Alive or Dead?*
*it’s not that easy

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Financial Disclosure
Michael Levy MD

- None
Objectives

• Rethink what we think we know about death
• Redefine the parameters for when we terminate a code
• Consider the impact of decisions for life and death and the basis for the decision
Case 1

- 91 year old with dementia, coronary artery disease, chronic congestive heart failure, renal failure and diminishing capacity

- Witnessed cardiac arrest with CPR, 1 AED shock and now PEA
Case 2

- 45 year old business man collapses at the health club. No known medical problems
- CPR delayed for 5 minutes
- AED shock given x2 then no shock advised
- You find PEA
Types of prolonged resuscitations

- Asystole
- PEA
- Recurrent VF/VT
- Trauma
Asystole: Environment for a Prolonged Resus?

- Picture of osborn waves
- Severe hypothermia
- LVAD?
Not always hopeless

- 46 patients w deep hypothermia and CA
- Cardiopulmonary bypass rewarming in 32
- 15 overall survivors
<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Sex/ Age (yr)</th>
<th>Cause of Hypothermia</th>
<th>Additional Injuries</th>
<th>Core Temperature before Rewarming (°C)</th>
<th>Neurologic Findings</th>
<th>Electroencephalography</th>
<th>Neurophysiologic Testing</th>
<th>MRI of Brain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F/24</td>
<td>Fall into crevasse and ice water</td>
<td>Injury of left brachial plexus during resuscitation</td>
<td>24.0 (E)</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>2</td>
<td>F/20</td>
<td>Exposure while bailing</td>
<td>—</td>
<td>24.4 (E)</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>3</td>
<td>F/41</td>
<td>Avalanche</td>
<td>Shoulder fracture</td>
<td>19.6 (E)</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>4</td>
<td>F/21</td>
<td>Exposure after slip and slide attempt</td>
<td>—</td>
<td>25.0 (E)</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>5</td>
<td>M/42</td>
<td>Fall into crevasse and ice water</td>
<td>Femur fracture</td>
<td>20.0 (E)</td>
<td>Normal</td>
<td>Borderline</td>
<td>10</td>
<td>Symmetry of left retrotemporal area</td>
</tr>
<tr>
<td>6</td>
<td>M/9</td>
<td>Fall into crevasse and ice water</td>
<td>—</td>
<td>21.0 (E)</td>
<td>Mild abnormalities of coordination and fine finger movements</td>
<td>Normal</td>
<td>Borderline</td>
<td>8-9</td>
</tr>
<tr>
<td>7</td>
<td>M/25</td>
<td>Fall into crevasse</td>
<td>Brochitis</td>
<td>17.5 (E)</td>
<td>Normal</td>
<td>Borderline</td>
<td>7-11</td>
<td>Slow waves in left frontotemporal area</td>
</tr>
<tr>
<td>8</td>
<td>F/22</td>
<td>Exposure after slip and slide attempt</td>
<td>—</td>
<td>22.0 (E)</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>9</td>
<td>M/28</td>
<td>Fall into crevasse</td>
<td>—</td>
<td>22.1 (E)</td>
<td>Dysesthesia of left foot, reflex asymmetry, no motor impairment</td>
<td>Normal</td>
<td>Borderline</td>
<td>7-8</td>
</tr>
<tr>
<td>10</td>
<td>M/13</td>
<td>Exposure after attempted murder</td>
<td>Brain injury, bilateral anterior subcortical syndrome</td>
<td>24.0 (E)</td>
<td>Borderline (mild ataxia)</td>
<td>Bilateral foot drop and appendage ataxia after anterior subcortical syndrome</td>
<td>Pathologic</td>
<td>9</td>
</tr>
<tr>
<td>11</td>
<td>M/17</td>
<td>Exposure after slip and slide attempt</td>
<td>Rib fractures</td>
<td>20.0 (E)</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>12</td>
<td>M/12</td>
<td>Fall into crevasse</td>
<td>Injury of left brachial plexus during resuscitation</td>
<td>17.1 (E)</td>
<td>Mild lesion of left brachial plexus with extension deficit of fingers due to injury during resuscitation</td>
<td>Borderline</td>
<td>7-8</td>
<td>Focal sharp waves, left temporal slowing</td>
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<tr>
<td>13</td>
<td>F/26</td>
<td>Exposure after slip and slide attempt</td>
<td>—</td>
<td>23.0 (E)</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>14</td>
<td>F/35</td>
<td>Exposure after slip and slide attempt</td>
<td>—</td>
<td>23.5 (E)</td>
<td>Preexisting hemidystonia syndrome on the right</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>15</td>
<td>F/35</td>
<td>Exposure after slip and slide attempt</td>
<td>—</td>
<td>—</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
</tbody>
</table>

*CNS denotes central nervous system, PNS peripheral nervous system, MRI magnetic resonance imaging, E esophageal, and R oral.

†Borderline results refer to abnormal findings without clinical relevance. Pathologic results refer to abnormal findings with clinical relevance. Pathologic neurologic and neuropsychological findings were not due to hypothermia. Patient 10 had a cerebral injury before hypothermia occurred, and Patient 14 had a pre-existing Brown-Sequard’s syndrome. Patient 12, who had pathologic findings on electroencephalography, did not have seizures.

‡These patients attempted suicide by ingestion with various substances and were exposed to cold after losing consciousness.

§Patient 4 refused to complete neuropsychological testing; however, on the basis of data obtained from the interview and the history there were no findings to indicate clinically significant cognitive impairment.

|| Patient 6 underwent testing with a neuropsychological battery for children.

Patient 7 had cerebellar atrophy that was presumably related to the hypothermia and calcification of the basal ganglia that was presumably unrelated to the hypothermia. Patient 10 had post-traumatic lesions of the right frontal and temporal lobes.

**Cognitive performance in this patient was evaluated on the basis of data obtained from the history and the interview, because there were neither test material nor test norms available in her native language of Swedish.
PEA: When to keep trying?

- Think of etiology for the PEA
- Ultrasound?
VF/VT: Prolonged Resus

• What causes this?
• Cardiomyopathy
• Coronary occlusion
What Causes SCA?

- CAD 80%
- 40-60% of pt’s first ACS symptom is SCA(1,2)
- What does refractory VF likely represent???

1. Framingham
2. Maastricht
SCA w Acute Coronary Occlusion

- Much more likely to be LAD or circumflex than RCA
- Proximal occlusions more risk than distal
- Proximal LAD occlusion higher risk than distal LAD or non-LAD lesions (RR 4.4 CI 1.95-8.38)

Effect of Coronary Occlusion Site on Angiographic and Clinical Outcome in Acute Myocardial Infarction Patients Treated With Early Coronary Intervention
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The Most Important Changes in the International ECC and CPR Guidelines 2000
Richard O. Cummins, MD; Mary Fran Hazinski, RN, MSNI

15. Death Pronouncement in the Field, Survivor Support Plans, the Futility of Transport of Patients Needing Continued CPR

There has been little evidence that EMS systems and Medical Control Emergency Departments in the United States have reacted to the large and consistently negative experience with transporting pulseless patients from the field to the Emergency Department. The survival rate of patients who fail to respond to effective ALS care in the field has never been improved by high-speed, potentially dangerous transportation to an Emergency Department. Researchers in Europe report the same dismal outcomes. Unless patients are suffering from rare, specific pathological conditions (eg, hypothermia, drug overdose), there are no in-hospital interventions that will successfully resuscitate patients who fail out-of-hospital efforts. High-speed transport of pulseless patients persists to a large extent because EMS personnel are uncomfortable with having to stop efforts in a victim’s home and, in effect, making such a public acknowledgment of failure. In addition, both family and personnel experience discomfort with leaving a body at the scene. The indignity, futility, and danger involved with these transports, however, must end, as it has in many countries.
Continuous mechanical chest compression during in-hospital cardiopulmonary resuscitation of patients with pulseless electrical activity.


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Abstract
Survival after in-hospital pulseless electrical activity (PEA) cardiac arrest is poor and has not changed during the last 10 years. Effective chest compressions may improve survival after PEA. We investigated whether a mechanical device (LUCAS™-CPR) can ensure chest compressions during cardiac arrest according to guidelines and without interruption during transport, diagnostic procedures and in the catheter laboratory.

METHODS: We studied mechanical chest compression in 28 patients with PEA (pulmonary embolism (PE) n=14; cardiogenic shock/acute myocardial infarction; n=9; severe hyperkalemia; n=2; sustained ventricular arrhythmias/electrical storm; n=3) in a university hospital setting.

RESULTS: During or immediately after CPR, 21 patients underwent coronary angiography and or pulmonary angiography. Successful return of spontaneous circulation (ROSC) was achieved in 27 out of the 28 patients. Ten patients died within the first hour and three patients died within 24h after CPR. A total of 14 patients survived and were discharged from hospital (13 without significant neurological deficit). Interestingly, six patients with PE did not have thrombolytic therapy due to contraindications. CT-angiography findings in these patients showed fragmentation of the thrombus suggesting thrombus breakdown as an additional effect of mechanical chest compressions. No patients exhibited any life-threatening device-related complications.

CONCLUSION: Continuous chest compression with an automatic mechanical device is feasible, safe, and might improve outcomes after in-hospital-resuscitation of PEA. Patients with PE may benefit from effective continuous chest compression, probably due to thrombus fragmentation and increased pulmonary artery blood flow.
• Alive or dead?
• Work or not?
• If worked, how long?
61 yo m awakes w CP

- Awoke w L arm numbness. CP w ambulation. Progressively worse. No PMH
- EKG: No STEMI on #1
- NTG,ASA: pain improves. Transport
- During: Pain, anxiety, no response to ntg.
- 12 lead now STEMI
61 yo m awakes w CP (cont)

- Cardiac Arrest
- Shock to ROSC, back to VF, Shock to ROSC back to VF
- Arrives at hospital and shocked back to ROSC, then back to VF
61 yo m awakes w CP (cont)  

• Goes directly to cath: multiple episodes of VF on the way  
• Epi, amio and multiple defibs  
• LAD and diagonals opened
Outcome

- Survived with excellent outcome
- Question: if the ED had not taken ownership of him, would he have been taken to cath?
- Question: how many protocols would have had him stay at home if he had fibrillated at home?
“Double Sequential Defib”

Second Pad and Double Sequential External Defibrillation Protocol for shock resistant VF/VT

Shock-refractory ventricular fibrillation will be defined as failure to convert VF/VT (pulseless) after 3 full power defibrillation attempts.

**Indication for second pad location:**

- Any adult patient with persistent pulseless ventricular fibrillation/tachycardia that has been completely unresponsive to at least 3 debrillations (including AED uses)

**Indication for Double Sequential shock:**

- Any adult patient who after 5 shocks, 2 of which were from a different pad location, has at no time shown conversion to a non-VF/VT rhythm and after routine, full ACLS protocols have been provided

**Procedure for 2nd defib pad placement:**

- Apply second set of pads in a different location than the first to try to create a new direction of current through the chest (new shock vector) after the third unsuccessful shock.
- Pads may be placed adjacent to existing pads but should not touch.
- Prepare site by drying and taking steps to minimize interference to good pad adhesion.
- Assure that high quality CPR is not compromised

**Procedure for Double Sequential External Defibrillation**

1. Assure that high quality CPR is not compromised
2. Attach second defibrillator to patient
3. Lead paramedic or CMO will verify that both defibrillators are properly attached, pads are well adhered and will direct that both devices be charged to maximum joules.
4. After charging and with usual safety measures, one individual will discharge both defibrillators as synchronously as possible.
5. Perform very brief rhythm and pulse check and resume CPR as appropriate.
6. Continue resuscitation as indicated by rhythm. Repeat double shock may be used. Consider transport options versus contact with medical control.
7. Complete and FD-1 regarding the incident and forward to Medical Director
59 yo Sudden CP and SOB

- Recent flu symptoms, no other complaints. Went to room w blanket at 11:40am
- Family heard noise, pt leaning over bed w CP and SOB
- BLS: unconscious, slow irregular 50, breathing “slow but full”
- Laid back: CA:VF
59 yo “Flu”

- Defib 13x
- Autopulse, ITD, vasopressin, epinephrine, amiodarone, lidocaine, sodium bicarb
- Transport after 45 min on scene
- Hospital was 2:36 away
- Died
“Let’s call it, we aren’t doing her any favors at this point”
63 Yr Old F with “upset stomach”

Thanks to Marvin Wayne, MD
April 10 2011

• 4/10/11
• 63 yr old f “upset stomach” all day
• Now chest pain
• First EMS responders noted “sick patient”
• Seizure like activity, CA, CPR, ITD (impedance threshold device) AED x 2
• ALS and EMS supervisor now on scene
63 yr old female

- Pt woke with CPR went into PEA, iced saline started
- LUCAS® device applied, sedated to Intubate
- Awake with CPR (LUCAS) “dead” without
- To ED with device, brief pulse -> EKG
- To Cath Lab with LUCAS on
- Pulses returned in Cath Lab post stent
Acute LAD Occlusion
63 yr old female

- Cath -> Total LAD occlusion
- Pulse, BP, post Cath
- Therapeutic hypothermia stopped in ICU
It all came together

• Rapid recognition CPR & AED by first responders
• Mechanical CPR with pt awakening with, dying without
• Transport with ongoing mechanical CPR to ED/Cath Lab (total CPR time 47min)
• DTB time 28 min
Prolonged VF Arrest

- 60 yo F witnessed arrest at elementary school
- Bystander CPR
- Police Arrive with AED: CPR and 2 shocks
- EMS 1st-in: CPR and defib and Mechanical Compression
Prolonged VF Arrest

- Routine ACLS
- 8 shocks + AED
- 2 “double defibs”
- Pt converts after 2nd “double defib”
- PEA: pulse/pulse lost
- Compression device running when brought into ED
Prolonged VF (cont)

- Cooling initiated
- Pulse maintained in ED
- EKG
- Cath lab
- Occlusion of Left Main (!) and LAD
Outcome

• ICU and coma
• Purposeful movement
• Up and drinking beverage in ICU
• Communicating fluently
66 yo Male w Difficulty Breathing

• BLS at pt: 8 min, ALS at patient 9 min 30sec
• Code 99 called: pt was talking to AFD and AFD BLS and collapsed, CPR started immediately
• PEA 40’s
• Lucas, IO, epi
• ROSC in and out
66 yo male (cont)

• Epi, Lucas, sodium bicarb
• Intermittent effective respirations
• EKG suggested AWMI (acute)
• At hospital cardiologist took pt directly to cath lab with device running
66 yo male (cont)

- Lucas I used in cath lab; AFD crews exchange 5 bottles of compressed air during procedures
- Angio: no occlusion of coronaries
- Evidence of PE
- Catheter placed through clot
Causes of Cardiac Arrest

- Perhaps 50% due to coronary occlusion
- 50% due to other causes
- Is recurrent/refractory VF a declaration of coronary occlusion
SCA w Acute Coronary Occlusion

- Much more likely to be LAD or circumflex than RCA
- Proximal occlusions more risk than distal
- Proximal LAD occlusion higher risk than distal LAD or non-LAD lesions (RR 4.4 CI 1.95-8.38)

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Are we missing a new group of “saves”?

• Refractory VF is a low probability for prehospital save but a potential PCI save?

• How to build buy-in for PCI in this seemingly desperate situation?
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Stay and Play

- AHA: work the patient to pulse or death
- Valid argument: compressions in a moving ambulance?
- Still the best option?
CPR Report

Device Type: LIFEPAK 15
Power On: 2/8/2012 2:41:26 PM
CPR Annotations Edited: No
Device Configuration: 05JL5ROK02B9OR
Duration: 00:45:56
Incident ID: 2012020814412500-LP157846
Statistical Parameters: 1000-0300-3000-05

*Times have been adjusted by the system*

CPR Ratio (total time)

Prompted CPR Ratio (AED-prompted CPR time)

Compressions Ratio (total time)

Prompted Compressions Ratio (AED-prompted CPR time)

38:29 / 39:53 = 96% Compression Rate

Compressions/minute

37:15 / 39:53 = 93% Ventilation Rate

Ventilations/minute

102/minute

96/minute

--
Ready for prime time?

• Early transport of PEA and VF prior to ROSC (and)
• Resuscitation centers
• Early effective cooling
• Reevaluation of drugs and cocktails
• Lower barrier to PCI
What does seem to be working?

• Bystander CPR, Dispatch CPR, Quality CPR
• Early Defibrillation
• Cooling
• PCI for STEMI w SCA
Key Unknowns

- Adequacy of intensive care
- Therapeutic hypothermia: metric for time to temp, rewarming
- Reflow injury
- Evidence-based termination of care
Key Unknowns

- Shock timing
- Waveform
- Shock early shock late
- Compression devices
- Airway: types
- Ventilation parameters
It Takes a System of Care
List all evidence-based research on TOR

- Trauma
- Medical
Upon what do you base your conclusion that they are “better off”?
Compliments to Lance Becker MD
Summary

• Medicine requires a periodic reassessment of “obvious truths”
• Some assessments are anecdotes, some have support from scientific method
• New technology can change obvious truths
• Change can be hard to accept
• This kind of change requires a system of care