AED Therapy for Sudden Cardiac Arrest: Focus on Exercise Facilities

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Disclosures

I have no conflict of interest related to this talk and no financial relationship with industry.

The use of an AED as a monitor is off-label.
AHA “CHAIN OF SURVIVAL”

- Early access (911)
- Early CPR
- Early defibrillation (AED)
- Early Advanced Care
AHA “CHAIN OF SURVIVAL”

- Early access (911)
- Early CPR
- Early defibrillation (AED)
- Early Advanced Care
Cardiopulmonary Resuscitation Remains Critical

• Prompt CPR is associated with:
  - a better chance of survival
  - better quality of life among survivors

• Less than a quarter of cardiac arrest victims receive bystander CPR prior to EMS arrival in many communities.
Hemodynamic Response During Simulated “Typical” Single Lay Rescuer CPR (15:2 Ratio)

“Aorta

“Typical” lay rescue-breathing
(16 ± 1 sec)

Ewy GA. Circulation 2005;111:2134-2142
2005 Guidelines for CPR:

“push hard, push fast, allow full chest recoil after each compression, and minimize interruptions in chest compressions,”
2010 AHA Guidelines

– A strong emphasis on delivering high-quality chest compressions remains essential: rescuers should push hard to a depth of at least 2 inches (or 5 cm) at a rate of at least 100 compressions per minute, allow full chest recoil, and minimize interruptions in chest compressions.

– Rescuers trained to provide ventilations use a compression: ventilation ratio of 30:2.

– For untrained rescuers, EMS dispatchers should provide telephone instruction in chest compression–only CPR.

Prolonged CPR Holds Benefits, a Study Shows

Duration of resuscitation efforts and survival after in-hospital cardiac arrest: an observational study

- 64,399 cardiac arrests in AHA Get With The Guidelines Registry

- Median duration of resuscitation
  - Survivor: 12 minutes
  - Non-survivor: 20 minutes

- Survival to discharge was associated with hospital duration of resuscitation attempts
  - Shortest quartile: 16 minutes
  - Longest quartile: 25 minutes
  - Risk ratio 1.12, p<0.0001

Goldberger et al. Lancet, Early Online Publication, September 5, 2012
AHA “CHAIN OF SURVIVAL”

- Early access (911)
- Early CPR
- Early defibrillation (AED)
- Early Advanced Care
A 54 year old executive with sudden cardiac arrest

- Mr. Smith was an overweight, hypertensive CEO
- He was sitting next to his wife when he arrested
- What is the likelihood that he would survive?
Importance of Rapid Defibrillation

Lessons Learned from AED Use Aboard Aircraft
Background

- Under the best conditions, flying over land, it takes a jet 20 minutes to reach a gate, and longer to obtain ground-based medical care.

- Previously a victim of ventricular fibrillation aboard an aircraft had a remote chance of survival.

- AA was the first major carrier to place AEDs, training all flight attendants.

- Ideal laboratory to evaluate the AED in a controlled but remote condition.
RESULTS:
PATIENT POPULATION

• The AED was placed in 200 events:
  – mean age 58 years;
  – 66% men.

• Indications for AED placement:
  – Loss of consciousness was documented in 99;
  – Remainder (101) were placed for other indications such as chest pain or dyspnea.

RESULTS:
CLINICAL CONDITIONS

• A physician was available in 139 cases (69%).

• Location of AED use
  – Airport: 9 (5%)
  – Aircraft: 191 (95%)

Mr. Smith

2.5 minutes

10 minutes

A 45 y/o woman with syncope

A 77 y/o man with transient LOC and palpitations

A 52 Y/O MALE PASSENGER FOUND TO BE UNCONSCIOUS

RESULTS:
VENTRICULAR FIBRILLATION

• Ventricular fibrillation was present in 16 patients (14 documented and 2 presumed).

• All VF episodes were recognized (sensitivity 100%) and shock delivered in 15/16 (withheld by the family in one case). First shock success was 100%.

• 6 of 15 patients receiving shocks for VF survived to hospital discharge (40%).

RESULTS:
AED USE AS A MONITOR

- Rhythms other than VF were recorded in 167 passengers.
- Shock was never recommended, much less delivered (specificity 100%).

VF in Casinos: The Gaming Experience

(The odds are good!)
VF in Casinos: The Gaming Experience

- Security officers at 10 facilities were trained in CPR and AED use (5-6 hours).

- Inclusion criteria: unconscious, unresponsive, no carotid pulse, and no spontaneous breathing.

- 148 patients with confirmed cardiac arrest:
  - 105 (71%) VF

Witnessed VF in Casinos: Survival

- 53/90 (59%) survived to hospital discharge:

- There was a significant difference in survival between defibrillation before and after 3 minutes ($p = 0.018$):
  - 26/35 (74%) if defibrillated within 3 minutes;
  - 27/55 (49%) if defibrillated after 3 minutes.

The Public Access Defibrillation (PAD) Trial
To evaluate whether adding AEDs to a CPR-based, community volunteer response system increases survival in victims of out-of-hospital cardiac arrest.
The PAD Trial

• 1000 distinct sites with stable population of >250 (public areas, gated communities, malls, etc.)

• Randomized to intervention or control group:
  – all trained in recognizing CA, access to 911, and CPR.
  – intervention group trained in prompt use of AED while awaiting emergency team.
PAD Trial Design

- Prospective, randomized controlled clinical trial
- Compared two lay volunteer-based OOH-CA response systems:
  - High-risk Community Units
    - Call 911, CPR
  - Call 911, CPR AED

Primary endpoint = survival to hospital discharge
### PAD: Main Results

<table>
<thead>
<tr>
<th></th>
<th>CPR-only</th>
<th>CPR+AED</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td># survivors to hospital discharge</td>
<td>15</td>
<td>29</td>
<td>.042*</td>
</tr>
<tr>
<td>Residential units</td>
<td>1</td>
<td>1</td>
<td>.74**</td>
</tr>
<tr>
<td>Non-residential units</td>
<td>14</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>

* Adjusted for Sequential Monitoring

** p-value for interaction between type of unit and AED effect on survival

PAD Investigators, NEJM 2004
Survival After Application of AEDs Before Arrival of the EMS: Evaluation of the ROC Population of 21 Million

- 13,769 out-of-hospital arrests
  - 32% received CPR but no AED before EMS arrival
  - 21% had an AED placed before EMS arrival

- Survival to hospital discharge:
  - 9% with CPR only
  - 24% with AED application
  - 38% with AED shock delivery

- With multivariate analysis, likelihood of survival with AED application was increased (OR 1.75; p<0.002)

- Extrapolation to US/Canada population: 474 lives/ year

Weisfeldt et al. JACC 2010; 55:1713
Long-Term Outcomes After Early Defibrillation: Survival

Where Should AEDs Be Placed?
## Incidence of Arrest per Higher-Incidence Site

<table>
<thead>
<tr>
<th>Location category</th>
<th>Annual arrests per site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airport</td>
<td>7</td>
</tr>
<tr>
<td>County jail</td>
<td>1</td>
</tr>
<tr>
<td>Large shopping mall</td>
<td>0.6</td>
</tr>
<tr>
<td>Public sports venue</td>
<td>0.4</td>
</tr>
<tr>
<td>Large industrial site</td>
<td>0.4</td>
</tr>
<tr>
<td>Golf course</td>
<td>0.1</td>
</tr>
<tr>
<td>Shelter</td>
<td>0.1</td>
</tr>
<tr>
<td>Ferries / train terminal</td>
<td>0.1</td>
</tr>
<tr>
<td>Health club/gym</td>
<td>0.08</td>
</tr>
<tr>
<td>Community / senior center</td>
<td>0.03</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location category</th>
<th>Annual arrests per site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entertainment place</td>
<td>0.01</td>
</tr>
<tr>
<td>Hotel / Motel</td>
<td>0.01</td>
</tr>
<tr>
<td>Private ambulance</td>
<td>0.003</td>
</tr>
<tr>
<td>Bus</td>
<td>0.005</td>
</tr>
<tr>
<td>Bar / tavern</td>
<td>0.005</td>
</tr>
<tr>
<td>Government office</td>
<td>0.003</td>
</tr>
<tr>
<td>Industrial manufacturing</td>
<td>0.002</td>
</tr>
<tr>
<td>School / church</td>
<td>0.002</td>
</tr>
<tr>
<td>Retail store</td>
<td>0.0005</td>
</tr>
<tr>
<td>Construction site</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

Sudden Cardiac Arrest at Exercise Facilities: Survival and Implications for AED Placement

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Methods

- Seattle and King County: a heterogeneous metropolitan setting
- Population-based cohort study of SCA between 1/1/96 and 12/31/08
- Every SCA occurring in an indoor public location was classified as occurring at:
  - Exercise facility (n=136)
    - Traditional exercise facility
    - Alternative exercise facility
  - Non-exercise public indoor location (n= 713)

Page et al. Unpublished
## Exercise Facilities

<table>
<thead>
<tr>
<th>Traditional</th>
<th>Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health club</td>
<td>Basketball at church or juvenile hall</td>
</tr>
<tr>
<td>Fitness Center</td>
<td>Bowling alley</td>
</tr>
<tr>
<td></td>
<td>Community center</td>
</tr>
<tr>
<td></td>
<td>Dance Studio</td>
</tr>
<tr>
<td></td>
<td>Golf clubhouse</td>
</tr>
<tr>
<td></td>
<td>Hotel gym</td>
</tr>
<tr>
<td></td>
<td>Ice arena</td>
</tr>
<tr>
<td></td>
<td>Indoor paintball</td>
</tr>
<tr>
<td></td>
<td>Martial arts school</td>
</tr>
<tr>
<td></td>
<td>Workplace gym</td>
</tr>
<tr>
<td></td>
<td>Senior rec center</td>
</tr>
<tr>
<td></td>
<td>Roller rink</td>
</tr>
<tr>
<td></td>
<td>School gym</td>
</tr>
<tr>
<td></td>
<td>Ski clubhouse</td>
</tr>
<tr>
<td></td>
<td>Indoor tennis</td>
</tr>
</tbody>
</table>

Page et al. Unpublished
## Results

### Demographics and Outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Formal, n=52</th>
<th>Alternative, n=82</th>
<th>Non-ex: n=713</th>
<th>Ex v Non</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median</td>
<td>54 yrs</td>
<td>54 yrs</td>
<td>60 yrs</td>
<td>.007</td>
</tr>
<tr>
<td>Male</td>
<td>90%</td>
<td>92%</td>
<td>76%</td>
<td>.001</td>
</tr>
<tr>
<td>Witnessed</td>
<td>89%</td>
<td>91%</td>
<td>74%</td>
<td>.001</td>
</tr>
<tr>
<td>Initial Rhythm: VT/VF</td>
<td>79%</td>
<td>72%</td>
<td>61%</td>
<td>.001</td>
</tr>
<tr>
<td>CPR</td>
<td>83%</td>
<td>82%</td>
<td>62%</td>
<td>.001</td>
</tr>
<tr>
<td>AED</td>
<td>25%</td>
<td>12%</td>
<td>9%</td>
<td>.003</td>
</tr>
<tr>
<td>Survival</td>
<td>56%</td>
<td>45%</td>
<td>32%</td>
<td>.001</td>
</tr>
</tbody>
</table>

Page et al. Unpublished
Results: Activities at the Time of SCA

- Basketball 20.5%
- Dancing 11.6%
- “Working out” 11.6%
- Treadmill 8.9%
- Tennis 6.3%
- Bowling 5.4%
- Swimming 4.5%

Page et al. Unpublished
Site Incidence Rates of SCA

- National Establishment Time-Series Database was used to calculate the number of sites for some of the types of exercise facilities (2002).
- We conducted web-based searches to estimate the number of community centers and hotels with gyms.
- These data allowed calculation of site incidence per year for SCA.
## Site Incidence Rates of SCA

<table>
<thead>
<tr>
<th>Exercise facilities</th>
<th>Number of arrests</th>
<th>Number of sites</th>
<th># of arrests per site/yr</th>
<th># of years to have 1 arrest/site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health clubs/fitness centers</td>
<td>52</td>
<td>167</td>
<td>0.024</td>
<td>42</td>
</tr>
<tr>
<td>Indoor tennis facilities</td>
<td>6</td>
<td>5</td>
<td>0.092</td>
<td>11</td>
</tr>
<tr>
<td>Ice arenas</td>
<td>3</td>
<td>3</td>
<td>0.077</td>
<td>13</td>
</tr>
<tr>
<td>Bowling alleys</td>
<td>11</td>
<td>23</td>
<td>0.037</td>
<td>27</td>
</tr>
<tr>
<td>Community centers</td>
<td>33</td>
<td>130</td>
<td>0.020</td>
<td>51</td>
</tr>
<tr>
<td>Roller skating rinks</td>
<td>1</td>
<td>7</td>
<td>0.011</td>
<td>91</td>
</tr>
<tr>
<td>Dance studios</td>
<td>4</td>
<td>165</td>
<td>0.002</td>
<td>536</td>
</tr>
<tr>
<td>Hotel gyms</td>
<td>4</td>
<td>225</td>
<td>0.001</td>
<td>731</td>
</tr>
<tr>
<td>Martial arts schools</td>
<td>1</td>
<td>160</td>
<td>&lt;0.001</td>
<td>2080</td>
</tr>
</tbody>
</table>

Page et al. Unpublished
Typical Wisconsin Bowler?
AED Therapy for Sudden Cardiac Arrest: Focus on Exercise Facilities

- CPR still plays a major role in resuscitation
- Data support AED placement in high risk sites
- The importance of AEDs at fitness centers is recognized, but new data suggest the need is as great at alternative exercise sites.
Thank You