td>
<td>37.7</td>
<td>37.8</td>
<td>37.6</td>
</tr>
<tr>
<td>None, %</td>
<td>42.1</td>
<td>46.0</td>
<td>46.2</td>
<td>46.0</td>
<td>47.7</td>
</tr>
<tr>
<td>Unknown, %</td>
<td>9.1</td>
<td>7.0</td>
<td>3.9</td>
<td>4.2</td>
<td>3.0</td>
</tr>
<tr>
<td>Bystander CPR, %</td>
<td>33.8</td>
<td>35.5</td>
<td>36.0</td>
<td>39.2</td>
<td>40.1</td>
</tr>
<tr>
<td>Mean arrival time in minutes (sd)</td>
<td>6.0 (1.3)</td>
<td>6.1 (1.3)</td>
<td>6.1 (1.3)</td>
<td>5.0 (1.3)</td>
<td>5.0 (1.3)</td>
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<tr>
<td>First EMS rhythm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V/T/V, %</td>
<td>24.1</td>
<td>22.7</td>
<td>22.2</td>
<td>22.3</td>
<td>21.5</td>
</tr>
<tr>
<td>PFA, %</td>
<td>20.3</td>
<td>20.4</td>
<td>20.0</td>
<td>22.8</td>
<td>21.8</td>
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<tr>
<td>Asystole, %</td>
<td>39.3</td>
<td>41.6</td>
<td>44.0</td>
<td>43.1</td>
<td>44.2</td>
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<tr>
<td>No shock, no stop, %</td>
<td>7.8</td>
<td>6.0</td>
<td>1.3</td>
<td>2.5</td>
<td>9.6</td>
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<tr>
<td>Cannot determine, %</td>
<td>6.0</td>
<td>7.0</td>
<td>10.7</td>
<td>7.0</td>
<td>7.6</td>
</tr>
<tr>
<td>Transplant, %</td>
<td>6.0</td>
<td>5.0</td>
<td>6.2</td>
<td>6.2</td>
<td>6.2</td>
</tr>
<tr>
<td>Non-cardiac etiology, %</td>
<td>33.1</td>
<td>4.0</td>
<td>5.4</td>
<td>4.0</td>
<td>4.7</td>
</tr>
<tr>
<td>Available ECG, %</td>
<td>94</td>
<td>91.0</td>
<td>64.3</td>
<td>73.3</td>
<td>73.9</td>
</tr>
<tr>
<td>ECG with data, %</td>
<td>94</td>
<td>91.7</td>
<td>55.5</td>
<td>61.6</td>
<td>62.8</td>
</tr>
</tbody>
</table>

Current survival

Fig. 2. Out of hospital cardiac arrest survival over time – all sizes and rhythm groups.
Factors associated with survival

Table 3
Logistic regression results.

<table>
<thead>
<tr>
<th></th>
<th>Model 1: All treated cases n = 44,066</th>
<th>Model 2: Presumed cardiac etiology cases n = 41,950</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td>2006</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>2007</td>
<td>1.29 (1.14, 1.46)</td>
<td>1.25 (1.10, 1.43)</td>
</tr>
<tr>
<td>2008</td>
<td>1.39 (1.23, 1.58)</td>
<td>1.40 (1.22, 1.59)</td>
</tr>
<tr>
<td>2009</td>
<td>1.29 (1.14, 1.47)</td>
<td>1.29 (1.13, 1.48)</td>
</tr>
<tr>
<td>2010</td>
<td>1.72 (1.53, 1.94)</td>
<td>1.73 (1.53, 1.96)</td>
</tr>
<tr>
<td>Age ≥ 60</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Age 40-49</td>
<td>0.76 (0.67, 0.86)</td>
<td>0.76 (0.66, 0.88)</td>
</tr>
<tr>
<td>Female</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Male</td>
<td>0.80 (0.73, 0.89)</td>
<td>0.80 (0.64, 0.98)</td>
</tr>
<tr>
<td>Arrival time ≤ 6 min</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Arrival time &gt; 5 min</td>
<td>0.73 (0.67, 0.79)</td>
<td>0.71 (0.66, 0.77)</td>
</tr>
<tr>
<td>Not witnessed</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>EMS witnessed</td>
<td>5.48 (4.85, 6.21)</td>
<td>5.68 (5.17, 6.30)</td>
</tr>
<tr>
<td>Bystander witnessed</td>
<td>2.40 (2.27, 2.74)</td>
<td>2.44 (2.21, 2.70)</td>
</tr>
<tr>
<td>No bystander CPR</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Bystander CPR</td>
<td>1.20 (1.10, 1.30)</td>
<td>1.24 (1.13, 1.35)</td>
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<tr>
<td>Public location</td>
<td>1.85 (1.70, 2.01)</td>
<td>1.86 (1.71, 2.03)</td>
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<tr>
<td>Initial rhythm: asystole</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Initial rhythm: VF/VT</td>
<td>13.73 (12.10, 15.57)</td>
<td>13.10 (11.70, 15.20)</td>
</tr>
<tr>
<td>Initial rhythm: PEA</td>
<td>3.07 (2.67, 3.54)</td>
<td>2.11 (1.72, 3.26)</td>
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<tr>
<td>Presumed cardiac etiology</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Non-cardiac etiology</td>
<td>1.47 (1.25, 1.72)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Survival disparities continue

Fig. 1. Out of hospital cardiac arrest site-level EMS-treated OHCA over time (lowest and highest survival by site by year, with 95% CI).
Langhelle - 4 cities in Norway

Survivors

<table>
<thead>
<tr>
<th>City</th>
<th>Survivors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oslo</td>
<td>0.3</td>
</tr>
<tr>
<td>Akerhus</td>
<td>0.4</td>
</tr>
<tr>
<td>Ostfold</td>
<td>0.5</td>
</tr>
<tr>
<td>Stavanger</td>
<td>0.6</td>
</tr>
</tbody>
</table>

The faces of sudden death

http://kenheart.org/html/memorials.html
Acute Resuscitation

Goals:
- Perfusion
- Rhythm stabilization
- Oxygenation

Methods:
- Defibrillation
- Compressions
- Ventilations
- Medications
- Reversible causes

Figure 1.11. Actual electrocardiograms from first human successfully defibrillated. Claude Beck, M.D., saved the life of a 14-year-old
Defibrillation

• Immediately if witnessed

• Immediately or after about 2 minutes of chest compressions if not witnessed by provider
  - No difference in survival in recent ROC trial
PAD-based studies:
VF proportion higher and constant

Las Vegas Casinos

- Security guards trained in CPR and AED use
- 53% survival for VF
- 74% survival when shock within 3 minutes of collapse

USA-ROC Study

- Review of cardiac arrests in ten areas in US and Canada (21 million population)

- Survival to hospital discharge:
  Overall: 7%
  Bystander CPR but no AED: 9%
  AED applied: 24%
  AED shock: 38%

Weisfeldt et al, JACC, 2010
Survival for OOH-VF

Survival (%)

Estimated Time from Collapse to Defibrillator Shock (minutes)

Cardiac-rehabilitation programs, electrophysiology laboratories
PAD programs
Home, after EMS response to 911 request

Some unfortunate facts

Bystander CPR – 32%
Bystander AED – 2%
AEDs do not save lives—

people using AEDs quickly and effectively saves lives!

New models of training and awareness

On a whiteboard, a picture of a basketball player is shown. The caption reads: "Iphone app helps save high school b-ball star's life."
Cell phone video training

- Lay persons randomized to standard training or also given video clip with text reminders
- At 3 months, performance of CPR and AED skills better in group with video clip
- Those with video/reminders reported greater confidence and willingness to perform

Ahn et al. Resuscitation 2011

PAD “programs” vs AED placement

- Coordinated program
- Strategic deployment (AED accessibility)
- Regular device checks (daily when feasible)
- Battery and pad maintenance
- Awareness and signage
- Response plan and training (when applicable)
- Annual and incident-based quality reviews
**Optimal deployment locations**

- Many studies on OOHCA location
- Typically highest rates at:
  - Airports, train/subway stations
  - Large sports venues
  - Large office buildings/malls
- Some look at census tracts
  - Age, race, family structure
- Rarely individual sites with multiple arrests

**Real-time alerting**

- 911 connected
  - Pre-arrival instructions to caller
  - Registry of AED locations
  - Text messaging to potential responders
  - Phone apps (Fire Department)
- Site-based alerts
  - Notify on-site response team
  - AED triggered alarms
• AED Link
• National AED Registry

“Fire department” iphone app
SMS Text Messaging

- Text alerts of cardiac arrest to lay persons
- Pilot trial reported from the Netherlands
- Responder actions:
  - CPR or AED: 49%
  - Assist EMS: 51%
  - Help family: 39%

Scholten et al. Resuscitation 2011

Linking dispatch to AEDs

- Retrospective review of OOHCA in Seattle
- 736 CAs 2007-2009
- AEDs applied:
  - Bystanders: 2.9%
  - Police first responders: 1.3%
- Nearby AED identified by dispatch: 8.1%
- Potential to increase bystander AED use

Rea et al. Resuscitation 2011
You determine whether they live or die.
Chest Compressions Critical

CPP = P (aortic diastolic) – P (atrial)
Coronary perfusion pressure approaches zero within seconds after stopping chest compressions.

Coronary Perfusion Pressure (Ao diastolic - RA diastolic)
Take Home Message:

- If you do not get the coronary perfusion pressure to >15mmHg, the heart will not beat

- Only compressions generate CPP!
Chest Compression–Only CPR by Lay Rescuers and Survival From Out-of-Hospital Cardiac Arrest

Bentley J. Bolzlow, MD
Daniel W. Spautz, MD
Robert A. Berg, MD

University of Pittsburgh School of Medicine - Department of Emergency Medicine

Context: Chest compression-only bystander cardiopulmonary resuscitation (CPR) may be as effective as conventional CPR with rescue breathing for out-of-hospital cardiac arrest.

Objective: To investigate the survival of patients with out-of-hospital cardiac arrest using compression-only CPR (COCPR) compared with conventional CPR.

Table 3. Survival and Odds Ratios for Various Risk Factors

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Survival</th>
<th>Odds Ratio (96% CI)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>No./Total No.</td>
<td>% (96% CI)</td>
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<tr>
<td>Bystander CPR</td>
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<tr>
<td>None</td>
<td>150/2000</td>
<td>5.2 (4.4-6.0)</td>
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<tr>
<td>Conventional</td>
<td>52/666</td>
<td>7.8 (5.8-9.8)</td>
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<tr>
<td>COCPR</td>
<td>113/849</td>
<td>13.3 (11.0-15.6)</td>
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<tr>
<td>Witnessed arrest</td>
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<tr>
<td>Yes</td>
<td>257/1982</td>
<td>13.4 (11.5-14.3)</td>
</tr>
<tr>
<td>No</td>
<td>48/3423</td>
<td>2.0 (1.4-2.6)</td>
</tr>
<tr>
<td>Shockable rhythm</td>
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<tr>
<td>Nonshockable</td>
<td>62/3020</td>
<td>2.1 (1.6-2.6)</td>
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<tr>
<td>VF/VT</td>
<td>257/1951</td>
<td>17.0 (15.4-19.2)</td>
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<tr>
<td>EMS protocol</td>
<td></td>
<td></td>
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<tr>
<td>BLS/ACLS</td>
<td>129/2689</td>
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<tr>
<td>No patient-specific parameters</td>
<td>196/1728</td>
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<tr>
<td>Age categories, y</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abella et al, 2005

JAMA October 6, 2010
University of Pittsburgh School of Medicine - Department of Emergency Medicine

Survival better with compression rate of 100 – 120 compressions/minute

Mean rate, ROSC group: 90 ± 17 *
Mean rate, no ROSC group: 79 ± 18 *

p=0.003

Abella et al, 2005
Survival better with compressions >2 inches deep

Survival:
- 2 inches vs 1.5 inches
- Survival: 100% vs 15%

Shock success by compression depth

Shock success, percent
- p=0.02
- Compression depth, inches
- <1: 50% (n=10), 1-1.5: 62% (n=13), 1.5-2: 93% (n=14), >2: 100% (n=5)

Edelson et al., 2006
Quality Chest Compressions

- Adequate depth (~5cm)
- Complete recoil
- Proper rate (100-120/minute)
- CONTINUOUS-limit interruptions
- Up to the second before shock and resume immediately after shock

- CONTINUOUS is CRITICAL

Shock success by pre-shock pauses

<table>
<thead>
<tr>
<th>Pre-shock pause, seconds</th>
<th>Shock success, percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤10.3 (n=10)</td>
<td>90%</td>
</tr>
<tr>
<td>10.5-13.9 (n=11)</td>
<td>64%</td>
</tr>
<tr>
<td>14.4-30.4 (n=11)</td>
<td>55%</td>
</tr>
<tr>
<td>≥33.2 (n=10)</td>
<td>10%</td>
</tr>
</tbody>
</table>

p=0.003
2015 AHA Guidelines

Mechanical CPR devices
Emergency Cardiopulmonary Bypass

ECB functions
**ECLS VS STANDARD CPR**

- 3 year prospective observational study (Taiwan)
  - E-CPR=59, C-CPR=113
  - Witnessed in-hospital arrest with CPR>10 min.

![Graph showing survival rates](image)

*Figure 2: Relation between CPR duration and the survival rate to discharge*

- E-CPR=extracorporeal CPR, C-CPR=conventional CPR

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**Implementing ECB in ED**

- Pre-arrival notification by EMS
- Call CT Surgery (or CCM) Attending on call
  - Call as early as possible
  - Requires perfusionist—not always in hospital
- Preserve vascular access site
  - Femoral vein and artery preferred
The “CHEER” Trial

- Alfred Hospital and Ambulance Victoria, Melbourne
- Mechanical CPR, Hypothermia, ECMO and Early Reperfusion
- Enrolled 26 patients (11-OOH, 15-IH)
- ROSC in 25
- Survival to D/C w/good neuro recovery – 54%
- PCI – 42%
- Pulmonary embolectomy in 1

Integration with EMS is critical

- Preplanning is a must—coordinated effort!
- Designated hospital(s)
- Criteria for patients who may benefit
  - Refractory VF
  - Hypothermic arrest
  - CA or severe shock from drug overdose
  - CA with other known potentially reversible cause
  - Severe cardiogenic shock
TRANSPORT on ECB

Ventilation
In the 1700’s: Blowing smoke up your...
Ventilation today

- Oral rather than rectal route
- In most cases, not as important as chest compressions initially
- Hazards:
  - Interrupting compressions for intubation
  - Hyperventilation
- Hyperoxia may be bad too

Hyperventilation-Induced Hypotension During CPR

- Observational study n=21 (Milwaukee)
- Ventilation rates were too high
- Reproduced in pig lab
- Excessive ventilation leads to:
  - Increased intra-thoracic pressure
  - Decreased coronary perfusion
  - Decreased survival rates

Aufderheide T. Circulation 2004
Medications proven to improve outcome in cardiac arrest:

- 
- 
- 

Drugs work in Animals, why not in Humans?

- Time to drug in animal studies:
  - 9.5 minutes

- Time to drug in human studies:
  - 17.7 minutes
  - Rittenberger et al 2006; Resuscitation; 72:201-206.
Survival varies with time – swine model

Probability of ROSC by time to first medication.

Full line: ACLS protocol
Dashed line: CPR with immediate drug cocktail protocol
AKA- “Ninja CPR”

Rittenberger et al. 2007; 
Resuscitation; 73:154-160.

Time to administration of epinephrine and outcome after in-hospital cardiac arrest and non-shockable rhythms: retroactive analysis of large in-hospital data registry (n=25095)
Donnino M et al.
BMJ 2014;348:g3028
One Year Survival of Patients Randomized to Receive IV Drugs During CPR or NO Drugs

Olasseveangen et al
JAMA. 2009 Nov 25;302(20):2222-9

Outcome when adrenaline (epinephrine) was actually given vs. not given – post hoc analysis of a randomized clinical trial

Theresa M. Olasseveangen, Lars Wik, Kjetil Sunde, Peter A. Steen
Resuscitation 2012; 83(3): 327–332

EMS arrival
200 chest compressions
Analysis
200 chest compressions
Analysis
200 chest compressions
Analysis
200 chest compressions

No intubation: Bag Valve Mask ventilation

Begin IV 1 mg EPINEPhrine every 3 to 5 minutes

Follow ACLS Guidelines?

If adequate bystander chest compressions are provided, EMS providers perform immediate rhythm analysis and shock if indicated.

“Ninja CPR” Arizona-style

- 200 compressions before defibrillation
- 200 compressions after defibrillation
- Delay intubation until after 3 cycles of CPR
- IV Epinephrine administration during first or second cycle of CPR
“Ninja CPR” Arizona-style

- Intervention group 9.1% survival to discharge
- Control group 3.8% survival to discharge
- Witnessed VF cohort:
  - MICR - 28.4% survival
  - No MICR - 11.9% survival
- Caveat: nationwide survival is ~8.4%
  (Nichol 2008; NEJM;300:1423-1431.)

PA Statewide Protocol: General Cardiac Arrest - Adult

- Don’t be fooled by agonal respirations
- Cycles of 200 uninterrupted compressions
- Early defib if good bystander CPR or EMS witnessed arrest

**GENERAL CARDIAC ARREST – ADULT STATEWIDE BLS PROTOCOL**

Initial Patient Contact - See Protocol # 201
Patient pulseless, may have gasping/agonal breathing

Cardiac arrest witnessed by EMS personnel OR
Quality CPR in progress on EMS arrival

200 Uninterrupted Chest Compressions

- Analyze with AED
  Shock (360 joules) if indicated

YES

NO
- 4 cycles of 200 compressions/defib
- Compressions cause passive ventilation
- Medical director sets airway/ventilation options

### DURING UNINTERRUPTED COMPRESSIONS:
- Airway Options: Naso/oropharyngeal Airway
- Ventilation Options: No Ventilation or 1 ventilation every 15 compressions
- Oxygen Options: Via NRB or Via BVM
- Give Compressions while AED is charging
- NO mechanical CPR device during initial 10 minutes

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**Post Cardiac Arrest Care**

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Outcomes after Cardiac Arrest

- Out-of-Hospital Location of Cardiac Arrest:
  - Survive without Symptoms: 10%
  - Survive with Neurological Deficit: 20%
  - Neurological Death: 40%
  - Cardiovascular Death: 20%
  - Multi-System Organ Failure: 20%

- In-Hospital Location of Cardiac Arrest:
  - Survive without Symptoms: 80%
  - Survive with Neurological Deficit: 60%
  - Neurological Death: 40%
  - Cardiovascular Death: 20%
  - Multi-System Organ Failure: 20%

Post-Cardiac Arrest Brain Injury
Brain Injury after Cardiac Arrest

If you have acute, severe cerebral edema, no therapy will help.

Proper care can improve outcome for those who are in the salvageable range.

Neurological Intensive Care

Proper care can improve outcome for those who are in the salvageable range.
Cerebral Blood Flow

Normal Physiology of CBF

• Ventilation set to keep eucapnia, normal pH
  - Good CBF with PCO2 30-50

• Blood pressure can vary widely
  - CBF perfusion maintained with MAP 50-150 mmHg
Effect of Systemic Blood Pressure and Ventilation on CBF after Cardiac Arrest

Auto-regulation
Impaired / right-shifted

CO2-reactivity
Preserved

CBF

MAP

pCO2

50 150

25 35 45 55

Patients can be hyperventilated to DEATH!

mean ventilation rate: 30 ± 3.2

first group: 37 ± 4

after retraining: 22 ± 3

Aufderheide et al. 2004

University of Pittsburgh School of Medicine - Department of Emergency Medicine
First priority of post arrest care: Maintain adequate perfusion

- Goal of SBP >110 mmHg
- Epinephrine - small boluses and drip
- Cautious IV fluids
- Arterial line in ED
- Transfuse if anemic

Therapeutic Hypothermia

The New England Journal of Medicine

MILD THERAPEUTIC HYPOTHERMIA TO IMPROVE THE NEUROLOGIC OUTCOME AFTER CARDIAC ARREST

The Hypothermia after Cardiac Arrest Study Group

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

Nielsen et al, NEJM, 2013
Figure 2. The Proportion of Comatose Patients Achieving Either Death Without Awakening or Awakening as a Function of Days After Cardiac Arrest for Enrolled Patients.

- Brain Injury
- Brain Protection
- Cardiac Irritability/Dysrhythmia
- Positive Inotropy, Increased SV, Decreased HR, Heart Protection

Temperature Ranges:
- 38°C
- 37°C
- 36°C
- 35°C
- 34°C
- 33°C
- 32°C
- 31°C
- 30°C

Temperature Effect:
- 36°C - 33°C
Why did they arrest?

Positive Cardiac Catheterizations by Rhythm

- VF/VT
- PEA
- Asystole
- Unknown

Positive= at least 1 vessel with ≥ 70% lesion

ACS common

- Up to 80% have MI as etiology for CA
- 2 Recent Consults:
  - 33 M with 99% LAD and 70% Circumflex
  - 35 F with 100% RCA
- 12 lead ASAP
- Not IF they need a cath, but WHEN!
Catheterization Doubles Good Outcomes

- Good outcome for
  - 52 / 96 (54%) cases with CATH versus
  - 36 / 145 (28%) of cases with no CATH

- CATH has 2.16 [1.12, 4.19] odds ratio of good outcome (after adjusting for Coma, Hypothermia, STEMI, Age, Sex, In-hospital or Out-of Hospital and Initial Rhythm)

Rehabilitation

- Brain
- Cardiovascular
- Musculoskeletal
- Psychological

And continued support after acute phase
Symptoms after Discharge (Health Utilities Index)

HUI - quality of health

Subscales of Symptoms

Post Cardiac Arrest Care Program

- Coordination with EMS/referring hospitals
- Maintain cerebral perfusion
  - Blood pressure support
  - Titrated ventilation (CO2)
- Coronary vasculature assessment
- Targeted temperature management
- Neurologic monitoring and support
- Post acute phase: EP, rehab
This isn’t for everyone...

Specialized Centers?

- Care for most diseases improves when provided by specialists who see problem often.
- Frequent use allows system improvement.
- Although CPR is a common event, most physicians care for post-CPR patients infrequently

- **Trauma Centers**
  - More than just the surgeon
  - Ancillary services and subspecialties

- **Stroke Centers**
  - More than tPA

- **STEMI Centers**
  - Emergent catheterization versus diagnostic catheterization.
  - Integration of EMS, ED and cath lab.
Volume Matters

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>95% CI</th>
<th>p value</th>
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<tbody>
<tr>
<td>Hospital volume (cases/year)</td>
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<tr>
<td>&lt;20</td>
<td>1.00</td>
<td>-</td>
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<tr>
<td>20–34</td>
<td>0.78</td>
<td>0.55–1.11</td>
<td>0.16</td>
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<td>35–50</td>
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<td>0.45–1.11</td>
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<tr>
<td>&gt;50</td>
<td>0.62</td>
<td>0.45–0.86</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Carr BG, et al. 2009 Resuscitation

Average hospital sees 10-15 eligible patients each year.
Summary

- SCA remains a leading cause of death
- Survival varies significantly based on locality
- Early defibrillation is critical with VF/VT
- Early, high quality and continuous chest compressions
- Comprehensive post resuscitation care
- Seamless transition of care between services
  - Prehospital → ED → ICU → Floor is a continuum

Because so many more can survive!™
A special patient

www.suddencardiaccarrest.org
References