Science Behind Resuscitation

Vic Parwani, MD
ED Medical Director
CarolinaEast Health System
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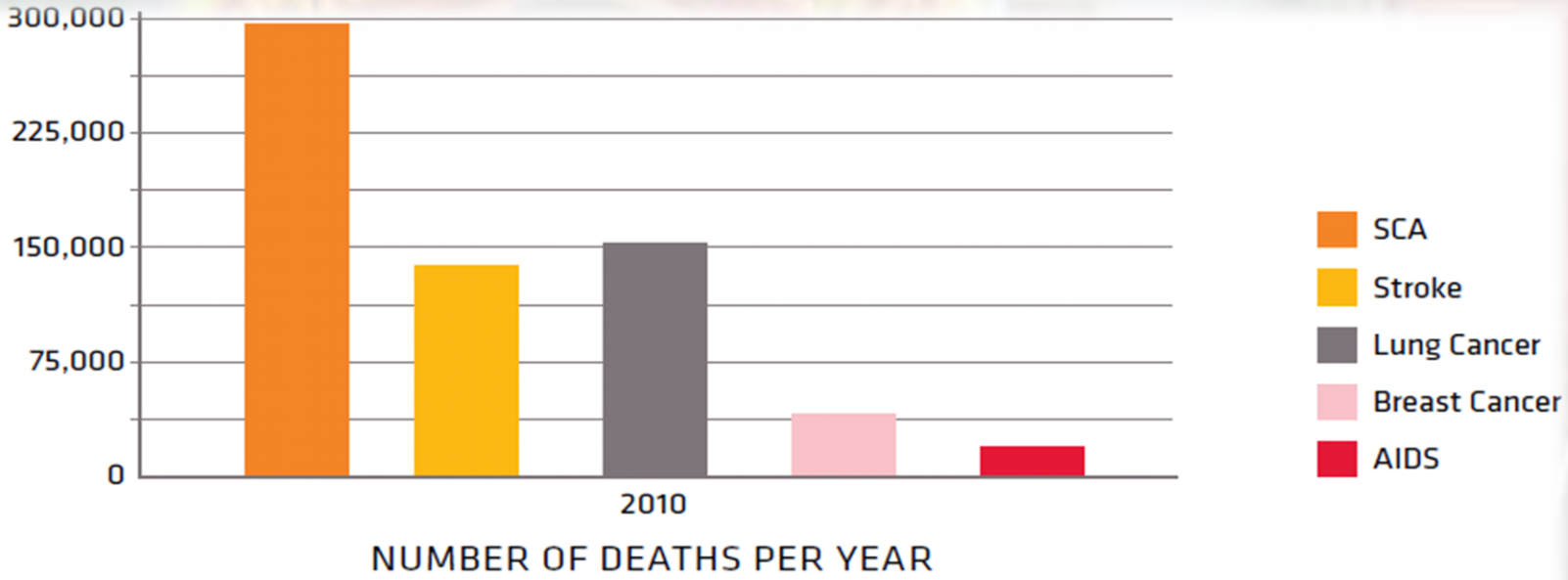
Conflict of Interest

- No Financial or Industrial Conflicts
- Slides: Drs. Nelson, Cole and Larabee

Outline

- Arrest Epidemiology / Outcomes
- Focus on Chest Compressions
- Decreased Emphasis on Intubation
- Timing of Defibrillation
- Hypothermia Literature
- Termination of Resuscitation

Sudden Cardiac Arrest



1. American Heart Association. Heart Disease and Stroke Statistics—2010 Update.
2. Jemal A, Siegel R, Xu J, et al. Cancer statistics, 2010. CA Cancer J Clin. 2010 Jul 7. [Epub ahead of print]
3. Centers for Disease Control. HIV prevalence estimates—United States, 2006. MMWR 57(39), 3 October 2008.

A need for change….

- 300,000+ persons die from out of hospital cardiac arrests each year in North America
- Survival rate is poor among these patients, an most do not survive to hospital discharge
- New research suggest CPR has a greater impact on cardiac arrest survival than previously thought

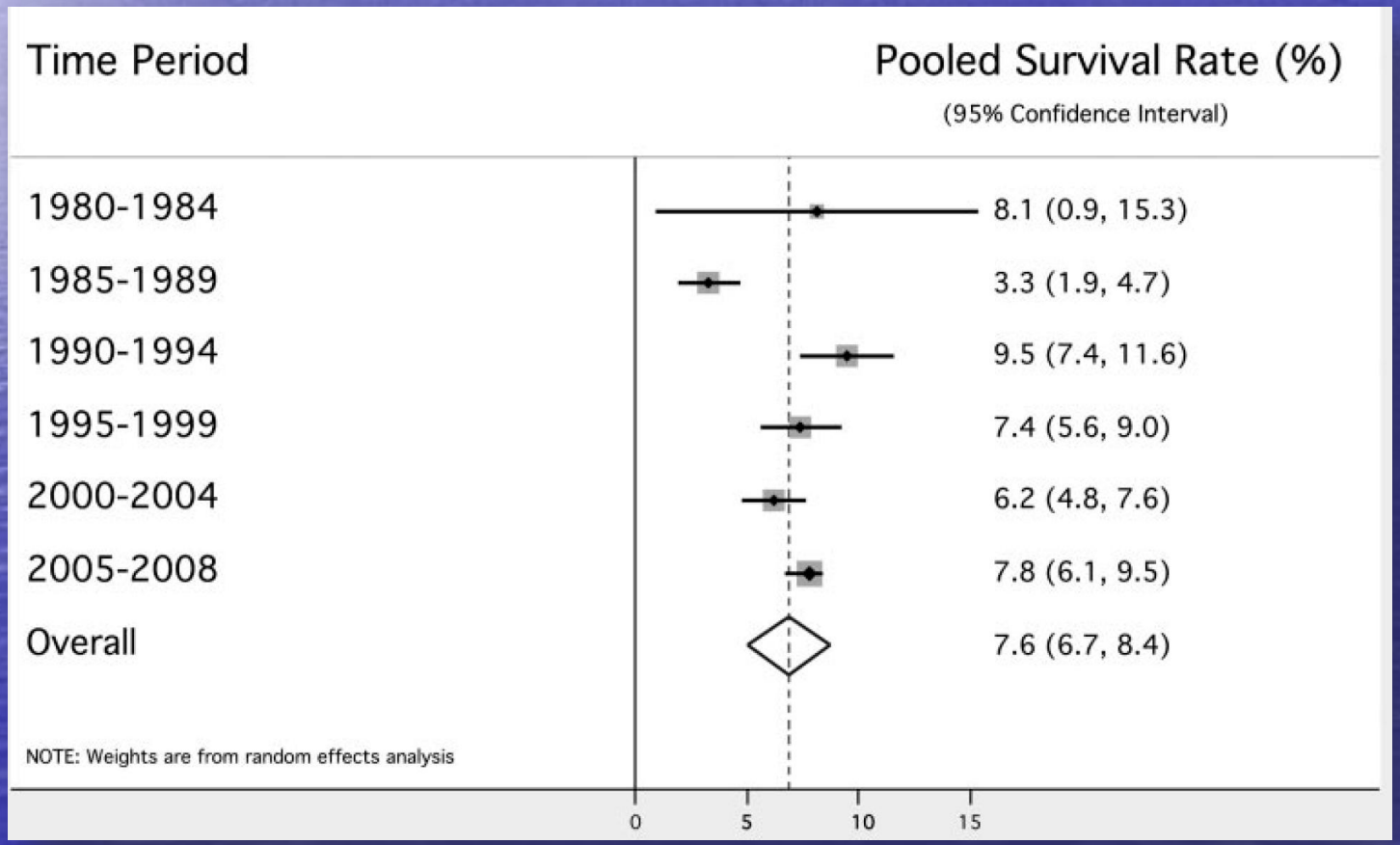
CPR in Hollywood……

- ROSC (Getting a pulse back): 75%
- Neurologically Intact: 67%

Real Life: Nearly Everyone Dies

OHCA survival to hospital discharge by 5-year time periods (n=141,581)

Overall 7.6%



Geography

WHAT GIVES YOU THE BEST CHANCE OF SURVIVAL?

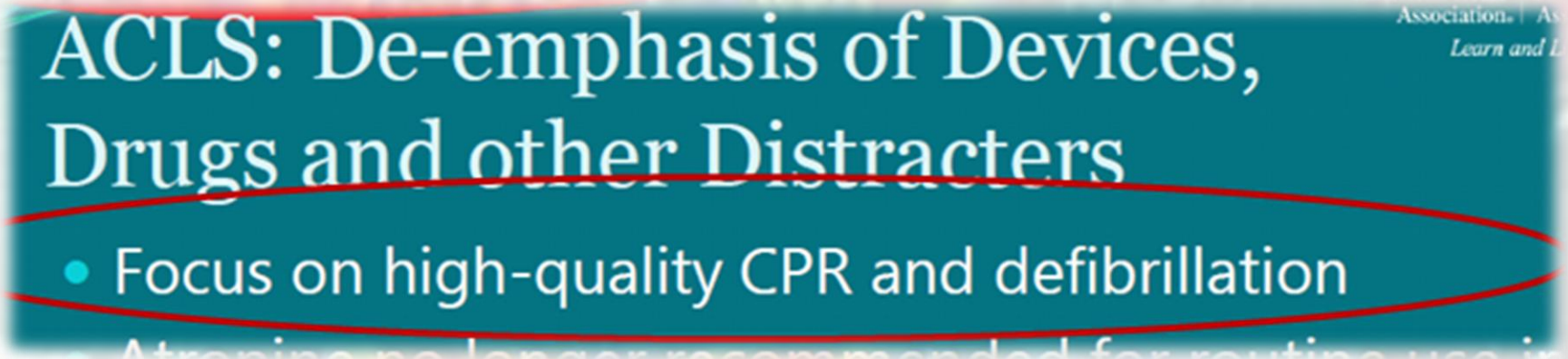
Out-of-Hospital-Cardiac Arrest

WHY ARE WE FAILING?

Why are we failing?

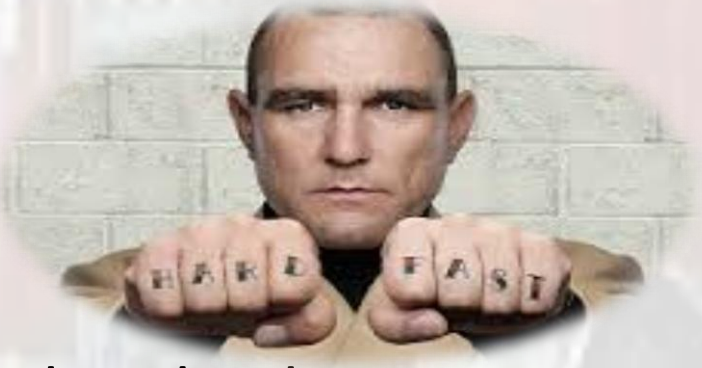
- Airway
- Breathing
- Circulation
- Technology
- Transport

HIGH QUALITY CPR



PREHOSPITAL HIGH QUALITY CPR

- Goal: High quality means continuous chest compressions with *<u>limited</u> interruptions*
  - Rate: 100 – 120/min
  - Depth: 2 inches
  - Allow for complete chest recoil
  - Change every 2 minutes with pulse check
    - not to exceed 5 seconds
  - Address airway 2 cycles unless indicated earlier

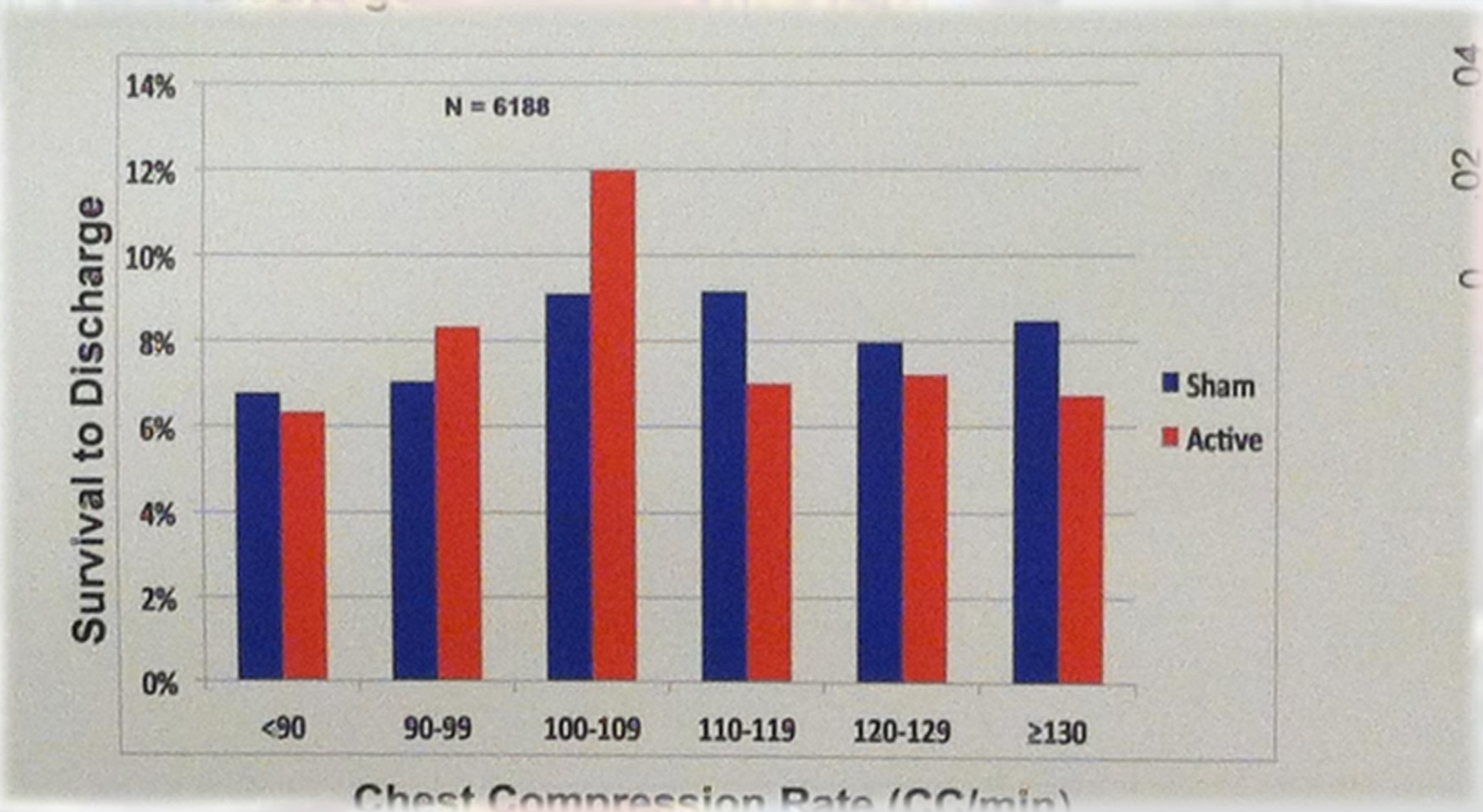


Why 100 – 120 Rate?

- Study measured rates from 2005 – 2007
- 3098 patients enrolled
- Mean compression rate 112
- ROSC peaked at 120
- ROSC declined markedly < 75
  - In this study ROSC not associated with hospital discharge

Idris AH et al. Relationship between chest compression rates and outcomes from cardiac arrest. Circulation 2012 Jun 19; 125:3004.

Why 100 – 120 Rate?



Chest Compression Fraction & Survival

Graph shows survival as it relates to chest compression fraction:

- Move from lower levels of CCF to intermediate has significant benefit
- Supports evidence that increasing pre-shock coronary and cerebral blood flow can improve outcomes

Increased chest compression fraction is independently predictive of better survival

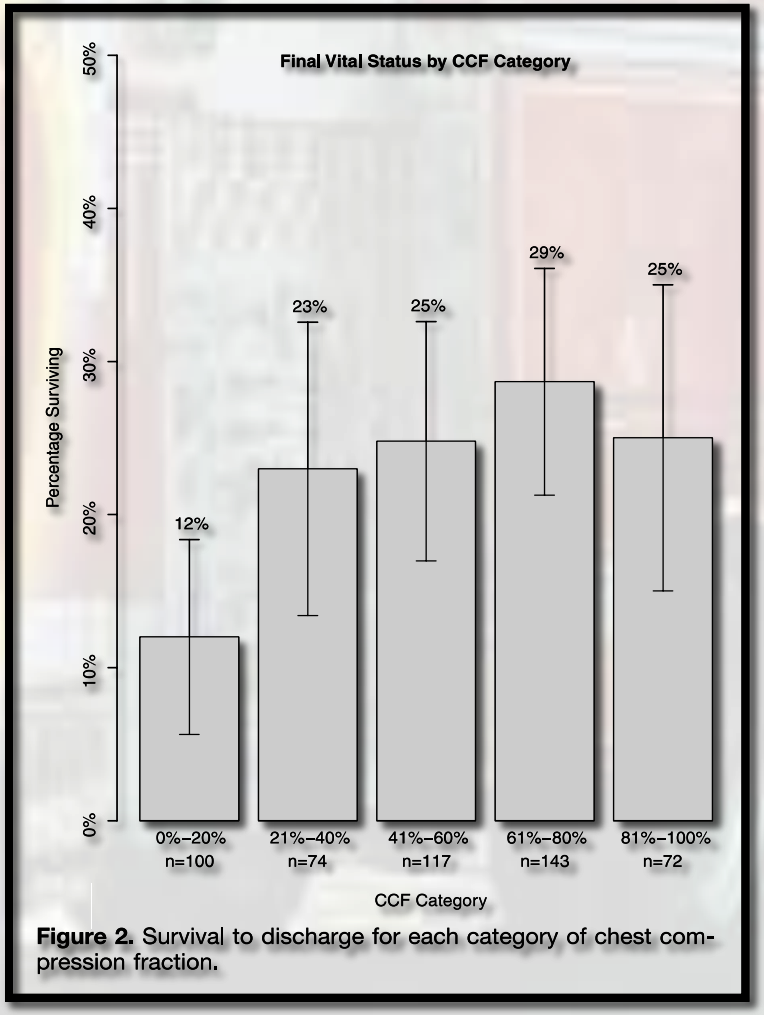


Figure 2. Survival to discharge for each category of chest compression fraction.

Depth and Speed Matter

- ROC Study
- 1029 Adult patients including 58 EMS agencies
- Median compression rate is 106
- Median compression depth is 37.5 mm
- 53 % with compression depth < 38 mm
- 92 % with compression depth < 50 mm
  - Faster compression rate = less depth
- Survival improved with depth > 38 mm

Stiell IG et al. What is the role of chest compression depth during out-of-hospital cardiac arrest resuscitation? Crit Care Med 2012 Jan 5

Why 2 Minutes?

- 45 Providers, single rescuer CPR – 10 minutes
- Child and Adult manikins with AV feedback
- Mean compression rate remained > 100
- Adequate compressions
  - Fell from 85 % to < 40 % over 10 minutes
  - < 70 % after 90 seconds in child
  - < 70 % after 120 seconds in adult
- Self reported fatigue low by 2 minutes

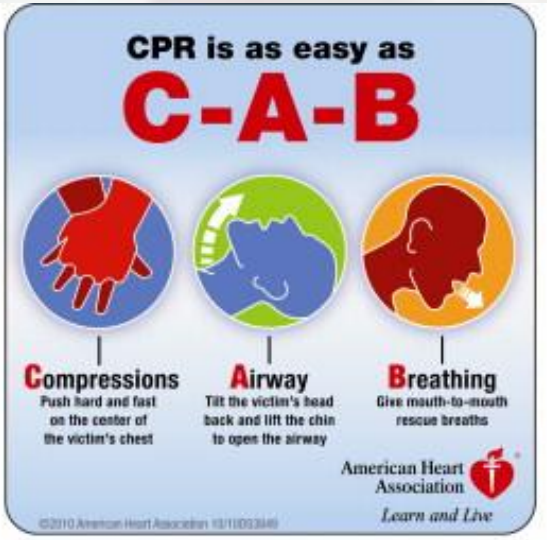
Badaki-Makun O et al. Chest compression quality over time in pediatric resuscitations. Pediatrics 2013 Mar; 131:e797.

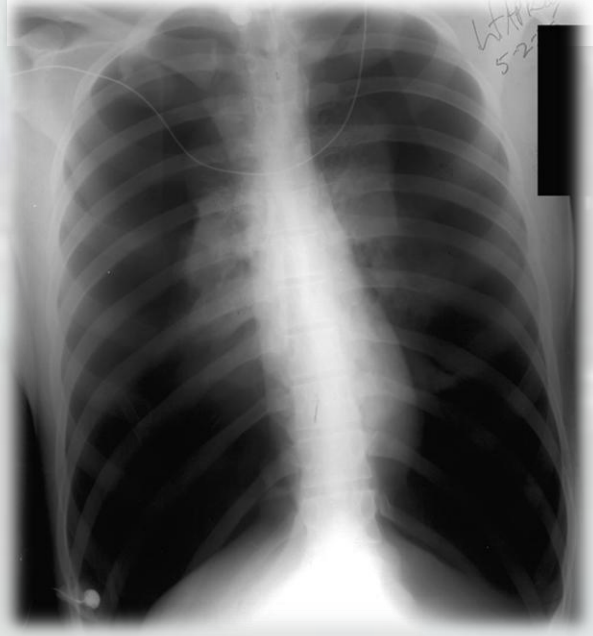

One, two three, BREATHE
He's dead, Jim

PREHOSPITAL HIGH QUALITY VENTILATIONS

Goal: High quality means NO hyperventilation / hyperoxygenation

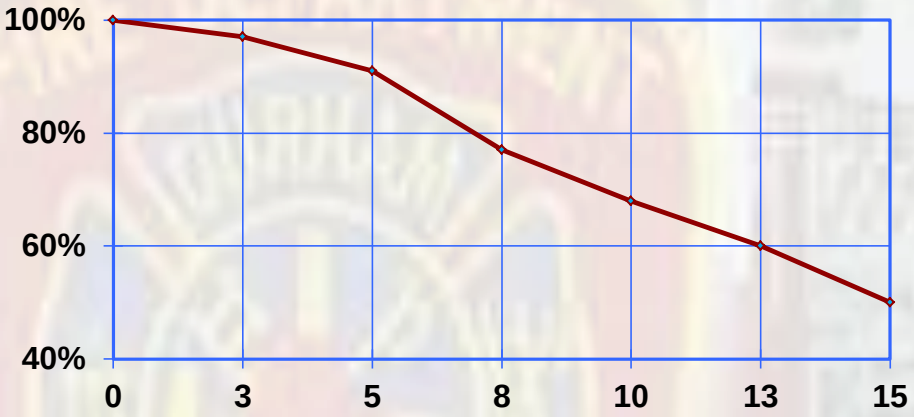
- Don't interrupt chest compression for inserting airway
  - Adult takes 10 – 15 minutes to de-saturate below 80%
  - Ventilate 8 – 10 / minute
  - Maintain SpO2 ≥ 94 %
  - Do NOT Hyperventilate



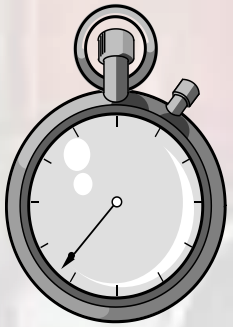


PREHOSPITAL HIGH QUALITY VENTILATIONS

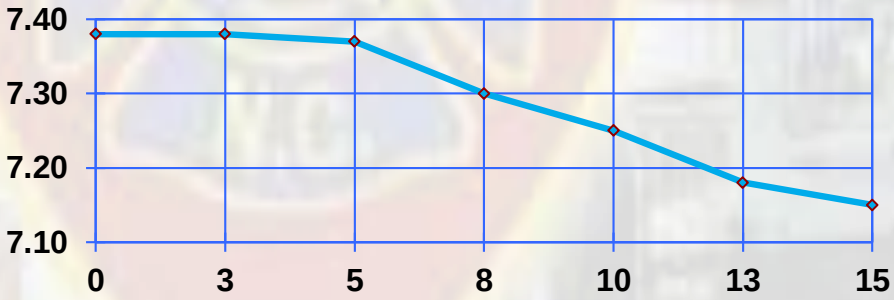
Oxygen Saturation



min



Arterial pH



min

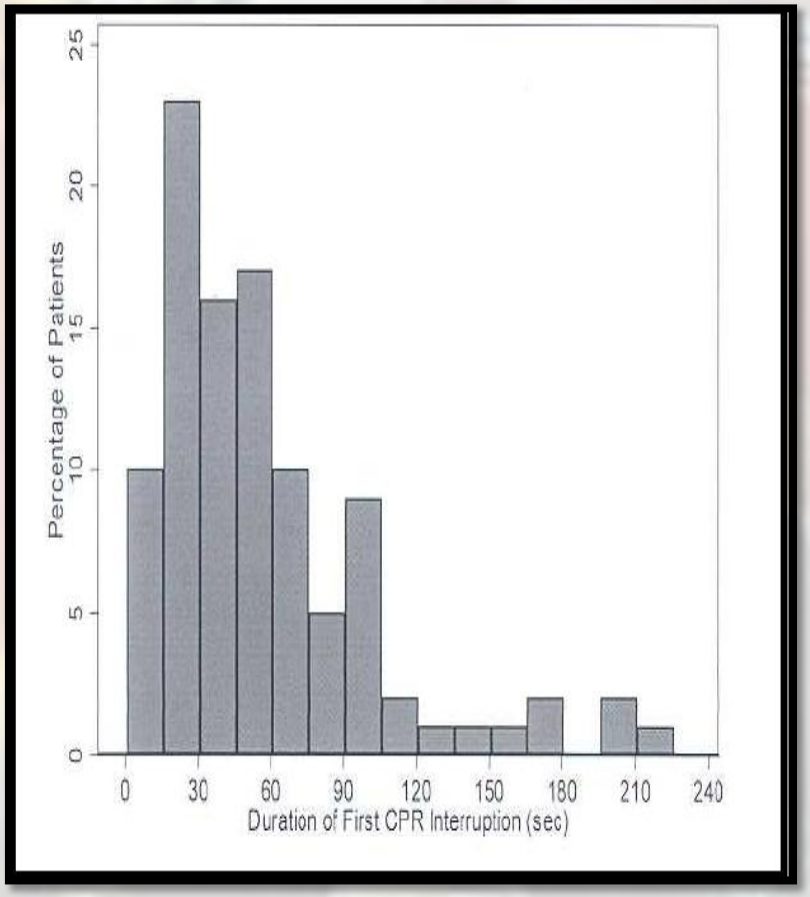
Advanced Airway Placement

Interruptions in CCC

- 100 cases reviewed
- Median 2 intubation attempts

- Median duration of interruption for 1st attempt = **46.5 sec**.

- Median total interruptions for all attempts = **109.5 sec**



Interruptions in Cardiopulmonary Resuscitation From Paramedic Endotracheal Intubation (WANG 2009)

JUST SAY NO TO INTUBATION

Why De-emphasis of Airway?

- Nationwide Japanese Registry 649,654
- ETT or Supraglottic Device Good Neurological Outcome 1 %
- BVM Good Neurological Outcome 3 %

Kohei Hasegawa, MD, MPH; Atsushi Hiraide, MD, PhD; Yuchiao Chang, PhD; David F. M. Brown, MD JAMA. 2013;309(3):257-266. doi:10.1001/jama.2012.187612.

Why De-emphasis of Airway?

- 170 Post-arrest patients with hypothermia
- 45 % survived to hospital discharge
- Survivors had lower median PaO2 198 mmHg
  - Nonsurvivors PaO2 254 mmHg
- Good neurological outcome 197 mmHg
  - Poor neurological outcome 247 mmHg
- Increased oxygen in first 24 hours
  - 1.5 times more likely to have poor outcome

Janz DR et al. Hyperoxia is associated with increased mortality in patients treated with mild therapeutic hypothermia after sudden cardiac arrest. *Crit Care Med* 2012 Dec;

Si's First Rule of Resuscitation

Forget about the airway initially…Jack

Easy

DEFIBRILLATION

Perishock Pause

Independent Predictor of Survival

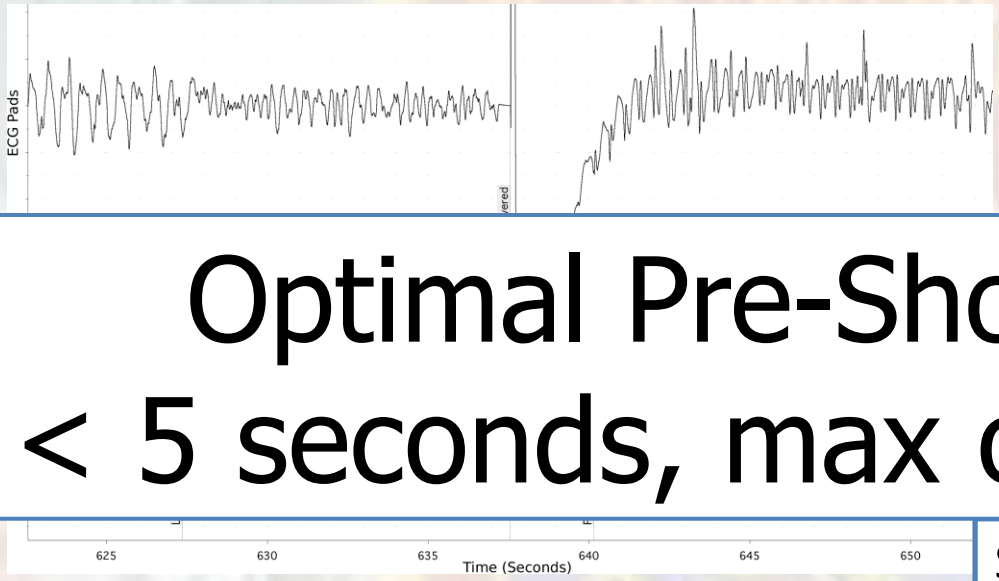


Figure 1. Diagram of preshock, postshock, and perishock pause. Preshock pause of 10 seconds, postshock pause of 2.3 seconds and perishock pause of 12.3 seconds depicted in the impedance channel of the cardiopulmonary resuscitation process file.

Perishock Pause = interruption in chest compressions before and after defibrillatory shock

Optimal Pre-Shock Pause: < 5 seconds, max of 10 seconds

Resuscitation Science

Perishock Pause

An Independent Predictor of Survival From Out-of-Hospital Shockable Cardiac 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

Study showed that odds of survival were significantly lower for patients with:

1. Pre-shock pause > 20 seconds
2. Peri-shock pause > 40 seconds

Anesthesia and Analgesia

THE USE OF HYPOTHERMIA AFTER CARDIAC ARREST

DONALD W. BENSON, M.D.
G. RAINEY WILLIAMS, JR., M.D.
FRANK C. SPENCER, M.D.
ADOLPH J. YATES, M.D.

Baltimore, Maryland*

"SUMMARY AND CONCLUSIONS

Nineteen patients resuscitated after cardiac arrest with resultant neurological damage were studied as to the effect of hypothermia on the outcome. Seven patients did not receive hypothermia and one lived. Twelve were cooled and 6 lived. The improvement in survival rate from 14 per cent to 50 per cent with use of hypothermia is clinically significant and warrants the use of cooling in all patients who have had cardiac arrest with demonstrable neurological injury."

Original Article

Mild Therapeutic Hypothermia to Improve the Neurologic Outcome after Cardiac Arrest

The Hypothermia after Cardiac Arrest Study Group

N Engl J Med 2002; 346:549-556

Original Article

Treatment of Comatose Survivors of Out-of-Hospital Cardiac Arrest with Induced Hypothermia

Stephen A. Bernard, M.B., B.S., Timothy W. Gray, M.B., B.S., Michael D. Buist, M.B., B.S., Bruce M. Jones, M.B., B.S., William Silvester, M.B., B.S., Geoff Gutteridge, M.B., B.S., and Karen Smith, B.Sc.

N Engl J Med 2002; 346:557-563

What did we learn from these trials?

- From the HACA trial
  - 75/136 (55%) patients with MTH had a favorable neurologic outcome as compared with 54/137 (39 %) in the normothermia group (RR= 1.40; 95% CI: 1.08-1.81).
  - Mortality at six months was 41% in MTH (56/137) as compared with 55% in the normothermia group (76/138; RR=0.74; 95%CI=0.58 to 0.95).

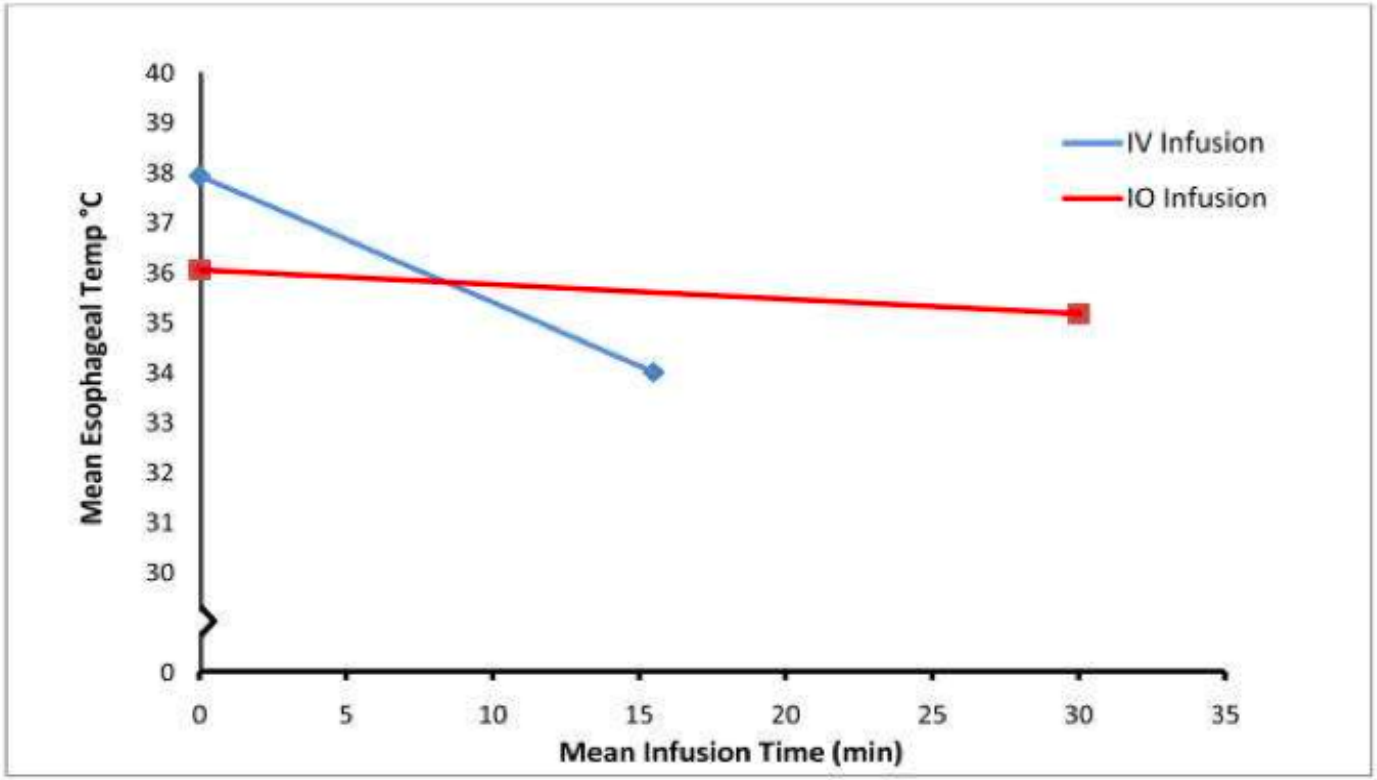
- From Bernard, et.al.,
  - 21/43 (49%) treated with MTH survived and had a good outcome vs 9/34 treated with normothermia (26%, P=0.046).
  - OR =5.25 (95%CI: 1.47 to 18.76; P=0.011) for a good neurologic outcome.

MTH induction by EMS: Use of Cold Saline

- RCT of 19 patients randomized to 4°C Ringer's solution with target temp of 33°C vs 18 patients receiving conventional fluids[1]
  - Significantly lower temps at hospital admission
  - No difference in survival to discharge (8 per group) or neurologic outcome (all CPC 1 or 2)
- Safety and efficacy of 2 liter infusion has been demonstrated in additional studies [2,3]

1. Kaarainen A., et.al., Prehospital therapeutic hypothermia for comatose survivors of cardiac arrest: a randomized controlled trial. Acta Anaesthesiol Scand 2009; 53: 900-907
2. Kim F, et.al., Pilot randomized clinical trial of prehospital induction of mild hypothermia in out-of-hospital cardiac arrest patients with a rapid infusion of 4 degrees C normal saline. Circulation 2007, 115(24): 3064-70
3. Bruel C, et.al., Mild hypothermia during advanced life support: a preliminary study in out-of-hospital cardiac arrest. Crit Care 2008, 12(1): R31

MTH induction by EMS: IV vs IO



Larabee TM, et.al, Resuscitation (2011), 82: 603-606

Therapeutic Hypothermia

- Growing Body of evidence
- All agree minimal side effects
- All agree better neurological outcomes
  - Greatest in VF
  - Still present in all other rhythms
- None have determined better outcome by starting in field
- Bottom line: Start if feasible
  - What you start is difficult for hospital to stop

Family Presence / TOR

- France: 15 EMS crews
- Randomized
- Questionnaires following
- 90 days later survivor interviewed
- 570 families enrolled / 475 completed
- 76 % witnessed in intervention group
- 43 % witnessed in control group
- PTSD symptoms 1.7 X higher in control

Jabre P et al. Family presence during cardiopulmonary resuscitation. N Engl J Med 2013 Mar 14; 368:1008.

TOR

- 2483 patients with CPR performed 08 – 10
- Survival to discharge is 6.6 %
- Field ROSC 36 %
- Survival 17.2 % with ROSC
- Without ROSC in field survival is 0.7% (11 patients)
  - No asystolic pt without ROSC survived to hospital discharge

Wampler DA et al. Cardiac arrest survival is rare without prehospital return of spontaneous circulation. Prehosp Emerg Care 2012 Jul 26

Summary

- Outcomes unchanged over time
- Focus on Chest Compressions
- Decreased Emphasis on Intubation
- Focus on Defibrillation
- Hypothermia beneficial when indicated
- Consider Termination of Resuscitation Protocols

QUESTIONS?