Heart rhythm analysis during chest compressions

Comparison between conventional AEDs and the cprINSIGHT algorithm

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Resuscitation Science Symposium 2019
Conflict of interests

• Research grant Stryker
AED heart rhythm analysis

• Standard settings of AEDs: chest compressions interrupted during rhythm analysis
New AED algorithm: cprINSIGHT

• cprINSIGHT: chest compressions not interrupted during rhythm analysis

• Only stop chest compressions for shock delivery
cprINSIGHT classification

• First analysis is conventional analysis, subsequent analyses cprINSIGHT

• cprINSIGHT classifies the rhythm as:
  1. Shockable
  2. Non-shockable
  3. No decision -> conventional analysis
1. Shock
2. No Shock
3. No Decision

Analysis
Shock / No Shock
Analysis pause
Chest compressions

Standard AED

cprINSIGHT

1. Shock
2. No Shock
3. No Decision
• cprINSIGHT analyses the ECG without need for a pause in ~70% of analyses
• cprINSIGHT high sensitivity 100% [LCL 96%], high specificity 99% [LCL 96%]

**Hypotheses**

Compared to conventional AEDs, AEDs with cprINSIGHT will have:

1. Higher chest compression fraction (CCF)
2. Shorter pauses before shock delivery (pre-shock pause)
Methods (1/3)

- Amsterdam Police
  - 2016 -> conventional AEDs (LIFEPAK® 1000 defibrillator)
    - “Control” cardiac arrest cases
  - 2018 -> AEDs with cprINSIGHT (LIFEPAK CR2 AED)
    - “Intervention” cardiac arrest cases
Methods (2/3)

• Comparison of CCF and pre-shock pause

• CCF: proportion of time with chest compressions from the start of CPR after analysis 1 to the start of CPR after analysis 2
Methods (3/3)

• Comparison of CCF and pre-shock pause

• Pre-shock pause: time between stop of CPR and Shock

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## Results (1/4)

<table>
<thead>
<tr>
<th>Control N=111</th>
<th>Intervention N=87</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First monitored rhythm, n (%)</strong></td>
<td><strong>Shockable (VF/VT)</strong></td>
<td><strong>42 (38%)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Not shockable</strong></td>
<td><strong>69 (62%)</strong></td>
</tr>
</tbody>
</table>
Results (2/4)

- CCF ≥90% in 10% of control and 38% of intervention cases
Results (3/4)

- Intervention cases had a significantly higher median CCF
Results (4/4)

<table>
<thead>
<tr>
<th>Peri-shock pause*</th>
<th>Control (N=28)</th>
<th>Intervention (N=19)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-shock pause</td>
<td>22 (20,24)</td>
<td>7 (4,11)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Post-shock pause</td>
<td>4 (3,6)</td>
<td>5 (3,9)</td>
<td>0.30</td>
</tr>
</tbody>
</table>

*seconds, median (IQR 25,75)
Conclusion

• Compared to conventional AEDs, the use of CPRINSIGHT leads to:
  • Significant increase in CCF
  • Significantly shorter pre-shock pauses
Future research

• Comparison of multiple analyses per patient

• Comparison of outcome variables
  • Defibrillation success rate
  • Return of spontaneous circulation (ROSC)
  • Survival
Questions?

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Improving AED analysis

Analysis of recordings from 665 patients with OHCA
73.3% of VF was identified in step 1: **Sensitivity 73%**; False positive?
Additional 21.8% of VF was identified after 9 sec interruption
**Sensitivity after 9 sec interruption 95.1% - LCL?**
**Specificity after 9 sec interruption 99.5% - LCL?**
Improving AED analysis

Zoll protocol: fast reconfirmation
“Fast shock”

Analysis of 7264 intervals of 2701 patients
Derivation set and test set

Test set:
Shockable rhythm: Sensitivity 95% (LCL 93%)
Shockable single segment: Sens 94% (LCL 92%)
Coarse VF: sensitivity 99% (LCL 96%)
Fine VF: sensitivity 91% (LCL 86%)
Non-shockable: specificity 99% (LCL 99%)
Non-shockable single segment
spec: 99% (LCL 98%)

Caveat:
Definition “Coarse VF” peak-peak >400 µV

Fumagalli HeartRhythm 2017