Tools to Improve CPR Quality

National Teaching Institute
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Objectives

- Discuss current issues with CPR quality
- Discuss the role of Waveform Capnography in cardiac arrest
- Describe ways to incorporate CPR assist devices into resuscitation events
2010 AHA ACLS Guidelines

- Bigger emphasis on compressions
- Early defibrillation
- Waveform Capnography
- Post resuscitation algorithm

Coming October 15, 2015...

New ACLS Guidelines!!!
Quality of compressions

Current AHA recommendations:
• Rate = at LEAST 100/min
• Depth 2 inches (50 mm)
• Allow for full recoil of the chest

Compressions provide only 25–33% of normal cardiac output

Resuscitation Science

Relationship Between Chest Compression Rates and Outcomes From Cardiac Arrest

Abbasal H. Idris, MD; Danielle Goffrey, BS; Tom P. Ankerbechle, MD; Sibshah Brown, PhD; Laurie J. Morrison, MD, MSc; Patrick Nichols, DO; Judy Powell, BSN; Mohamad Daya, MD; Blair L. Bigham, MSc; Dianne L. Aitken, MD; Robert Berg, MD; Dan Davis, MD; Ian Stiell, MD, MSc; George Sopko, MD, MPH; Graham Nichol, MD, MPH; the Resuscitation Outcomes Consortium (ROC) Investigators


95% CI
Optimal Rate?

• ROC PRIMED Study
• Prospective observational study
• OHCA
• After adjusting for
  ◦ chest compression fraction &
  ◦ depth

highest survival to discharge was found when the rate was...

100 – 119 per minute!


Optimal chest compression depth?

ROC PRIMED Trial

• Out of hospital cardiac arrest
• Current depth recommendation is 50 mm
• 2005 rec. 38 – 50 mm
• No upper limit
• Highest survival depth interval of 40.3 mm – 55.3 mm
• Peak survival 45.6 mm (~1.8 inches)

Are you performing HIGH quality CPR?

How do you know?

In-Hospital Consensus Recommendations

Strategies for Improving Survival After In-Hospital Cardiac Arrest in the United States: 2013 Consensus Recommendations: A Consensus Statement From the American Heart Association

Laurie J. Morrison, Robert W. Neumar, Janice L. Zimmerman, Mark S. Link, L. Kristin Newby, Paul W. McMullan, Jr, Terry Vanden Hoek, Colleen C. Halverson, Lynn Doering, Mary Ann Peberdy and Dana P. Edelson

on behalf of the American Heart Association Emergency Cardiovascular Care Committee, Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation, Council on Cardiovascular and Stroke Nursing, Council on Clinical Cardiology, and Council on Peripheral Vascular Disease

May 2013
Compression Fraction

- The amount of time spent providing compressions
- May also be called “compression ratio”
- Goal: At least 80%!

An increased chest compression fraction is independently predictive of better survival in patients who experience a pre-hospital ventricular fibrillation/tachycardia cardiac arrest.
Metronomes
Compression rate “Push fast, push hard”

Too Slow (Before 2010)

Too Fast (current)

100 – 120 /min

Real-time Advantage Goals
Disco Lives!!!

- 5 Medical students & 10 MDs
- With beat avg. 103 /minute
- 5 weeks later repeated

Use a metronome!!!

Auditory cue that takes the guess work away

Chest compressions with metronome
How do you accurately measure compression depth?

Real Time Feedback Devices

Clinical paper
Compression feedback devices over estimate chest compression depth when performed on a bed.

Gavin D. Perkins, Laura Kocierz, Samuel C.L. Smith, Robert A. McCulloch, Robin P. Davies
**The Mattress Issue:**

- Mattress compression = 35 – 40% of total compression depth
- Accelerometer feedback devices fail to account for mattress compression
- Use of a backboard fails to compensate for mattress compression
Real time CPR Feedback:

- Real-time feedback
  - Rate, Depth, CCF
- Metronome
- Ventilation prompts
- Post-event data:
  - Immediate
  - Reports

True-CPR Report

When compressions are too fast, the depth is too shallow!!!
Waveform Capnography

- Used as a marker of perfusion
- Normal is 35 – 45 mmHg
- Goal with compressions is at least 10 mmHg
- Will see increase with ROSC
Waveform Capnography

• Attaches to ET tube, measures CO2

Other adjuncts

• **Coronary Perfusion Pressure (CPP)**
  - Diastolic pressure
  - Goal > 20 mmHg

• **Central venous saturation**
  - ScvO₂ – normal 60 – 80%
  - Goal > 30%
  - If < 30%, assess quality of compressions
Post-Event Review

AHA Consensus Recommendation

2013 Consensus Recommendation:
“…resuscitation data from the defibrillator or any other device or source documentation that captures data at the scene should be used for feedback to the team”
Circulation, 2013
CODE-STAT™ Data Review Software

- May be used with Lifepak 12, 15, 20 or 1000 (AED)
- Wireless data transmit from defibrillator
- As soon as pads are placed, data are being recorded
  - Records compressions, pauses, shocks, EtCO₂
  - No additional equipment needed

Intra-arrest review:
Compression fraction

Goal: at least 80%!
2 months after giving feedback to teams

- ED patient with STEMI
- PEA Arrest
- What do you think about the rate?
- Compression fraction?

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- ED patient
- Compression rate?
- Fraction?
- What happened at minute 7?
Intra-Arrest Data Report

1 Second

Vfib – No Shock, but stopped to assess?

Issues here?

17 second pause
### CPR QUK-VIEW

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<th>Comp. Rate (%)</th>
<th>Comp. Rate</th>
<th>Comp. Depth</th>
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### CC Rate 141

![CC Rate 141 Graph](image-url)
Does debriefing post-event improve outcomes?

Pediatric patients 8 years or older
119 cardiac arrest events
   60 Control, 59 Intervention
Prospective quality improvement interventional trial

Debriefing: **Safe environment**
- Patient history
- Pre-arrest studies (radiographs, CT scans, labs)
- Quantitative resuscitation data
- Patient Outcome & Summary

Wolfe et al. (2014) Critical Care Medicine 42(7)

Four Targets: “Excellent CPR”
- Depth ≥ 38 mm
- Rate ≥ 100/min
- CPR Fraction > 90%
- Leaning < 10%

Wolfe et al. (2014) Critical Care Medicine 42(7)
Man vs. Machine?

- Simulated CA in pigs—coronary blood flow
- CPP 20-25 mmHg LUCAS vs. 5-10 mmHg manual
  - EtCO₂ 25.5 mmHg LUCAS vs. 16.5 mmHg manual
- EtCO₂ measurement in humans
  - EtCO₂ values higher compared to humans
  - 126 OHCA patients
  - Average 24.5 mmHg vs. 20.4 mmHg

In conclusion:

- Provide good quality compressions
- Minimize interruptions in compressions
- Practice! Utilize feedback on CC performance
- Consider utilization of a mechanical compression device!

- You can’t (won’t) improve what you don’t measure!!!