Improving Resuscitation Outcomes: Partnering with EMS and the Community

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Nothing to Disclose
Out of Hospital Cardiac Arrest
Chain of Survival
Despite the Chain of Survival - Long Term Outcomes Remain Dismal

- **1999** - 30% of patients had return of spontaneous circulation, 10% survived 24 hours, 4% survived to hospital discharge. *Weil and Tang 1999, CPR*

- **2012** - 60 out of 100 die out of hospital w/out return of pulse or blood pressure. Only 10 out of 40 of patients with restored vital signs survive to hospital discharge. *Kerns 2012, JACC: Cardiovascular Interventions*
The greatest drop-off in survival is not at the initial treatment in the field, but occurs in the hospital where 75% of those initially resuscitated die before hospital discharge (DC). Hosp = hospital; OHCA = out-of-hospital cardiac arrest; pts = patients; ROSC = return of spontaneous circulation; Surv = survival.
What Do We Need To Work On?

- Recognition of an arrest by the lay person
- Chest compression only CPR “*call and pump*”
- Transport effectively- minimally interrupted resuscitation
- More effective post arrest algorithm:
  - Preserve the brain – Hypothermia
  - Preserve the heart – Early angiography/PCI
Main Cause of Morbidity/Mortality After Resuscitation

• Anoxic brain injury/death
• Myocardial failure
  – 1/3 die from CNS injury
  – 1/3 die from myocardial injury
  – 1/3 die from a variety of causes- infection etc.

Schoenenberger Arch Int Med 1992; 154:2433
Post-Resuscitation Care that Improves Outcomes

• Mild Hypothermia after Cardiac Arrest
  (patients not regaining consciousness)

  Cooling to a core temperature of 32 to 34 degrees centigrade for 12 to 24 hours before a slow rewarming

• Coronary angiography and percutaneous intervention after cardiac arrest

  - Incidence of coronary disease among those resuscitated was over 70%.
  - Nearly 50% of those resuscitated had an occluded coronary artery
Hypothermia Prevents the *Death Spiral* of Brain Cells

- Hypothermia drives fatally injured cells away from lysis which can cause further inflammation and brain damage.
- Hypothermia drives marginally injured cells away from death and toward recovery.
- Decreases glucose & oxygen consumption by the brain- reduces supply-demand mismatch
- Maintains good cellular pH.
- Slows the breakdown of the blood-brain barrier that worsens cerebral edema.
The Use of Hypothermia After Cardiac Arrest

- Comatose survivors
- Asystole or VF
- 31-32°C
- Cooling until neurologic recovery (3 hours to 8 days)
- Water-filled blanket

Cooling Methods

- Iced IV saline induction
- Surface cooling with cooling blankets, ice bags, Cincinnati Subzero® etc.
Surface Cooling System

Medivance Arctic Sun®
What Are We Doing at RiverBend?

- Cool all comatose post-arrest adults with ROSC arriving < 8 hrs. unless MAP < 60 x 30 mins, pregnant, terminally ill or existing coagulopathy.
- Intubate if not previously done
- Do not delay cardiac treatments
- Sedation: Propofol to level 2-3 sedation
- Analgesia: Fentanyl
- Induce with 2 liters 4°C saline over 30-60 mins.
- Maintain goal temperature 33°C-34°C x 24 hours with Arctic Sun® started in ED or cath lab
What About the Heart?

IMMEDIATE CORONARY ANGIOGRAPHY IN SURVIVORS OF OUT-OF-HOSPITAL CARDIAC ARREST

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ABSTRACT

Background The incidence of acute coronary-artery occlusion among patients with sudden cardiac arrest outside of the hospital is unknown, and the role of reperfusion therapy has not been determined. We therefore performed immediate coronary angiography and angioplasty when indicated in survivors of out-of-hospital cardiac arrest.

Methods Between September 1994 and August 1996, coronary angiography was performed in 84 consecutive patients between the ages of 30 and 75 years who had no obvious noncardiac cause of cardiac arrest.

relative contraindication to thrombolytic therapy. Furthermore, it may be difficult to establish a clinical and electrocardiographic diagnosis of coronary-artery occlusion in patients with out-of-hospital cardiac arrest. Coronary angiography followed in suitable candidates by angioplasty could therefore be a therapeutic option in such cases.

To address this issue, we prospectively performed coronary angiography with angioplasty when indicated immediately after hospital admission in 84 consecutive survivors of out-of-hospital cardiac arrest. We assessed the prevalence of coronary artery disease and

(N Engl J Med 1997;336:1629-33.)
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Study Findings

- Immediate coronary angiography in 84 patients between 9/94 & 8/96- age 30 to 75 yrs w no obvious non-cardiac cause of cardiac arrest
- Male sex - 82%
- Mean age – 55.5 yo
- Chest pain expressed before arrest – 33%
- Bystander CPR – 80%
- Median interval between arrest & CPR – 3 minutes
- Median interval between arrest and ROSC – 25 minutes
- First rhythm- ventricular fibrillation 72%, ventricular tachycardia 21%
Arrest vs. Non-Arrest Cath Treatment Protocols – Should they be the Same?
Study Findings: EKG Data

- ST segment elevation in 42%
- ST depression in 9%
- Left Bundle Branch Block in 21%
- Right Bundle Branch Block in 2%
- No specific ST or T wave patterns 12%
- Normal ST and T wave 13%
Study Findings: Angiographic Data

- Clinically significant coronary disease 71%
- Single vessel 26%
- Two vessel 15%
- Three vessel disease 29%
- Isolated left main 1 out of 84
- Recent coronary artery occlusion 67%
Study Findings: Cath Data

- Door to balloon 32 minutes
- Out of 34 angioplasties attempted 28 were successful
- Intra-aortic balloon placed in 9 out of 84
### Table 4. Relation between ST-Segment Elevation, Chest Pain before Cardiac Arrest, and Recent Coronary-Artery Occlusion in the 84 Patients Who Underwent Coronary Angiography.*

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of Patients</th>
<th>No. with Recent Coronary-Artery Occlusion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST-segment elevation and chest pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>15</td>
<td>13 (87)</td>
</tr>
<tr>
<td>Absent</td>
<td>69</td>
<td>27 (39)</td>
</tr>
<tr>
<td>ST-segment elevation or chest pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>49</td>
<td>31 (63)</td>
</tr>
<tr>
<td>Absent</td>
<td>35</td>
<td>9 (26)</td>
</tr>
</tbody>
</table>

*ST-segment elevation was defined as an elevation of more than 1 mm in two contiguous leads.
Coronary Angiography Results

Coronary angiographic results showing that 1 of every 4 resuscitated patients without ST-segment elevation has an acute culprit lesion found at early coronary angiography.
Clinical paper

Strong and weak aspects of an established post-resuscitation treatment protocol—A five-year observational study

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\textbf{ARTICLE INFO}

\textbf{Article history:}
Received 21 March 2011
Received in revised form 17 April 2011
Accepted 6 May 2011

\textbf{Keywords:}
Cardiac arrest
Post-resuscitation period
Therapeutic hypothermia
Myocardial revascularization
Myocardial infarction
Neurological injury

\textbf{ABSTRACT}

\textbf{Aim of study:} Favourable hospital survival increased from 26% to 56% in the implementation phase of a new standard operating procedure (SOP) for treatment after out-of-hospital cardiac arrest (OHCA) in 2003. We now evaluate protocol adherence and survival rates after five years with this established SOP.

\textbf{Methods:} This observational study is based on prospectively collected registry data from all OHCA patients with cardiac arrest admitted with spontaneous circulation to Ullevål Hospital between September 2003 and January 2009. Three patient categories are described based on early assessment in the emergency department: conscious, comatose, and comatose patients receiving only palliative care, with main focus on comatose patients receiving active treatment.

\textbf{Results:} Of 248 patients, 22% were consciousness on admission, 70% were comatose and received active treatment, while 8% received only palliative care. Favourable survival from admittance to discharge remained at 56% throughout the study period. Among actively treated patients 83% received emergency coronary angiography and 48% underwent subsequent percutaneous coronary intervention. In this cohort 63% had an acute myocardial infarction, ten of whom did not receive emergency coronary angiography. Among actively treated comatose patients, 6% survived with unfavourable neurology, while 51% of the deaths followed treatment withdrawal after prognostication of severe brain injury.

\textbf{Conclusion:} The previously reported doubling in survival rate remained throughout a five-year study period. Establishing reliable indication for emergency coronary angiography and interventions and validating prognostication rules in the hypothermia era are important challenges for future studies.

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Five Year Observational Study - Norway

• Noted a historical post-resuscitation survival rate of only 26% in 2003.
• Instituted a standardized post-resuscitation program that mandated use of mild hypothermia (32 to 34 degree C) + early cardiac catheterization w/percutaneous intervention for appropriate coronary lesions.
Study Findings

- After several years with new protocol their initial survival rate for those initially resuscitated + admitted to the hospital rose to 56%.
- Greater than 90% of those who survived had normal cognitive function.
- From 2003 to 2009 – 248 patients: survival to hospital discharge was 61% of those initially resuscitated w/93% of survivors having favorable neurological outcome at discharge.

1-year survival improved from 26% to 56% in the first few years after instituting a formal standard operating procedure for post-resuscitation care, including emphasis on therapeutic hypothermia and early coronary angiography for possible percutaneous coronary intervention. Continued use of this new standard operating procedure resulted in a persistent 1-year survival rate of 56% for 6 consecutive years.
Optimal Treatment of Patients Surviving Out-of-Hospital Cardiac Arrest

Karl B. Kern, MD

Tucson, Arizona

Interest in post-resuscitation care has risen with the development of treatment modalities that can affect long-term survival rates even when begun after the systematic ischemia/reperfusion insult associated with cardiac arrest. Mild therapeutic hypothermia has become the foundation for improvement of neurologically favorable survival after cardiac arrest. Reperfusion therapy, specifically early percutaneous coronary intervention, is becoming an important adjunct to therapeutic hypothermia. Identifying which post–cardiac arrest patient had an occluded or unstable coronary vessel is difficult because such events are not reliably predicted by precedent symptoms or standard electrocardiographic analysis. Increasing clinical experience suggests that resuscitated cardiac arrest victims without an obvious non-cardiac etiology should undergo emergency coronary angiography and, where indicated, percutaneous coronary intervention. If comatose, they should receive concurrent therapeutic hypothermia. Such an approach can double long-term survival rates among those successfully resuscitated after out-of-hospital cardiac arrest. (J Am Coll Cardiol Intv 2012;5:597–605) © 2012 by the American College of Cardiology Foundation
Parisian Region Out of Hospital Cardiac Arrest Registry- 12/03-12/08

Figure 2. Survival rates according to the performance and outcome of PCI. ns indicates not significant.
The Question....

• Is finding 1 acute culprit coronary lesion out of every 3 to 4 patients taken emergently to the cath lab enough to submit all to emergent coronary angiography?
• The ‘number needed to treat’ is, in fact, just 4 patients.
• Anyone successfully resuscitated from OHA thought cardiac in etiology should undergo emergent coronary angiography regardless of the post-resuscitation EKG findings.
Out of Hospital Cardiac Arrest
Chain of Survival
What is Our Community Doing?

• In our community, currently 51% of patients with a witnessed arrest get lay CPR
• Community education of hands-only CPR with a goal to improve these rates
Chest Compression Only CPR

Gordon Ewy, MD Circulation 2005;1111-2134-2142
Outcome Findings

Comparison of Outcome During a Simulated Single Lay Rescuer Scenario of Out-of-Hospital Ventricular Fibrillation Cardiac Arrest

24-Hour Neurological Normal Survival (percent)

- CCC CPR: 73%
- Standard CPR: 13%

P < 0.003

Gordon Ewy, MD Circulation 2005;1111-2134-2142
Cardiocerebral resuscitation (EMS) Revised Pre-hospital ACLS protocol

- Delays endotracheal intubation in favor of uninterrupted chest compression.
- Encourages near continuous chest compression before and after each single shock.
- Encourages early administration of epinephrine.
- Initiation of mild hypothermia in the field with return of spontaneous circulation.
Program Coordinator:  Josh Moore

Paramedic/Firefighter

Eugene Fire & EMS
Public Education Campaign

PSA on Radio, TV, Internet, LTD Buses and Social Media.

Public Hands-Only Compression CPR Training.

- 300+ Volunteers from local NHS & FSL Chapters.
- AHA/Laerdal CPR Anytime Kits. Reusable. 10min. Portable.
- Bilingual Format (English & Spanish)
- 7th Grade school children and 5 of their family members.
- Community Groups: OTC, Girl Scouts, Centro Latino Americano, Faith Groups, Care Facilities.
Sudden Cardiac Death

- Claims the lives of est. 300,000 Americans each year
- 21 out-of-hospital cardiac arrests are responded to by EMS with a shockable rhythm per 100,000 population per year
- If chest compression only CPR and other aspects of cardiocerebral resuscitation were implemented—estimated 58,000 lives saved/yr in the United States alone.

To be successful, we need interconnected community, EMS and hospital response to out-of-hospital cardiac arrest, that is coherently organized, to improve processes and outcomes in a region.

Graham Nichol, MD, Circulation 2010: 121:709-729