In-Hospital Cardiac Arrest: Measuring Effectiveness and Improving Outcomes

J. Matthew Aldrich, MD
Anesthesia & Critical Care
UCSF

Disclosures

• Research support from UCOP CHQI award

Overview

• Epidemiology of in-hospital cardiac arrest (IHCA)
  – Definitions
  – Outcomes
• Guidelines
• New approaches to IHCA

Cardiopulmonary Arrest: Quality Measures

• Incidence
• Outcomes
  – Immediate survival
  – Survival to discharge
  – Survival to discharge with good neurological outcome
• Process measures
Definitions

- Lots of variability
  - Ten different definitions for IHCA

- What’s a “Code”? 
  - Activation of emergency team?
  - Chest compression and/or defibrillation?
  - Billing codes?


More definitions

- Immediate survival or “survived event”: sustained return of spontaneous circulation for > 20 minutes

- Survival to discharge 
  - Generally, the gold standard
  - Helpful to also track functional outcomes (cerebral performance category or Mod Rankin score)

Utstein definition of cardiac arrest: “cessation of cardiac mechanical activity confirmed by the absence of a detectable pulse, unresponsiveness, and apnea (or agonal respirations).

In reality, (at least at UCSF): chest compressions or defibrillation

Jacobs et al. Resuscitation 2014
Incidence

- Limited data
- ~200,000 IHCA annually in the US
- Based on both single institution and registry data, ~1-5/1000 hospitalized adults will experience a cardiac arrest
- Incidence appears to be increasing

Practical issues with determining incidence and outcomes

- Finding the "event"
  - Pager logs, code records, IRs, billing codes, etc.
- Determine the outcomes
- Know the institutional DNAR rate
  - Before and after CPR
  - DNAR decisions after IHCA can dramatically impact survival statistics

IHCA Outcomes
Poor outcomes

• Survival to discharge remains poor for IHCA
• Registry based study outcomes
  – Nadkarni et al. JAMA 2006: 18%
  – Girotra et al. NEJM 2012: 17%
  – Goldberger et al. Lancet 2012: 15.4%
• Medicare data
  – Ehlenbach et al. NEJM 2009: 18.3%

Factors associated with worse outcomes

• Rhythm: PEA, asystole
• Race: black and other non-white patients
• Time of day: nights and weekends
• Time to defibrillation: delay > 2 minutes
• Vasopressor use prior to arrest

Rhythms and outcomes of adult in-hospital cardiac arrest

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>ROSC</th>
<th>Survival to Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT</td>
<td>67.5%</td>
<td>36.9%</td>
</tr>
<tr>
<td>VF</td>
<td>62.6%</td>
<td>37.3%</td>
</tr>
<tr>
<td>PEA</td>
<td>45.2%</td>
<td>11.9%</td>
</tr>
<tr>
<td>Asystole</td>
<td>39.6%</td>
<td>10.8%</td>
</tr>
</tbody>
</table>

Meaney et al. CCM 2010

First Documented Rhythm and Clinical Outcome From In-Hospital Cardiac Arrest Among Children and Adults

<table>
<thead>
<tr>
<th>Rhythm</th>
<th>ROSC</th>
<th>Survival to Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT/VF</td>
<td>62%</td>
<td>36%</td>
</tr>
<tr>
<td>PEA</td>
<td>42.9%</td>
<td>11.2%</td>
</tr>
<tr>
<td>Asystole</td>
<td>38.4%</td>
<td>10.6%</td>
</tr>
</tbody>
</table>

Nadkarni et al. JAMA 2006
Race and Outcomes

Ehlenbach et al. NEJM 2009

Nights & Weekends

Peberdy et al. JAMA 2008

Time to Defibrillation is Critical

Chan et al. NEJM 2008

Outcomes of Critically Ill Patients Who Received Cardiopulmonary Resuscitation

Chan et al. AJRCCM 2010

- NRCPR data from 2000-2008
- Overall survival to discharge: 15.9%
- Odds of survival 55% lower in patients taking pressors (OR 0.45, CI 0.42-0.48)
- Pressor (s) + MV = 7.6% survival to discharge
- Only 3.3% of patients having a CPA despite pressors discharged home with good neurologic outcome
A little hope?

Process Measures

- CPR performance
  - Time to compressions
  - Time to defibrillation
  - Interruptions in compressions
  - Compression depth and frequency
- Postarrest care

What, if anything, can be done to improve outcomes?

Training & Quality Improvement

- Certification in advanced resuscitation techniques
  - AHA: BLS and ACLS (2010)
- Quality Improvement at the institutional level
  - Device data
  - Post code debriefing
Criticisms of ACLS

- Not specific to IHCA
- ACLS trainers often unaware of particular hospital concerns
- Training is removed from inpatient environments
- Trainer-trainee “mismatch”
Alternate Approaches

Advanced Resuscitation Training

- UCSD program
- Currently, the focus of a UCOP CHQI grant that includes
  - UCSD, UCSF, UCLA, UCD, UCI
- Resuscitation management program that builds the framework for a “culture of resuscitation”

Specifics of ART

- CQI
- Enhanced training focused on provider- and unit-specific tasks
- Novel treatment algorithms
- Focus on early recognition

ART Outcomes

UCSD Center for Resuscitation Science
AHA’s new focus on IHCA

Key Points

- Acknowledges differences between OHCA and IHCA
- Comprehensive focus on:
  - Reporting
  - Planning
  - Best practices

Best Practices: Prearrest

- Equipment
- Code Teams
- Code team training
- Early recognition and intervention
  - Rapid Response
  - Early warning systems
    - MEWS
    - DNAR orders
Rapid Response Teams

• Implemented to improve recognition and response
  – Goal 16 of TJC’s 2009 NPSG
  – Key strategy of IHI’s 100,000 Lives Campaign
• Mixed results
• Variability in team design and mission makes research challenging

Key RRT studies

• Hillman et al. (MERIT study) *Lancet* 2005
  – No change in composite outcome
• Priestley et al. *ICM* 2004
  – Reduced in-hospital mortality
• Chan et al. *Arch Int Med* 2010
  – Meta-analysis of 18 studies
  – Reduced out-of-ICU cardiac arrest but no reduction in hospital mortality

Best Practices: Intra-arrest

• Structural aspects
  – Mechanical devices, AEDs
• Care pathways
  – Minimize interruptions in compressions, optimize depth, avoid hyperventilation, provide early defibrillation
• Process issues
  – Use real-time feedback
Best Practices: Post-arrest

- Goal-directed mild therapeutic hypothermia*
- Coronary reperfusion
  - All patients with new LBBB or ST elevation should have emergent angiography
- Seizure monitoring
- Hemodynamic optimization
- Prognostication

Public reporting

- Many hospitals and physicians reluctant to publicly report “poor” outcomes
- Must have standardized approach to tracking incidence and mortality rates
- Need measurement tools that adjust for severity of illness

Conclusions

- No clear improvement in outcomes
- Need to focus on IHCA as its own entity
- Best hope likely exists in better reporting, training, and quality improvement efforts focusing on the “chain of survival”