Shocking Results: How Accurate is Paramedic ECG Analysis in Cardiac Arrest?

Scott T. Youngquist, MD, MS, FACEP, FAEMS, FAHA
Medical Director
Salt Lake City Fire Department
HIGHEST IMPACT CARDIAC ARREST INTERVENTIONS
Inter-Rater Agreement of Paramedic Rhythm Labeling

Study hypothesis: Substantial inter-rater agreement is present in the labeling by paramedics of ventricular fibrillation and asystolic rhythms.

Design: Prospective, cross-sectional study.

Type of participants: One hundred five practicing paramedics from nonvolunteer agencies who are advanced cardiac life support certified.

Methods: Five static cardiac arrest rhythm strips, classified by Cummins’ average peak amplitude method, were arranged into five different orders of presentation and placed into five booklets. The paramedics were instructed to label each rhythm ventricular fibrillation or asystole based on rhythm recognition, not on treatment plan.

Results: The overall \( \kappa \) value for labeling the five rhythms was .63, indicating a moderate degree of inter-rater agreement. However, as the rhythm’s amplitude decreased, the amount of
Figure.

*The five study rhythms*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Medium Ventricular Fibrillation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Fine Ventricular Fibrillation</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Fine Ventricular Fibrillation</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Asystole</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Asystole</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2
Results of paramedic rhythm labeling

<table>
<thead>
<tr>
<th>Strip</th>
<th>Average Peak Amplitude (mm)</th>
<th>No. Labeled Ventricular Fibrillation</th>
<th>No. Labeled Asystole</th>
<th>Proportion Labeled Ventricular Fibrillation (95% CI)</th>
<th>κ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 to &lt; 7</td>
<td>104</td>
<td>1*</td>
<td>0.99 (.97, 1.0)</td>
<td>≈1</td>
</tr>
<tr>
<td>2</td>
<td>1 to &lt; 3</td>
<td>104</td>
<td>1*</td>
<td>0.99 (.97, 1.0)</td>
<td>≈1</td>
</tr>
<tr>
<td>3</td>
<td>1 to &lt; 3</td>
<td>85</td>
<td>20</td>
<td>0.81 (.73, .89)</td>
<td>.13</td>
</tr>
<tr>
<td>4</td>
<td>&lt; 1</td>
<td>48</td>
<td>57</td>
<td>0.46 (.36, .56)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>105</td>
<td>0 (0, .04)</td>
<td>NA</td>
</tr>
</tbody>
</table>

All rhythms

*Not the same individual.

93% SENSITIVITY FOR VF
WHAT IS THE FIELD ACCURACY OF PARAMEDIC INTERPRETATION OF RHYTHM DURING RESUSCITATION?

<10 sec to decide*
Larger variation in VF amplitude
High-pressure setting
Might phone a friend
SENSITIVITY = WHAT PROPORTION OF VF CASES GIVEN SHOCK?

<table>
<thead>
<tr>
<th></th>
<th>&gt;1 Shock Delivered</th>
<th>No Shocks Delivered</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Shockable</td>
<td>222 (98%)</td>
<td>4 (2%)</td>
<td>226</td>
</tr>
<tr>
<td>Non-Shockable</td>
<td>254 (44%)</td>
<td>325 (56%)</td>
<td>579</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>805</td>
</tr>
</tbody>
</table>

BY CASE ANALYSIS
HOW FAST ARE APPROPRIATE SHOCKS DELIVERED?

MEDIAN 70 sec (IQR 30-145)

Why the Delay?

N=648 arrests
n=880 shocks

MEDIAN 70 sec (IQR 30-145)
ANALYSIS BY 2 MIN EPOCH IN VF

Excludes 4 cases in which no shock ever delivered

n=880 shocks

Not shocked 30%
Shocked 70%
SHOCKING THE NON-SHOCKABLE: Immediate Post-Shock Rhythms

251 Asystole
- 177 (71%) Asystole
- 58 (23%) PEA
- 12 (5%) Shockable
- 4 (2%) Unknown

140 PEA
- 98 (70%) PEA
- 26 (19%) Asystole
- 12 (9%) Shockable
- 4 (3%) Unknown
SUMMARY

- Paramedics have high case sensitivity for shockable rhythms
  - Consider empiric shock for perceived asystole
- Delayed defibrillation is frequent and occurred ~30% of the time in ALS care
- Our future areas of focus:
  - limiting delays in defibrillation

In a setting of continuous review and feedback
Those who cannot learn from history are doomed to repeat it.

-George Santayana
CAVEATS

- Gold Standard is single reviewer (me!)
- Paramedics instructed to monitor filtered rhythm for VF recurrence and administer shock without waiting
- Pit Crew approach with 6-8 hands
- Includes period in which empiric shock of asystole protocolized
- Excluded epochs in which rhythm couldn’t be determined
- Used interpolation of last visualized rhythm in some cases