Long-term outcomes in elderly survivors of myocardial infarction with and without out-of-hospital cardiac arrest

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Disclosures

• Presenting author has no relevant conflicts to disclose

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Background

• Over 400,000 people experience out-of-hospital cardiac arrest (OHCA) in the U.S. annually
• OHCA incidence increases with age
• 70% of OHCA due to underlying CAD
  – OHCA occurs in 5 to 8% of MI patients
• Care of OHCA patients is costly

Go, Circulation 2014
Becker, NEJM 1993
Straus, J Clin Epi 2004
Damluji, Circ Cardiovasc Qual Outcomes 2015
Older patients with OHCA: prognosis?

• Generally, poor
  – Conflicting and limited evidence
  – Small, single center studies with highly selected populations and short-term follow-up

• Underrepresented population
  – RCTs showing benefit of TH: younger patients or elderly excluded

Arrich, Resuscitation 2009
Bunch, Crit Care Med 2004
Pleskot, Crit Care Med 2014

Bernard, NEJM 2002
HACA Group, NEJM 2002
Nielsen, NEJM 2013
Aims

Among older MI survivors ± OHCA:

1. Compare 1-year mortality post-hospital discharge

2. Compare composite of 1-year mortality or all-cause readmission

3. Compare days alive out-of-hospital (DAOH) within 1 year
ACTION-CMS data linkage

Patients admitted with myocardial infarction

In-hospital outcomes

Patients ≥ 65 yrs

Vital statistics

Health care utilization

Probabilistic matching: DOB, sex, hospital identifier, date of admission/discharge

Patients ≥ 65 years old
Admitted with myocardial infarction
Followed for 1-year post discharge
Vital statistics, health care utilization
Statistical methods

• Multivariable selection
  – 28 covariates were selected by clinical expert judgment and literature review

• 1-year mortality or all-cause readmission post-discharge
  – Kaplan-Meier method
  – Analyzed using multivariable Cox models

• Investigate OHCA and days alive and out of hospital (DAOH) at 1-year
  – Multivariable logistic generalized estimating equations method
Patient flow chart

Starting Population
65,354 patients with MI ≥ 65 years old admitted to 547 ACTION Registry-GWTG hospitals linked to CMS data April 2011 to December 2012

Excluded for all analyses
- 4,353 died in-hospital
  - 44.4% with OHCA
  - 5.9% without OHCA
- 2,308 transferred out of ACTION hospitals
- 341 experienced an outside facility OHCA
- 357 had missing OHCA field
- 2,135 non-index admissions

Analysis Population
54,860 patients surviving to discharge from 545 sites

54,219 patients (98.8%) without OHCA
641 patients (1.2%) with OHCA

Excluded for outcomes analyses*
1,444 patients discharged to hospice
Baseline clinical characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall (n=54,860)</th>
<th>With OHCA (n=641)</th>
<th>Without OHCA (n=54,219)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>76 (70, 83)</td>
<td>73 (68, 79)</td>
<td>76 (70, 83)</td>
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<tr>
<td>Male</td>
<td>56.0</td>
<td>68.6</td>
<td>55.8</td>
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<tr>
<td>Non-white race</td>
<td>12.9</td>
<td>13.9</td>
<td>12.9</td>
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<tr>
<td>Current/recent smoker (&lt;1 year)</td>
<td>15.9</td>
<td>20.4</td>
<td>15.8</td>
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<tr>
<td>Hypertension</td>
<td>82.5</td>
<td>76.4</td>
<td>82.6</td>
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<tr>
<td>Dyslipidemia</td>
<td>67.6</td>
<td>64.3</td>
<td>67.6</td>
</tr>
<tr>
<td>Currently on dialysis</td>
<td>2.7</td>
<td>3.3</td>
<td>2.7</td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>18.5</td>
<td>14.4</td>
<td>18.5</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>35.8</td>
<td>28.7</td>
<td>35.9</td>
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<tr>
<td>Prior MI</td>
<td>27.1</td>
<td>25.3</td>
<td>27.1</td>
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<tr>
<td>Prior HF</td>
<td>17.6</td>
<td>13.7</td>
<td>17.7</td>
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<tr>
<td>Prior PCI</td>
<td>26.4</td>
<td>20.0</td>
<td>26.4</td>
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<tr>
<td>Prior CABG</td>
<td>19.9</td>
<td>15.6</td>
<td>19.9</td>
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<tr>
<td>Prior stroke</td>
<td>11.2</td>
<td>11.2</td>
<td>10.5</td>
</tr>
<tr>
<td>AF or a-flutter (past 2 weeks)</td>
<td>12.2</td>
<td>15.6</td>
<td>12.2</td>
</tr>
<tr>
<td>Peripheral arterial disease</td>
<td>13.7</td>
<td>10.8</td>
<td>13.8</td>
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<tr>
<td>STEMI diagnosis</td>
<td>30.0</td>
<td>63.2</td>
<td>29.6</td>
</tr>
<tr>
<td>HF</td>
<td>19.0</td>
<td>20.3</td>
<td>19.0</td>
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<tr>
<td>Cardiogenic shock</td>
<td>2.5</td>
<td>29.0</td>
<td>2.2</td>
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</table>
In-hospital clinical events in survivors

P < .001 for all comparisons

<table>
<thead>
<tr>
<th>Condition</th>
<th>With OHCA</th>
<th>Without OHCA</th>
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</thead>
<tbody>
<tr>
<td>Cardiogenic shock</td>
<td>12.6</td>
<td>2.8</td>
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<td>CHF</td>
<td>13.4</td>
<td>6.6</td>
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<tr>
<td>Cardiac arrest</td>
<td>10.9</td>
<td>1.4</td>
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<td>Major bleeding</td>
<td>29.6</td>
<td>8.6</td>
</tr>
<tr>
<td>RBC transfusion</td>
<td>19</td>
<td>12</td>
</tr>
</tbody>
</table>

%
Discharge disposition

With OHCA
- Home: 64%
- Skilled nursing facility: 29%
- Hospice: 8.3%

Without OHCA
- Home: 83.4%
- Skilled nursing facility: 15.9%

$P < .001$
1-year mortality post-discharge

Outcomes consistent between subgroups
Age
STEMI vs NSTEMI
LVEF

Adjusted HR (With OHCA)
0.88, 95% CI, 0.67 – 1.12

Probability of mortality

Days since discharge

p=0.17
1-year mortality or all-cause readmission post-discharge

Adjusted HR (With OHCA) 0.83, 95% CI, 0.71 – 0.96

Outcomes consistent between subgroups
Age
STEMI vs NSTEMI
LVEF
Days alive and out of hospital (DAOH)

Adjusted OR (With OHCA) 1.41, 95% CI: 1.03 – 1.93

Without OHCA  With OHCA

Ariti, AHJ 2011
Bagai, AHJ 2013
Limitations

• **ACTION**: voluntary registry with only MI

• Applies to patients ≥ 65 years old

• No information on pre-hospital care
Conclusions

• Compared to patients without OHCA, older MI survivors complicated by OHCA have:
  – Similar 1-year survival
  – Lower rates of healthcare utilization (readmission and DAOH) at 1 year
Implications

• Excellent prognosis of OHCA patients following discharge: Counterintuitive
• Supports efforts to improve survival to discharge
  – Focus on pre- and intra-hospital processes of care
• Informs patients, families, and clinicians of expected post-discharge prognosis
Acknowledgments

• Co-authors
  – Duke
    • Tracy Wang, MD, MHS, MS
    • Anita Chen, MS
    • Laine Thomas PhD
    • Christopher Granger MD
    • Carolina Hansen, MD
    • Kristian Kragholm, MD
    • Eric Peterson, MD, MPH
    • Monique L. Anderson, MD
  – Brigham and Women's Hospital
    • Benjamin Scirica, MD
  – Cedars-Sinai Medical Center
    • Timothy Henry, MD
  – University of British Columbia
    • Graham Wong, MD, MPH
    • Krisnan Ramanthan, MB, ChB

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  – UBC Clinician Investigator Program
  – UBC & VGH Hospital Foundation
Backup slides
In-hospital costs of OHCA patients

- Resuscitation
- TTM
- Intensive care
- Mechanical circulatory support
- Coronary angiography +/- PCI +/- CABG
- Rehabilitation

Damluji, Circ Cardiovasc Qual Outcomes 2015
Older OHCA patients: Long-term prognosis post-discharge?

Kern, JACC Cardiovasc Interv 2012

![Graph showing patient outcomes over time](image-url)
<table>
<thead>
<tr>
<th>Variable (%)</th>
<th>Overall (n=54,860)</th>
<th>With OHCA (n=641)</th>
<th>Without OHCA (n=54,219)</th>
<th>p-value</th>
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<tr>
<td><strong>Lifestyle</strong></td>
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<tr>
<td>Cardiac rehabilitation</td>
<td>77.4</td>
<td>84.9</td>
<td>77.3</td>
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<td>Smoking cessation counseling</td>
<td>97.7</td>
<td>97.5</td>
<td>97.7</td>
<td>0.73</td>
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<tr>
<td>Diet modification counseling</td>
<td>94.4</td>
<td>95.2</td>
<td>94.4</td>
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<tr>
<td>Exercise counseling</td>
<td>85.1</td>
<td>86.9</td>
<td>85.1</td>
<td>0.25</td>
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<tr>
<td><strong>Medications</strong></td>
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<tr>
<td>Aspirin</td>
<td>97.8</td>
<td>96.8</td>
<td>97.8</td>
<td>0.14</td>
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<tr>
<td>Clopidogrel</td>
<td>67.3</td>
<td>67.8</td>
<td>67.3</td>
<td>0.86</td>
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<td>Prasugrel</td>
<td>9.7</td>
<td>11.4</td>
<td>9.6</td>
<td>0.17</td>
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<td>Beta blocker</td>
<td>96.6</td>
<td>97.7</td>
<td>96.6</td>
<td>0.12</td>
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<tr>
<td>ACE-I</td>
<td>60.2</td>
<td>68.2</td>
<td>60.2</td>
<td>&lt; 0.001</td>
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<td>ARB</td>
<td>15.3</td>
<td>12.5</td>
<td>15.4</td>
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<td>Aldosterone antagonist</td>
<td>4.8</td>
<td>9.4</td>
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<td>&lt;0.001</td>
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<td>Statin</td>
<td>92.6</td>
<td>93.7</td>
<td>92.6</td>
<td>0.29</td>
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</table>
Covariates for mortality model

• Baseline demographic
  – Age (year), sex, race, weight (kg), current/recent smoking status, diabetes mellitus, dyslipidemia, prior CABG, prior HF, prior stroke, prior atrial fibrillation or flutter, prior peripheral artery disease, initial systolic blood pressure (mmHg), initial heart rate (beats per minute), HF and cardiogenic shock on 1st medical contact, initial hemoglobin (g/dL), hospital transferred in from another acute care facility

• In-hospital events
  – Peak serum creatinine (mg/dL), in-hospital measured left ventricular ejection fraction (LVEF), in-hospital PCI, in-hospital CABG, in-hospital shock, in-hospital HF, in-hospital major bleeding

• Discharge interventions
  – Cardiac rehabilitation referral on discharge, discharge statin, discharge angiotensin-converting enzyme inhibitor or angiotensin receptor blocker, discharge beta-blocker,