Mechanical CPR

Better CPR or Attractive Nuisance?

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Medical Director Anchorage Fire Dept
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Conflicts

- No conflicts for this talk
- I have received honorarium in past for review of monitor defibrillator data for Physio-Control Corp
Known Knowns

- Humans perform CPR poorly, guidelines not met
- Machines are made to meet guidelines
- Machines reliably provide good circulation
- More can be done with less people
- Transport with CPR can be done safely and effectively
- CPR can be done in challenging environments
Thoughts

- Do great ideas from the bench always translate to the field?

- Do the current Randomized Controlled Trials on mechanical CPR guide us on whether the technology works?

- What is best practice in the use of piston powered compression devices?
Thank you for your attention

...a couple of details
Randomized Controlled Trials

4 Trials enrolling ~ 12,000 patients
Different methods, Different end points

Slide compliments of Tom Rea MD
### Piston CPR

#### Hospital Discharge / 30 Day

<table>
<thead>
<tr>
<th></th>
<th>Manual Alone</th>
<th>Manual + Piston CPR</th>
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</thead>
<tbody>
<tr>
<td>LINC Trial</td>
<td>9.2%</td>
<td>9.0%</td>
</tr>
<tr>
<td>PARAMEDIC</td>
<td>6.2%</td>
<td>6.8%</td>
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</table>

Differences were not statistically significant.

2 Trials enrolling ~7000 patients

Slide compliments of Tom Rea MD
Mechanical CPR Devices: Increased Risk of Harm without Benefits

Joseph Tennyson, MD
Mechnanical CPR Devices Tied to Worse Outcomes
CORRESPONDENCE

Association of Mechanical Cardiopulmonary Resuscitation Device Use With Cardiac Arrest Outcomes
A Population-Based Study Using the CARES Registry (Cardiac Arrest Registry to Enhance Survival)

David G. Buckler, Rita V. Burke, Maryam Y. Naim, Andrew MacPherson, Richard N. Bradley, Benjamin S. Abella, Joseph W. Rossano and For the CARES Surveillance Group

DOI https://doi.org/10.1161/CIRCULATIONAHA.116.026053
Circulation. 2016;134:2131-2133
Originally published December 19, 2016
Cares Registry

• Key finding (per Dr Rossano) is that “minority of agencies used these devices and that the use of the devices was associated with (worse) neurologically favorable survivable at discharge”
Other points

- mCPR: more likely to have unwitnessed arrest, airway placement, AED placement, ITD and prehospital cooling

- Analysis was performed with those having ROSC before ALS provided excluded and overall good neurological outcome was less with mCPR (5.9% v 4.6%)

- No difference in outcome between mCPR and CPR was found in agencies using mCPR in 50-75% of cases and >75% of cases.
Axiom 1

Measure

Improve
Mechanical chest compressions improved aspects of CPR in the LINC trial.

Esibov A¹, Banville J², Chapman FW², Boomars R³, Box M⁴, Rubertsson S⁵.

Author information

Abstract

AIM: We studied resuscitation process metrics in patients with out-of-hospital cardiac arrest enrolled in a randomized trial comparing one protocol designed to best use a mechanical CPR device, with another based on the 2005 European Resuscitation Council guidelines for manual CPR.

METHODS: We analyzed clinical data, ECG signals, and transthoracic impedance signals for a subset of the patients in the LUCAS in Cardiac Arr (LINC) trial, including 124 patients randomized to mechanical and 82 to manual CPR. Chest compression fraction (CCF) was defined as the fraction time during cardiac arrest that chest compressions were administered.

RESULTS: Patients in the mechanical CPR group had a higher CCF than those in the manual CPR group [0.84 (0.78, 0.91) vs. 0.79 (0.70, 0.86), p<0.001]. The median duration of their pauses for defibrillation was also shorter [0s (0, 6.0) vs. 10.0s (7.0, 14.3), p<0.001]. Compressions were interrupted for a median of 36.0s to apply the compression device. There was no difference between groups in duration of the longest pause in compressions [32.5s vs. 26.0s, p=0.24], number of compressions received per minute [86.5 vs. 88.3, p=0.47], defibrillation success rate [73.2% vs 81.0%, p=0.15], or refibrillation rate [74% vs. 77%, p=0.79].

CONCLUSIONS: A protocol using mechanical chest compression devices reduced interruptions in chest compressions, and enabled defibrillation during ongoing compressions, without adversely affecting other resuscitation process metrics. Future emphasis on optimizing device deployment r be beneficial.

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KEYWORDS: Cardiopulmonary resuscitation (CPR); Chest compression fraction; Defibrillation; Mechanical CPR; Out-of-hospital cardiac arrest (OHCA); Perishock pause
<table>
<thead>
<tr>
<th></th>
<th>Mechanical</th>
<th>Manual</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>CCF</td>
<td>0.84 (0.78, 0.91)</td>
<td>0.79 (0.70, 0.86)</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Pause for Defib(median)</td>
<td>0s (0, 6.0)</td>
<td>10.0s (7.0, 14.3)</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Application</td>
<td>36s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longest pause</td>
<td>32.5</td>
<td>26</td>
<td>p=.24</td>
</tr>
<tr>
<td>CPM</td>
<td>86.5</td>
<td>88.3</td>
<td>p=.47</td>
</tr>
<tr>
<td>Defib Success</td>
<td>73.2%</td>
<td>81%</td>
<td>p=.15</td>
</tr>
<tr>
<td>Re-Fib</td>
<td>74%</td>
<td>77%</td>
<td>p=.79</td>
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**Mechanical chest compressions improved aspects of CPR in the LINC trial.**

Esibov A1, Banville l2, Chapman FW2, Boomars R3, Box M4, Rubertsson S5.
Esibov Study

- Mean time to application was 36 sec
Yost, et al., Assessment of CPR interruptions from transthoracic impedance use of the LUCAS mechanical compression system, in press

Michael Levy MD 2015
Conclusions—In patients with cardiac arrest presenting in a shockable rhythm, longer perishock and preshock pauses were independently associated with a decrease in survival to hospital discharge. The impact of preshock pause on survival suggests that refinement of automatic defibrillator software and paramedic education to minimize preshock pause delays may have a significant impact on survival.

Arrest

Sheldon Cheskes, MD; Robert H. Schmicker, MS; Jim Christenson, MD; David D. Salcido, MPH; Tom Rea, MD; Judy Powell, RN; Dana P. Edelson, MD; Rebecca Sell, MD; Susanne May, PhD; James J. Menegazzi, PhD; Lois Van Ottingham, RN, BSN; Michele Olsufka, BSN; Sarah Pennington, RN; Jacob Simonini, ACP; Robert A. Berg, MD; Ian Stiell, MD, MSc; Ahamed Idris, MD; Blair Bigham, MSc; Laurie Morrison, MD, MSc on behalf of the Resuscitation Outcomes Consortium (ROC) Investigators
AFD Changes in Protocol

- All CPR is manual to start
- Mechanical device is NEVER placed until after the second round of CPR is completed
- Mechanical device is ALWAYS placed in two steps
  - Backplate when convenient in first two cycles
  - Compression tower while CPR is ongoing
- Device immediately removed and manual resumed if any failure
Anchorage mCPR

- 78% of cardiac arrest of presumed cardiac etiology
- Survival shockable (PCE) mCPR 28.85%, CPR 25%
- Survival nonshockable (PCE) mCPR 2.3%, CPR .8%
- Survival (PCE) mCPR 9.9%, CPR 7.7%
Utstein Survival Report
Anchorage Fire Department
First Responder: Anchorage Fire Department | Service Date: Last Year

Resuscitations Attempted
240

Cardiac Etiology
177

Cardiac Etiology Survival Rates
Overall: 17.5% (177)
Bystander Wit’d: 32.5% (80)
Unwitnessed: 3.5% (86)
Utstein¹: 60.0% (40)
Utstein Bystander²: 63.9% (36)

Bystander Intervention Rates³
CPR: 84.7% (150)
AED Use: 1.3% (150)
Clinical Paper

A quality improvement initiative to optimize use of a mechanical chest compression device within a high-performance CPR approach to out-of-hospital cardiac arrest resuscitation

Michael Levy\textsuperscript{a, b}, Dana Yost\textsuperscript{c, d}, \href{mailto:}{Robert G. Walker}\textsuperscript{e}, Erich Scheunemann\textsuperscript{a, b}, Steve R. Mendive\textsuperscript{a, b}
Results

Manual to mechanical transition

Levy M, Yost, D et al Resus 92, 2015
Figure 3. Duration of chest compression interruptions prior to first mechanical chest compression for the years prior to and after initiation of the quality improvement initiative, illustrated by Tukey boxplot. Individual dots represent outliers.
Results

Measure...Improve
Piston Driven Mechanical CPR Summary
Better than world class manual CPR?
Does it provide a better solution for re-arrests?
Applicable to Unique and Important Situations?
Does It Affect Scene Dynamics?
A Carefully Reasoned Position

Get the Right Tool for the Job
...and Know How to Use It