Code Talkers 2018

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Cardiac Arrest 2018

Resuscitation & Post-arrest Management

What makes sense - & doesn't - in cardiac arrest management

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Disclosures Brady & Slovis

NONE

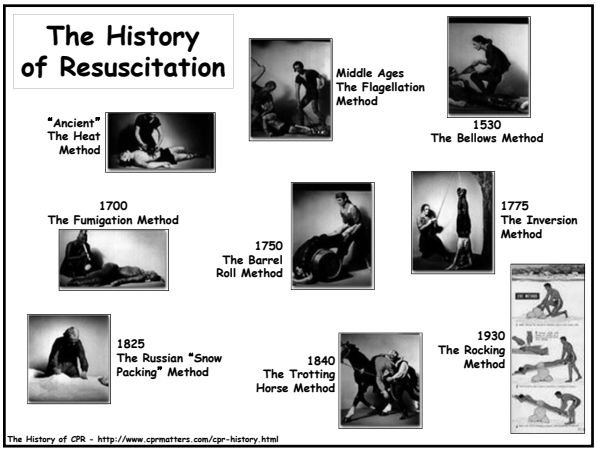
What we will discuss today…

1. **Pre-arrival care**
   - Lay provider alerts
   - Bystander CPR
   - AEDs
2. **The "Code" medications**
   - Anti-arrhythmic agents
   - Vasopressors
   - Others
3. **Airway management**
   - Endotracheal intubation
   - Supra-glottic device
   - BVM
4. **Post-ROSC care**
   - Targeted temperature management
   - PCI
   - ECMO

You should do 5 things

1. Enable **systems of response** in your community, supporting rapid community notification & public safety response, hands-only CPR, & public-access AEDs.
2. Perform **chest compressions** – high quality with limited interruptions.
3. Apply **defibrillation ASAP** for pulseless VT & VF via public-access AED or multifunction device.
4. Provide **appropriate airway** & administer bolus-dose **medications**, as appropriate, **without interruption** in chest compression or defibrillation.
5. Deliver **comprehensive post-resuscitation care**.

The History of Resuscitation



The History of CPR - http://www.cprmatters.com/cpr-history.html

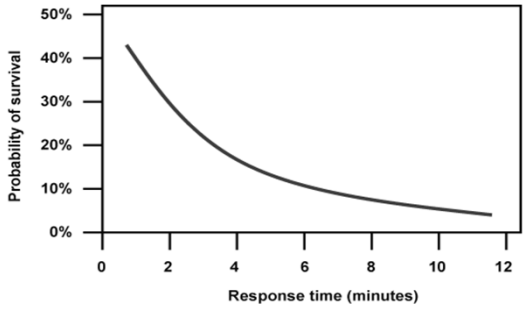
Pre-Arrival Care

Recognition of Arrest
Call for Help
Chest Compressions
Automatic External Defibrillator

What's all the fuss about this "pre-arrival" provider care?

Why not just take them to the hospital ASAP?

Survival in Cardiac Arrest
Time to Therapy is Key



Cardiac Arrest

Quality of care for EMS-managed cardiac arrest

Issue	Total	Adult	Pediatric
Bystander CPR (%)	**40.8**	**40.4**	**53.9**
AED before EMS (%)	**2.1**	**2.1**	**0**
Pulseless VT / VF (%)	**23**	**--**	**--**
Time to First EMS Shock (min)	**8.9**	**8.9**	**9.0**
Chest Compression Fraction	**0.75**	**0.75**	**0.80**
Compression Depth (mm)	**39.5**	**39.6**	**35.9**
Preshock Pause Duration (min)	**18.5**	**18.5**	**NA**
Number of Events (2013)	**359,400**	**--**	**--**
Survival (%)	**9.5%**	**--**	**--**

Circulation, Jan 2014, http://circ.ahajournal.org Resuscitation Outcomes Consortium Cardiac Epistry

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Survival in Cardiac Arrest
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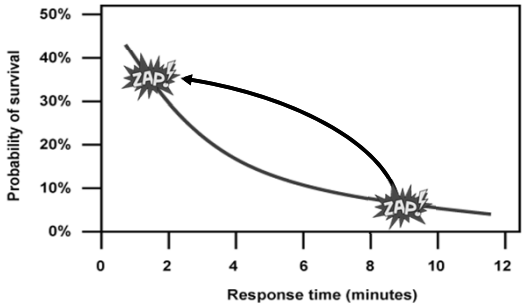
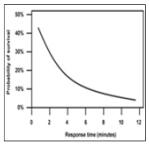
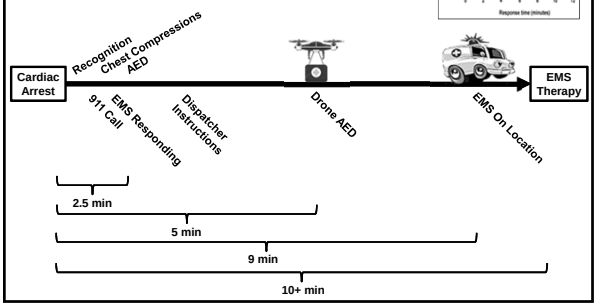


What makes a difference…

- Early intervention…by anyone
- Chest compressions
- Defibrillation…for pVT & VF
- Particularly in cardiogenic events
- Lay Provider……EMS……EM……Hospital

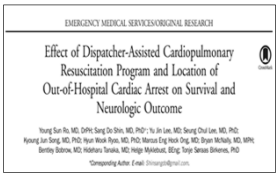
Pre-Arrival Care





Dispatcher Instructions

- 911 provides instructions for CPR
- Only after event identified, location confirmed, & units dispatched
- 37,924 events
- Instructions CPR from 31% to 56%


EMERGENCY MEDICAL SERVICES/ORIGINAL RESEARCH

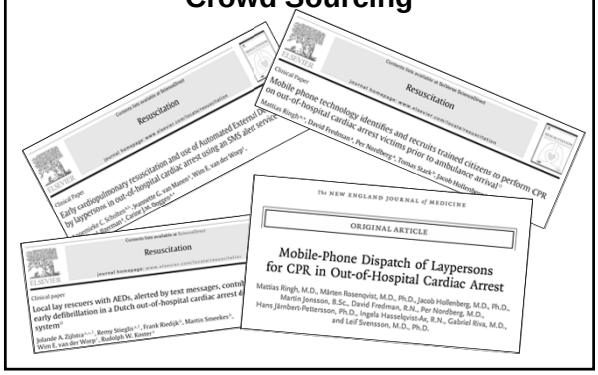
Effect of Dispatcher-Assisted Cardiopulmonary Resuscitation Program and Location of Out-of-Hospital Cardiac Arrest on Survival and Neurologic Outcome

- Public – any CPR increased neuro-intact survival
- Private – only CPR instruction group increased neuro-intact survival

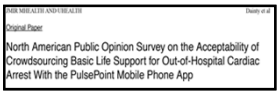
Community Notification Crowd Sourcing

- Smartphone-based technology
- Operated by 911 centers
- Intent – reduce time to lay interventions
- Largely endorsed by public safety agencies

Community Notification Crowd Sourcing



Crowd Sourcing


Original Paper

North American Public Opinion Survey on the Acceptability of Crowdsourcing Basic Life Support for Out-of-Hospital Cardiac Arrest With the PulsePoint Mobile Phone App

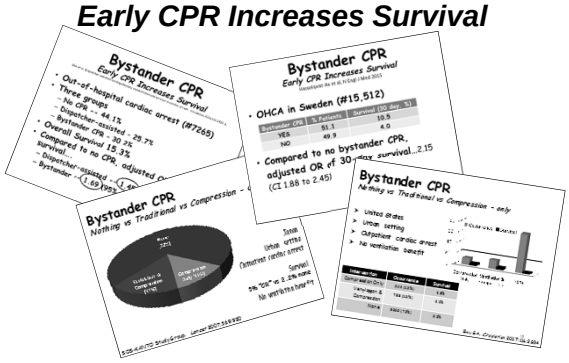
- Survey asking about appropriateness of community notification – PulsePoint
- North America – 2415 participants
- 96+% Approved of concept
  - 98% Canadians / 96% US
- Would download app
  - 84% Canadians / 55% US
- Would want such a response if a victim
  - 95% Canadians / 94% US

Bystander CPR

- **Compressions vs ventilations vs both**
  - Compression-only similar …or superior
  - Some form is highly important
- **Outcome improved**
  - Survival rate
  - Neurologic status

Bystander CPR

Early CPR Increases Survival



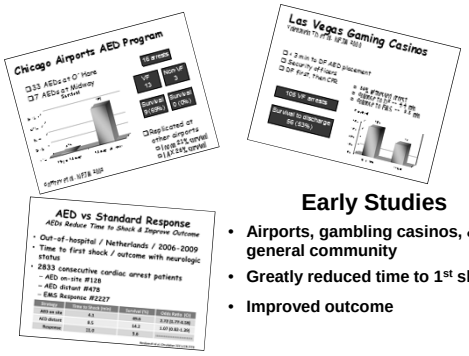
Bystander CPR

Study	Survival
Standard basic life support vs. continuous chest compressions only in out-of-hospital cardiac arrest	None 2.5%, CPR 4.3%, OR 1.72
Chest Compression–Only CPR by Lay Rescuers and Survival From Out-of-Hospital Cardiac Arrest	CPR 10-15%
Effectiveness of Bystander-Initiated Cardiac-Only Resuscitation for Patients With Out-of-Hospital Cardiac Arrest	None 2.5%, CPR 4.3%, OR 1.72
Cardiopulmonary resuscitation by bystanders with chest compression only (SOS-KANTO): an observational study	None 2.2%, CPR 5.2%
Comparison of chest compression only and standard cardiopulmonary resuscitation for out-of-hospital cardiac arrest in Singapore	OR 5.0 – 5.4
Time-dependent effectiveness of chest compression-only and conventional cardiopulmonary resuscitation for out-of-hospital cardiac arrest of cardiac origin	None 3.8%, CPR 7.1%, OR 1.78

Automatic External Defibrillator

- **Easy & safe**
- **Reduce time to defibrillation**
- **Used with CPR**
- **Can be life saving**
- **Obviously…only impact "*shockable rhythm*" presentations**

Public Access Defibrillation



Early Studies

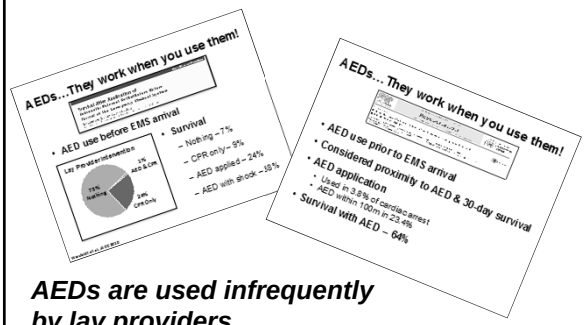
- **Airports, gambling casinos, & general community**
- **Greatly reduced time to 1st shock**
- **Improved outcome**

Public Access Defibrillation

Comparing EMS vs Bystander AED Shock

Study	Survival
Impact of Onsite or Dispatched Automated External Defibrillator Use on Survival After Out-of-Hospital Cardiac Arrest	EMS 6%, Bystander 50%, Bystander AED 2.72 OR
Survival after Public Access Defibrillation in Stockholm, Sweden – A striking success	EMS 31%, First Responder 42%, Bystander 70%
Public access defibrillation—Results from the Victorian Ambulance Cardiac Arrest Registry	EMS 31%, Bystander 45%, Bystander AED 1.62 OR
Survival After Application of Automatic External Defibrillators Before Arrival of the Emergency Medical System	None 9%, Bystander 38%, Bystander AED 1.75 OR
Public Access Defibrillation: Great benefit and potential but infrequently used	None 47%, Bystander 64%

Public Access AEDs…Less Frequently Used



AEDs are used infrequently by lay providers

Public Access Defibrillation

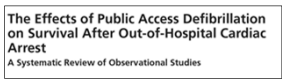
n engl j med 2016;375:1649

- **Bystander-witnessed, VF arrests, 2005-2013**
- **PAD use increased, from 1% to 17%**
- **30 day survival with intact neuro status**
  - 18% no PAD
  - 39% PAD
- **Neuro-intact survivors increased from 6 (2005) to 201 (2013)**

43,762 Total Patients
↓
4,499 (10.3%) PAD Applied
↓
1732 (38.5%) 30 day survivors with intact neuro status

Public Access Defibrillation

circulation 2017;136:954



- **Systematic review of 41 studies**
  - 18 non-dispatched lay provider
  - 3 dispatched lay provider
  - 20 dispatched first responder
- **Survival to D/C**
  - Overall median -- 40%
  - Non-dispatched lay provider – 53%
  - Dispatched lay provider – limited data
  - Dispatched first responder – 29%

Public Access Defibrillation

AJEM 2017;35:1043

- **Western Sweden, 2008-2015**
- **Shockable rhythm & AED applied prior to EMS**
- **PAD use increased from 5% (2008) to 20% (2015)**
- **OR for 30-day survival for PAD vs dispatched AED, 2.45 (1.02-5.95)**

6,675 Total Patients
↓
1602 (24%) VF
↓
162 (15%) PAD Applied
↓
44 (27%) 30-day survival

Drone AED

- **Delivery of AED**
- **911 center launch**
- **Rapid delivery – ~5 min (well developed system)**
- **AED used by lay provider**
- **Investigational in northern Europe**

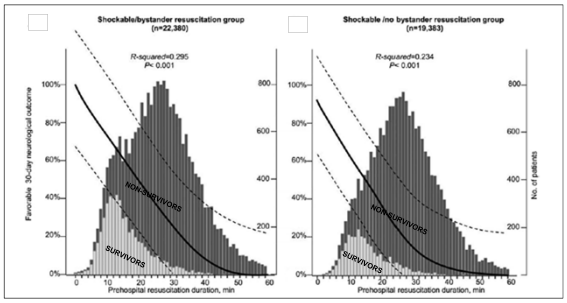
Pre-arrival Care & Duration of Resuscitation

Impact of Bystander Intervention

- **Bystander intervention – CPR +/- AED**
  - Improves neuro-intact survival **AND**
  - Mitigates impact of longer EMS response times
- **Bystander intervention – CPR +/- AED**
  - *"…30-day survival more than doubled…despite long ambulance response time."* Circulation 2016;134:2095
  - "*…risk of brain damage was significantly lower…*" NEJM 2017:376:1737
  - "*…with longer ambulance response times, the increase in mortality and worsening neurologic outcome appear to be mitigated…*" AJEM 2017;35:1049

Pre-arrival Care & Duration of Resuscitation

Impact of Bystander Intervention



Circulation 2016;133:1386

Take Homes

- **Basic has significant impact**
- **Interventions…CPR & AED**
- **Enhance early care**
  - Dispatcher instructions
  - Crowd sourcing
  - Drone AEDs
- **As EPs…**
  - Support programs in prehospital world
  - Extrapolate to ED care (compressions, defibrillator, etc)

Traumatic Cardiac Arrest

EMS Management

J Trauma Acute Care Surg 2016;81:285.

Prehospital traumatic cardiac arrest: Management and outcomes from the resuscitation outcomes consortium epistry-trauma and PROPHET registries

Christopher C.D. Evans, MD, Ashley Petersen, Eric N. Meier, MS, Jason E. Buick, MSc, PCP, Martin Schreiber, MD, Dolores Kannas, RN, MSN, Michael A. Austin, MBBS, and the Resuscitation Outcomes Consortium Investigators. *Kingston, Ontario, Canada*

- **2 registries - ROC & PROPHET - #2300**
- **Blunt & penetrating trauma – CPR**
- **6.3% survival to D/C – most survivors + vitals on EMS arrival**

	Epistry		PROPHET	
Intervention	Adjusted OR (95% CI)†	p Value	Adjusted OR (95% CI)†	p Value
EMS training of first rig: ALS	1.09 (0.54–2.22)	0.81	0.99 (0.44–2.21)	0.98
Airway intervention		0.20		0.015
Bag-mask ventilation only	Reference		Reference	
Supraglottic airway‡	0.35 (0.08–1.35)		0.27 (0.08–0.95)	
Endotracheal intubation	0.70 (0.38–1.31)		0.37 (0.17–0.78)	
Needle thoracostomy§			0.68 (0.26–1.78)	0.42
Hemorrhage control	0.76 (0.37–1.59)	0.47	1.10 (0.50–2.46)	0.82
Intravenous fluid administration	1.40 (0.78–2.49)	0.25	1.41 (0.66–3.01)	0.37
Intraosseous fluid administration	0.52 (0.07–1.52)	0.11	0.44 (0.14–1.37)	0.13

- ***"…no ALS procedures were associated with increased odds of survival"***

The "Code" Meds

None of the meds ever work! Giving any of them is a big waste of time!! So why do YOU do it?

Part 7: Adult Advanced Cardiovascular Life Support
2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

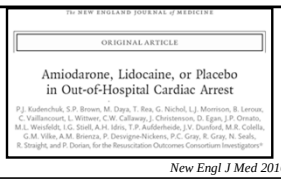
Mark S. Link, Chair; Lauren C. Berkow; Peter J. Kudenchuk; Henry R. Halperin; Erik P. Hess; Vivek K. Moitra; Robert W. Neumar; Brian J. O'Neil; James H. Paxton; Scott M. Silvers; Roger D. White; Demetris Yannopoulos; Michael W. Donnino

Circulation 2015:132 (suppl 2);5444-64

Antiarrhythmic for VF/pVT

- Amiodarone may be considered
- Lidocaine may be considered as alternative
- Magnesium not recommended

"No antiarrhythmic as yet been shown to increase survival or neurologic outcome after cardiac arrest due to VF/pVT"


The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Amiodarone, Lidocaine, or Placebo in Out-of-Hospital Cardiac Arrest

P.J. Kudenchuk, S.P. Brown, M. Daya, T. Rea, G. Nichol, L.J. Morrison, B. Leroux, C. Vaillancourt, L. Wittwer, C.W. Callaway, J. Christenson, D. Egan, J.P. Ornato, M.L. Weisfeldt, I.G. Stiell, A.H. Idris, T.P. Aufderheide, J.V. Dunford, M.R. Colella, G.M. Vilke, A.M. Brienza, P. Desvigne-Nickens, P.C. Gray, R. Gray, N. Seals, E. Straight, and P. Dorian, for the Resuscitation Outcomes Consortium Investigators*

New Engl J Med 2016;374:1711-22

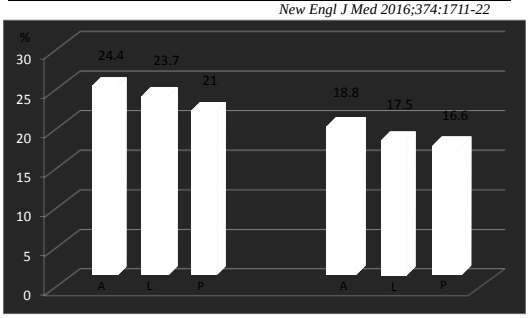
What is the best antiarrhythmic for shock resistant VF/pVT:
Amiodarone vs Lidocaine vs Placebo?

- 3,026 pts., 10 ROC sites
- Randomized, double blind, placebo controlled
- VF/pVT, s/p 1 or more shocks, s/p epi
- Only adult, medical VF/pVT OOH

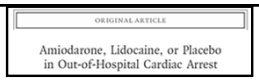
Survival to Discharge

Neurologic Outcome

New Engl J Med 2016;374:1711-22



Survival Mod Rankin ≤ 3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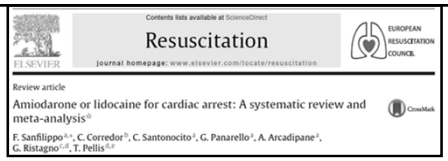
Percentage Differences

- Amiodarone vs Placebo 3.2% (p=0.08)
- Amiodarone vs Lidocaine 0.7% (p=0.70)
- Lidocaine vs Placebo 2.6% (p=0.16)
- Amiodarone vs Placebo Modified Rankin ≤ 3 2.2% (p=0.19)
- Amiodarone vs Lidocaine Modified Rankin ≤ 3 1.3% (p=0.44)


Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

EUROPEAN RESUSCITATION COUNCIL

Review article

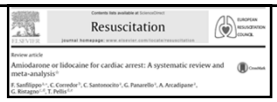
Amiodarone or lidocaine for cardiac arrest: A systematic review and meta-analysis*

F. Sanfilippo, C. Corredor, C. Santonocito, G. Panarello, A. Arcadipane, G. Ristagno, T. Pellis

Resuscitation 2016;107:31-7

What do all studies combined tell us about Amiodarone vs Lidocaine in VF/pVT?

- 7 studies: 3 RCTs, 4 non-RCTs
- 3,877 pts in RCTs and 700 in non-RCTs
- Includes 2016 NEJM trial
- Admission and Discharged Alive evaluated


Resuscitation

Review article

Amiodarone or lidocaine for cardiac arrest: A systematic review and meta-analysis*

Results

Resuscitation 2016;107:31-7

Amiodarone vs Placebo:

↑trend for hospital discharge with Amio (p=0.08)

No difference in favorable neuro outcomes

Lidocaine vs Placebo:

No significant difference at discharge

Amiodarone vs Lidocaine:

No difference in hospital discharge (p=0.81)

At the present time, there is no clear benefit of Amiodarone vs Lidocaine

Late in VF it's not clear either drug is beneficial

Do not always use pre-hospital data for in-ED and in-hospital arrests

ORIGINAL ARTICLE

Amiodarone, Lidocaine, or Placebo in Out-of-Hospital Cardiac Arrest

P.J. Kudenchuk, S.P. Brown, M. Daya, T. Rea, G. Nichol, L.J. Morrison, B. Leroux, C. Vaillancourt, L. Wittwer, C.W. Callaway, J. Christenson, D. Egan, J.P. Ornato, M.L. Weisfeldt, I.G. Stiell, A.H. Idris, T.P. Aufderheide, J.V. Dunford, M.R. Colella, G.M. Vilke, A.M. Brienza, P. Desvigne-Nickens, P.C. Gray, R. Gray, N. Seals, R. Straight, and P. Dorian, for the Resuscitation Outcomes Consortium Investigators*

NEJM 2016:375;801-3

Authors Note in Letter to Editor

- 5% absolute improvement of Amiodarone over placebo ($p \leq 0.04$) if arrest witnessed (1934 pts)
- 21.9% absolute increase Amiodarone vs placebo if EMS witnessed and gave drugs near immediately ($p < 0.01$ for 154 pts)

Corey, so there is limited to no benefit for med administration.

Is there anything other than amiodarone or lidocaine for refractory VF?

Refractory VF

- Switching pad locations
- Beta blockers
- Double sequential defibrillation
- ECMO/ECLS *(discussed later…)*

Refractory VF/pVT

Change Pad Location

Ant-Lat ⟷ Ant-Post

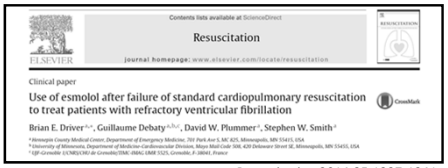
Part 7: Adult Advanced Cardiovascular Life Support
2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

Mark S. Link, Chair; Lauren C. Berkow; Peter J. Kudenchuk; Henry R. Halperin; Erik P. Hess; Vivek K. Moitra; Robert W. Neumar; Brian J. O'Neil; James H. Paxton; Scott M. Silvers; Roger D. White; Demetris Yannopoulos; Michael W. Donnino

Circulation 2015:132 (suppl 2);5444-64

Beta Blockers

- Use not addressed during VF/pVT
- "Inadequate evidence" to support post CPR use
- May be considered
- Not enough evidence to be for or against lidocaine or beta blockers s/p VF/pVT


Resuscitation

Clinical paper

Use of esmolol after failure of standard cardiopulmonary resuscitation to treat patients with refractory ventricular fibrillation

Brian E. Driver, Guillaume Debaty, David W. Plummer, Stephen W. Smith

Resuscitation 2014;85:1337-1341

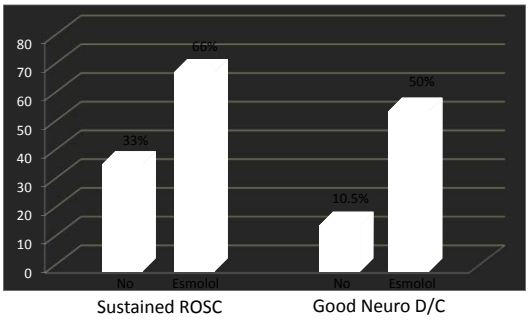
Is Esmolol effective in refractory VF/VT?

- Retrospective ED study
- All EMS to ED arrivals
- All s/p 3 shocks, 3 doses Epi, 300mg Amio
- Compares Esmolol vs no Esmolol

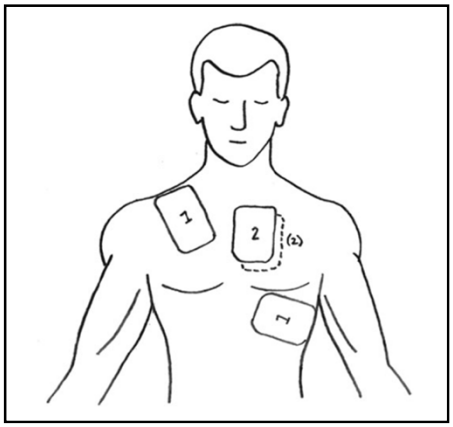
Esmolol for Refractory VF/VT

Sustained ROSC and Good Neuro D/C

Resuscitation 2014;85:1337-1341



I now always consider beta blockers in VF




Resuscitation

Available online 15 June 2017

In Press, Accepted Manuscript — Note to users

Clinical paper

Double sequential defibrillation therapy for out-of-hospital cardiac arrests: the London experience

Amber C. Emmerson, Mark Whitbread, Rachael T. Fothergill

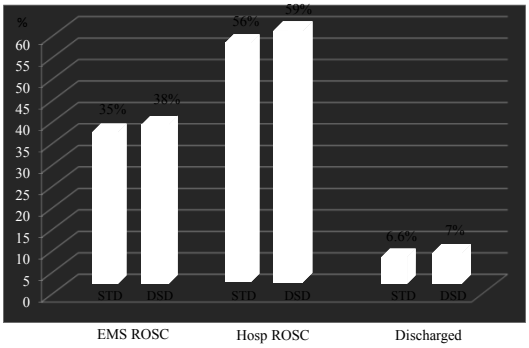
Resuscitation June 2017;117:97-101

Is double sequential defibrillation (DSD) beneficial in refractory VF/pVT?

- 45 patients treated with DSD
- Retrospective observational study
- London Ambulance Service
- Compared to 175 who got standard defibrillation
- Only patients with ≥ 6 shocks compared

Standard vs DSD in VF/pVT

Resuscitation June 2017;117:97-101



Double Sequential Defibrillation

- Not a randomized trial
- Many pts got up to 10 shocks pre DSD
- The role of Double Sequential Defibrillation is not yet clarified and needs a randomized larger trial

CARDIOLOGY/CASE REPORT

External Defibrillator Damage Associated With Attempted Synchronized Dual-Dose Cardioversion

Neal S. Gerstein, MD, FASE*; A. Robb McLean, MD, MHCM; Eric C. Stecker, MD, MPH; Peter M. Schulman, MD

*Corresponding Author. E-mail: ngerstein@gmail.com.

The simultaneous use of 2 external defibrillators to administer either dual or sequential cardioversion or defibrillation for

Annals Emergency Medicine 2018;71:109-12

Is Dual Sequential Defibrillation (DSD) dangerous to the defibrillators?

- Zoll M and/or Physio-Control LP 15s
- Two DSDs: 1 Zoll & 1 LP @ 560 J synched
- Two DSDs with 2 LPs at combined 720 J
- All 4 DSDs done A-P
- One LP found to become nonfunctional

External Defibrillator Damage Associated With Attempted Synchronized Dual-Dose Cardioversion

Neal S. Gerstein, MD, FASE*; A. Robb McLean, MD, MHCM; Eric C. Stecker, MD, MPH; Peter M. Schulman, MD

Annals Emergency Medicine 2018;71:109-12

"LIFEPAK defibrillators comply with standards which require defibrillators to withstand defibrillation shocks from a second defibrillator connected to a patient. This testing does not include delivering simultaneous/sequential or overlapping 360 J defibrillation shocks from two LIFEPAK defibrillators. There are no design and/or safety standards for use of external defibrillators to perform double sequential defibrillation. We cannot guarantee the reliability of functionality of devices subject to this off-label use. Product warranty cannot legally cover damage to LIFEPAK defibrillators which occurs as a result of performing an off-label use"

Dual Sequential Defibrillation Take Homes

- May not be more effective
- May damage defibrillator
- Is a crowd pleaser

Treating VF pVT

Take Homes

- Either Lidocaine or Amiodarone, not ready to drop antiarrhythmics completely in VF/pVT
- They work if given immediately
- Consider Beta Blockers in shock resistant refractory VF
- Consider moving pads
- Consider double sequential defibrillation

acep Scientific Assembly 18 SAN DIEGO, CA

Corey, anything new on epi?

Should we still use it?

Part 7: Adult Advanced Cardiovascular Life Support
2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

Mark S. Link, Chair; Lauren C. Berkow; Peter J. Kudenchuk; Henry R. Halperin; Erik P. Hess; Vivek K. Moitra; Robert W. Neumar; Brian J. O'Neil; James H. Paxton; Scott M. Silvers; Roger D. White; Demetris Yannopoulos; Michael W. Donnino

Circulation 2015:132 (suppl 2);5444-64

Epinephrine Use

Standard dose epinephrine (1 mg Q 3-5 min) may be reasonable for patients with cardiac arrest (class 11b)

- *Early administration may improve ROSC and neurologic outcomes – later administration may decrease both*

Resuscitation

Review article

Adrenaline for out-of-hospital cardiac arrest resuscitation: A systematic review and meta-analysis of randomized controlled trials

Resuscitation 2014;85:732-40

- Does Epinephrine use have true benefits in CPR?
- Meta analysis, 14 RCTs, 12,246 patients
- Studies were:
  - Epi vs placebo (1) n = 534
  - Epi vs high does Epi (6) n = 6,174
  - Epi vs Vasopression (1) n = 336
  - Epi vs Epi + Vasopressin (6) n = 5,202

Resuscitation

Review article

Adrenaline for out-of-hospital cardiac arrest resuscitation: A systematic review and meta-analysis of randomized controlled trials

Resuscitation 2014;85:732-40

- Does Epinephrine use have true benefits in CPR?
- Meta analysis, 14 RCTs, 12,246 patients

NO!!

ORIGINAL ARTICLE

A Randomized Trial of Epinephrine in Out-of-Hospital Cardiac Arrest

G.D. Perkins, C. Ji, C.D. Deakin, T. Quinn, J.P. Nolan, C. Scomparin, S. Regan, J. Long, A. Slowther, H. Pocock, J.J.M. Black, F. Moore, R.T. Fothergill, N. Rees, L. O'Shea, M. Docherty, I. Gunson, K. Han, K. Charlton, J. Finn, S. Petrou, N. Stallard, S. Gates, and R. Lall, for the PARAMEDIC2 Collaborators*

ABSTRACT

BACKGROUND

Concern about the use of epinephrine as a treatment for out-of-hospital cardiac arrest led the International Liaison Committee on Resuscitation to call for a placebo-

New Engl J Med 2018;379:711-21

What is the role of epinephrine in cardiac arrest?

- Large double blind placebo controlled trial
- 8,014 pts, London EMS, adults ≥ 16 yo
- 4,015 pts, 1 mg epi Q 3-5 min
- 3,999 placebo receiving patients

The study evaluated 30 day outcomes and functional neurologic outcomes at discharge and at 3 months

New Engl J Med 2018;379:711-21

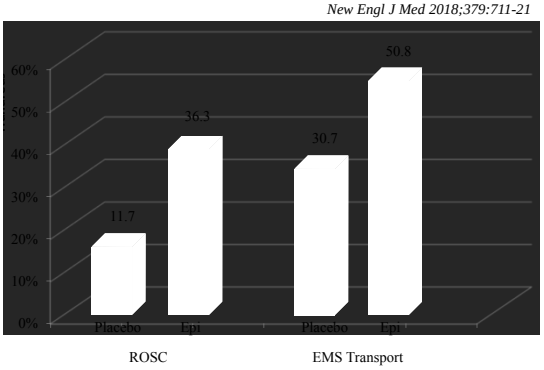
Times and Dose

New Engl J Med 2018;379:711-21

6.6 min	Call to EMS arrival (median)
21.4 min	Call to epinephrine or placebo
4.9 ± 2.5 mg	Epinephrine dose (mean)

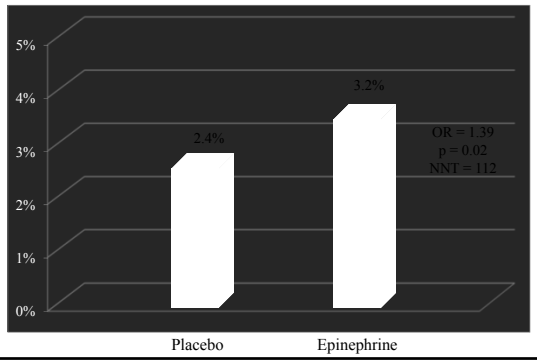
ROSC and EMS Transport

New Engl J Med 2018;379:711-21

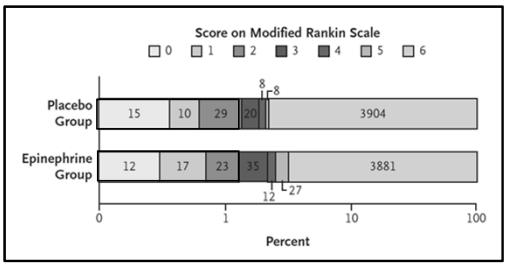


30 Day Survival

New Engl J Med 2018;379:711-21



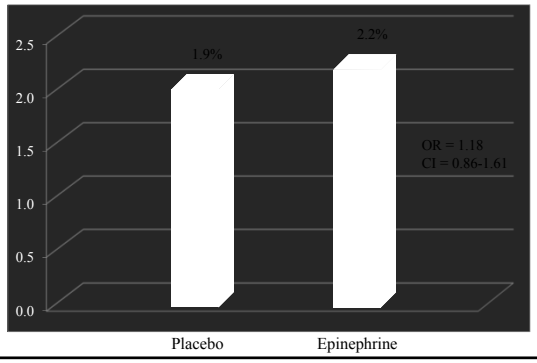
30 Day Neurologic Outcomes



New Engl J Med 2018;379:711-21

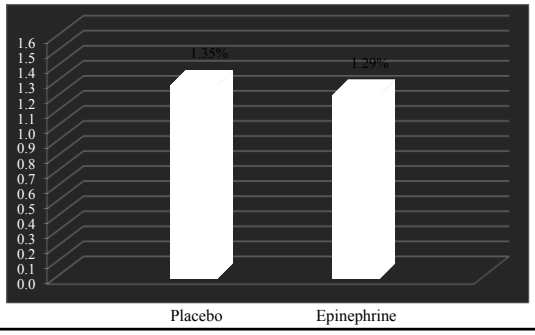
Rankin 0 - 3

New Engl J Med 2018;379:711-21



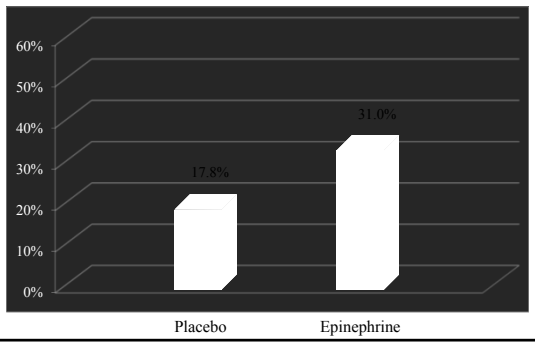
Favorable Neurologic Outcome
Rankin 0 - 2

New Engl J Med 2018;379:711-21



Severe Neurologic Disability (30 d)
Rankin 4, 5

New Engl J Med 2018;379:711-21



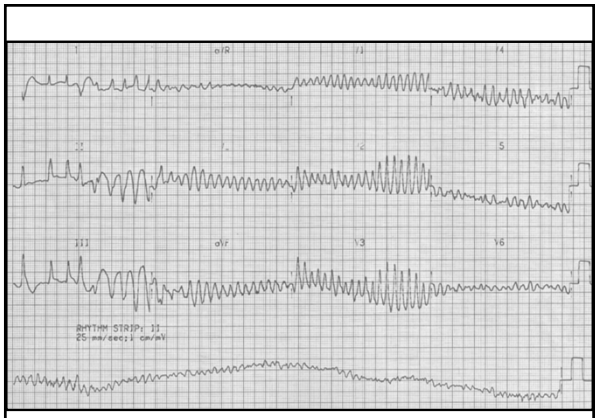
Adjusted Analysis
Paramedic Witnessed

New Engl J Med 2018;379:711-21

Epinephrine in Cardiac Arrest
Take Homes

The role of epinephrine in cardiac arrest will continue to be debated

Epinephrine increases survival but does not increase the rate of neurologically intact survival



Early administration of epinephrine (adrenaline) in patients with cardiac arrest with initial shockable rhythm in hospital: propensity score matched analysis

Lars W Andersen,[1,2,3] Tobias Kurth,[4] Maureen Chase,[1] Katherine M Berg,[5] Michael N Cocchi,[1,6] Clifton Callaway,[7] Michael W Donnino[1,5] for the American Heart Association's Get With The Guidelines-Resuscitation Investigators

ABSTRACT
OBJECTIVES
To evaluate whether patients who experience cardiac arrest in hospital receive epinephrine (adrenaline) within the two minutes after the first defibrillation (contrary to American Heart Association guidelines) propensity score with patients who were "at risk" of receiving epinephrine within the same minute but who did not receive it.
RESULTS
2978 patients were matched on the propensity score, and the groups were well balanced. 1510 (51%) patients

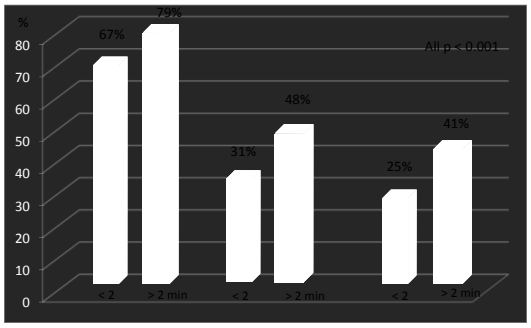
BMJ 2016;353:1577-87

Does giving epinephrine before 2nd shock help or hinder resuscitation?

- 2,974 VF/pVT arrests, 1,510 with epi < 2 min
- Inpatient data from 300 GWTG-R hospitals
- Propensity matched cardiac arrest pts
- 51% of patients received epi before 2nd shock

Epi Before vs After 2nd Shock

BMJ 2016;353:1577-87



Wait for second shock before giving Epi in VF!

Epinephrine in Cardiac Arrest Take Homes

Epinephrine increases the number of neurologically devastated survivors

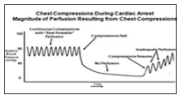
Do not give epinephrine until after second shock in VF

Airway Management

Intubation is very important. Everyone in cardiac arrest should be intubated ASAP.

Airway Management

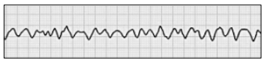
- **Prior teaching…**Focused on the "ABC's"
  - Favored ETT…early & in all
- **Alphabet no longer starts with "A"…**The "CAB's"
- **If performed**
  - properly…
  - without interruptions or delays…



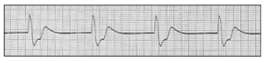
- **Cardiogenic vs non-cardiogenic events**

Airway Management

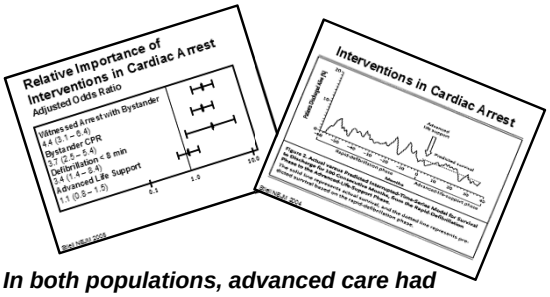
- **Cardiogenic**
  - Cardiac-based event
  - Sudden with oxygen "reserve" & little acidosis
  - "Less early" airway



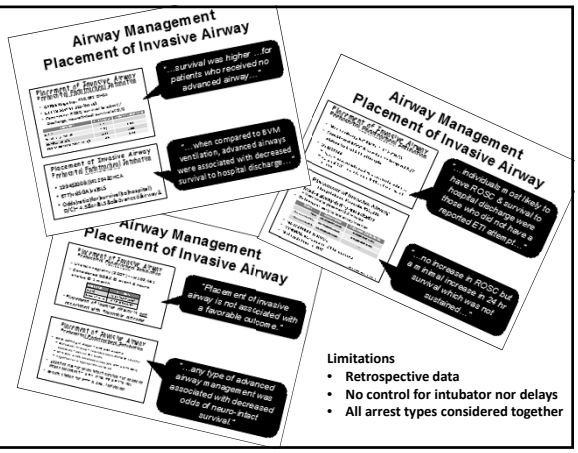
- **Non-cardiogenic**
  - Not initially cardiac…
  - Gradual with progressive hypoxia & acidosis
  - "Earlier" airway



Management Basic vs Advanced Care



In both populations, advanced care had marginal positive impact on outcome…



Limitations

- **Retrospective data**
- **No control for intubator nor delays**
- **All arrest types considered together**

Airway Management

JAMA | Original Investigation
Effect of Bag-Mask Ventilation vs Endotracheal Intubation During Cardiopulmonary Resuscitation on Neurological Outcome After Out-of-Hospital Cardiorespiratory Arrest
A Randomized Clinical Trial — Jabre et al, JAMA 2018;319:779

- **Randomized trial, multicenter – BVM vs ETI**
- **Adult OHCA - #2040: 1018 BVM & 1022 ETI**
- **Outcomes**
  - Primary– neuro @ 28 days
  - Secondary– ROSC, survival ED arrival / 28 days, difficulty
- **No difference in primary / secondary outcomes**
- "***Among patients with OHCA, the use of BMV compared with ETI failed to demonstrate noninferiority or inferiority… requires further research.***"

Airway Management

AIRWAY/SYSTEMATIC REVIEW SNAPSHOT

Does Intubation Improve Outcomes Over Supraglottic Airways in Adult Out-of-Hospital Cardiac Arrest?

EBEM Commentators
Jestin N. Carlson, MD, MS
Department of Emergency Medicine
Saint Vincent Hospital
Erie, PA
Department of Emergency Medicine
University of Pittsburgh School of Medicine
Pittsburgh, PA
Henry E. Wang, MD, MS
Department of Emergency Medicine
University of Alabama at Birmingham
Birmingham, AL

Carlson & Wang
Ann EM 2016;67:396

Meta-analytic results of combined data for intubation versus supraglottic airway.

	ETI, n	SGA, n	OR (95% CI)
All studies			
ROSC	33,256	40,594	1.28 (1.05–1.55)
Neurologically intact survival to hospital discharge	28,911	38,918	1.33 (1.09–1.61)
Sensitivity analysis*			
ROSC	31,405	36,205	1.30 (0.94–1.81)
Neurologically intact survival to hospital discharge	28,749	38,416	1.33 (1.04–1.69)

Airway Management

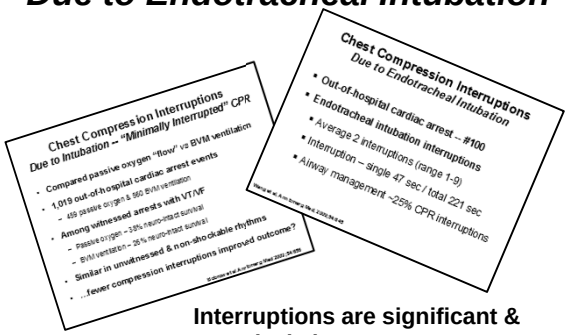
TAKE-HOME MESSAGE

In observational studies, intubation is associated with better outcomes than supraglottic airway devices in out-of-hospital cardiac arrest; however, the results of ongoing prospective trials are needed to confirm these findings.

Ongoing trials

- UK Airway Management in Cardiac Arrest Patients trial study (www.isrctn.com)
- US Pragmatic Airway Resuscitation Trial (www.clinicaltrials.gov)

Compression Interruptions *Due to Endotracheal Intubation*



Interruptions are significant & negatively impact outcome

Take Homes

Airway Management

- **Cardiogenic vs non-cardiogenic**

  AND

- **Early vs "less early" airway intervention**

  } **Cardiogenic & "Less Early"** / **Non-cardiogenic & Early**

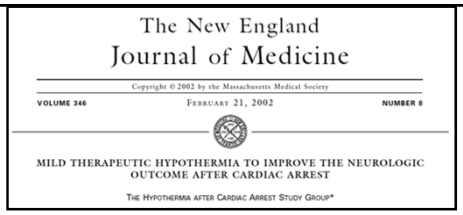
- **BVM vs invasive airway**
- **Avoid interruptions due to airway management**

Post-Resuscitation Care

Post-resuscitation care should only include BP & airway management. The rest of those interventions really are not of value in most patients & should be done in the ICU.

2017 ACC/AHA Guidelines PCI and Hypothermia

- Therapeutic hypothermia should be started ASAP for all comatose STEMI patients and out of hospital arrests due to VF or VT (1B)
- Immediate PCI is indicated in all STEMI arrest patients including those who are receiving therapeutic hypothermia (1B)


The New England Journal of Medicine

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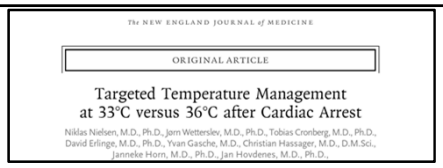
VOLUME 346 FEBRUARY 21, 2002 NUMBER 8

MILD THERAPEUTIC HYPOTHERMIA TO IMPROVE THE NEUROLOGIC OUTCOME AFTER CARDIAC ARREST

THE HYPOTHERMIA AFTER CARDIAC ARREST STUDY GROUP*

(32º - 34º) Therapeutic Hypothermia significantly improves survival (↑26%) and neurologic outcome (↑40%) after VF/pVT cardiac arrest


The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Targeted Temperature Management at 33°C versus 36°C after Cardiac Arrest

Niklas Nielsen, M.D., Ph.D., Jørn Wetterslev, M.D., Ph.D., Tobias Cronberg, M.D., Ph.D., David Erlinge, M.D., Ph.D., Yvan Gasche, M.D., Christian Hassager, M.D., D.M.Sci., Janneke Horn, M.D., Ph.D., Jan Hovdenes, M.D., Ph.D.,

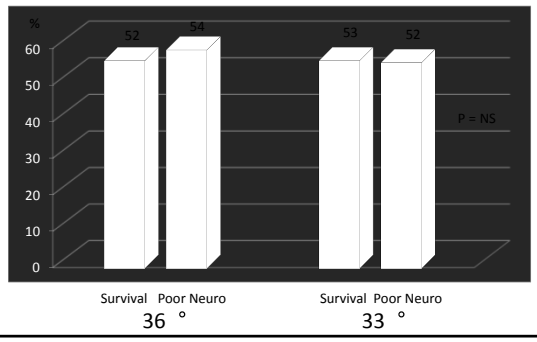
New Engl J Med 2013, 369:2197-2206

- What temperature for Therapeutic Hypothermia?
- Compares 32º - 33º to 35º - 36º TH
- 939 patients in randomized trial
- 36 ICUs in Europe and Australia
- Evaluated: mortality & neuro outcome at 180d
- 80% VF/VT; 20% AS and PEA *(12%/7%)*

Hypothermia vs Normal Temp

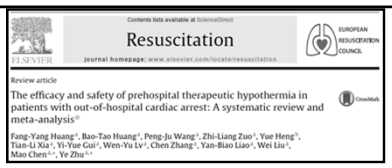
Survival and Neuro Outcomes

New Engl J Med 2013, 369:2197-2206



Therapeutic Hypothermia
Take Homes

- The future of deep TH is unclear
- Preventing Hyperthermia appears crucial
- Future studies will determine optimal TH temp
- Well done study, but likely not the final study
- 35° – 36° looks like the new 32° – 34°


Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Review article

The efficacy and safety of prehospital therapeutic hypothermia in patients with out-of-hospital cardiac arrest: A systematic review and meta-analysis☆

Fang-Yang Huang[a], Bao-Tao Huang[a], Peng-Ju Wang[a], Zhi-Liang Zuo[a], Yue Heng[b], Tian-Li Xia[a], Yi-Yue Gui[a], Wen-Yu Lv[a], Chen Zhang[a], Yan-Biao Liao[a], Wei Liu[a], Mao Chen[a,*], Ye Zhu[a,*]

Resuscitation 2015;96:170-179

There is no benefit to prehospital hypothermia regardless of cooling method, time to induce TH, continuation of TH in ED or initial arrest rhythm

Is ECMO really of value in patients with ongoing cardiac arrest?

…who are the patients?

…what are the system needs?

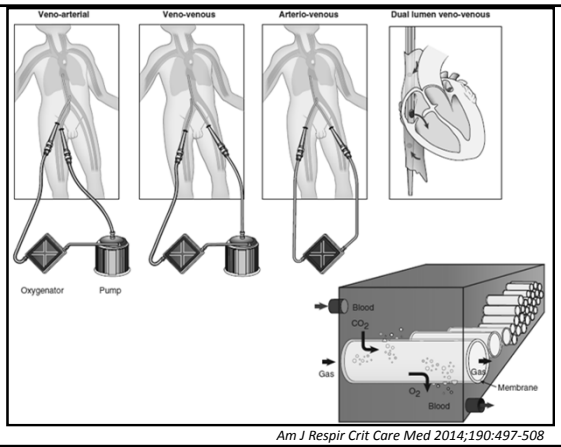
Does ECMO have a role in CPR?

Refractory cardiac arrest treated with mechanical CPR, hypothermia, ECMO and early reperfusion (the CHEER trial)☆

Resuscitation 2015;86:88-94

"E-CPR" 'ECLS"

- ECMO
- Mechanical CPR
- Therapeutic Hypothermia
- Immediate post ECMO PCI
- 24 hours of TH



Am J Respir Crit Care Med 2014;190:497-508

Uses of ECMO and ECLS

- Respiratory failure – ARDS, H_1N_1, SARS
- Bridge to heart transplant
- Bridge to lung transplant
- Cardiogenic shock
- **ECLS s/p cardiac arrest**

Refractory cardiac arrest treated with mechanical CPR, hypothermia, ECMO and early reperfusion (the CHEER trial)

Dion Stub[a,f,g], Stephen Bernard[a,b,d,e], Vincent Pellegrino[a], Karen Smith[b,d,e], Tony Walker[d], Jayne Sheldrake[a], Lisen Hockings[a], James Shaw[a,b,c], Stephen J. Duffy[a,h,c], Aidan Burrell[a,b], Peter Cameron[a,b], De Villiers Smit[a], David M. Kaye[a,h,c]

[a] Alfred Hospital, Australia
[b] Monash University, Australia
[c] Baker IDI Heart and Diabetes Research Institute, Australia
[d] Ambulance Victoria, Australia
[e] University of Western Australia, Australia
[f] University of Washington, United States
[g] St. Paul's Hospital, Vancouver, Canada

Resuscitation 2015;86:88-94

Does ECMO improve post-arrest resuscitation outcomes – The CHEER trial

- Refractory VF x 30 minutes
- No known underlying severe disease
- CPR within 10 minutes of arrest
- Mechanical CPR available
- ECMO Team with 2 MDs present

E-CPR Results

Resuscitation 2015;86:88-94

- 26 patients (11 OHCA, 15 IHCA)
- ECMO within 56 minutes; 2 days on
- 96% ROSC

54% (14/26) survived to discharge with CPC score of 1 – full neurologic recovery

ECPR

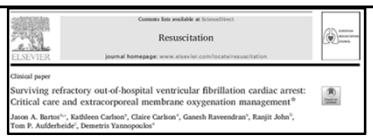
Annals Emerg Med 2016;68:678-89

- Shockable arrest rhythm or known precipitant
- Reversible cause of arrest
- Witnessed arrest with CPR
- Duration of pulselessness < 15-20 min or transient ROSC
- Absence of major life-limiting comorbidities

No ECPR

Annals Emerg Med 2016;68:678-89

- Elderly or serious underlying diseases
- Irreversible neurologic insult
- Morbid obesity or arterial disease
- ECLS team not readily available
- Contraindications to LVAD, Heart Transplant


Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical paper

Surviving refractory out-of-hospital ventricular fibrillation cardiac arrest: Critical care and extracorporeal membrane oxygenation management*

Jason A. Bartos[*,*], Kathleen Carlson[a], Claire Carlson[a], Ganesh Raveendran[a], Ranjit John[b], Tom P. Aufderheide[c], Demetris Yannopoulos[a]

Resus 2018;132:47-55

Does ECPR really improve survival s/p refractory VF/pVT arrest?

- 100 transported VF/pVT pts
- University of Minnesota in Minneapolis
- All pts 3 shocks without ROSC
- Amiodarone 300 mg IV
- EMS transport with LUCAS device

EMS → Cardiac Cath Lab
in less than 30 minutes
ECMO begun ASAP in CCL

Resus 2018;132:47-55

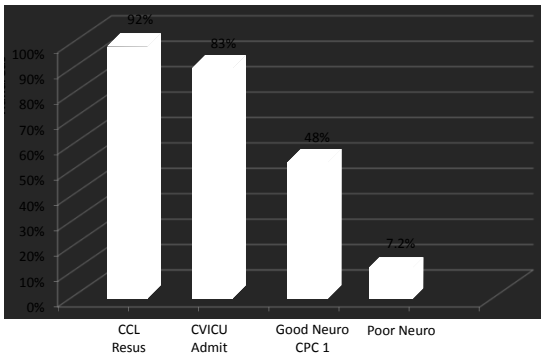
Declared Dead on CCL Arrival

Resus 2018;132:47-55

- $ETCO_2$ < 10 mm Hg
- PaO_2 < 50 mm Hg
- Lactate > 18 mmol/L
- EMS → CCL time > 90 min

Fate of 100 Refractory VF/pVT pts

Resus 2018;132:47-55



ECPR Complications

Resus 2018;132:47-55

- Mean time on ECMO 3.5 days
- All patients developed MOSF
- Anoxic CNS insult #1 cause of death
- ¼ of pts will have CPR trauma
- Requires team of intensivists, surgeons, cardiologists


Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical paper

Surviving refractory out-of-hospital ventricular fibrillation cardiac arrest: Critical care and extracorporeal membrane oxygenation management*

Jason A. Bartos[*,*], Kathleen Carlson[a], Claire Carlson[a], Ganesh Raveendran[a], Ranjit John[b], Tom P. Aufderheide[c], Demetris Yannopoulos[a]

Resus 2018;132:47-55

Does ECPR really improve survival s/p refractory VF/pVT arrest?

48% good neuro for
Shock resistant VF/pVT

ECLS clearly improves in-hospital arrest outcomes if begun within 30-60 minutes of arrest

ECLS of variable benefit for out of hospital arrests unless transported rapidly to the CCL

Bill, this is my last question…

What are your thoughts on PCI post arrest?

Corey…send 'em to the cath lab!

And this is why…

PCI after ROSC

Outcomes of ST Elevation Myocardial Infarction Complicated by Out-of-Hospital Cardiac Arrest (from the Los Angeles County Regional System)

David M. Sherrill, MD[a], Nichole Brown, MD, MPH[a], Joseph L. Thomas, MD[a], Amy H. Kaji, MD, PhD[a], Gene Sung, MD[b], William J. French, MD[a], and James T. Niemann, MD[a]

PCI indicated STEMI on ECG?

- **Los Angeles - Regional Registry Data**
- **OHCA with ROSC & STEMI**
  - 422 patients over 3.5 years
  - 74% shockable rhythm
  - Time to PCI 94 +/- 37 min
- **Outcome - Survival 62% with ~50% good neuro outcome**

Am J Cardiol 2017;120:729–733

PCI after ROSC

Patients without ST elevation after return of spontaneous circulation may benefit from emergent percutaneous intervention: A systematic review and meta-analysis☆

Michael G. Millin[a,*], Angela C. Comer[b], Jose V. Nable[c], Peter V. Johnston[d], Benjamin J. Lawner[e], Nathan Woltman[c], Matthew J. Levy[e], Kevin G. Seaman[e], Jon Mark Hirshon[e]

PCI indicated if VT/VF & no STEMI on ECG?

- **Systematic review & meta-analysis**
- **11 articles involving 2,885 pts.**
- **Evaluated in CCL if no STEMI on ECG**

Resuscitation 2016;108:54-60

PCI after ROSC

Patients without ST elevation after return of spontaneous circulation may benefit from emergent percutaneous intervention: A systematic review and meta-analysis☆

Michael G. Millin[a,*], Angela C. Comer[b], Jose V. Nable[c], Peter V. Johnston[d], Benjamin J. Lawner[e], Nathan Woltman[c], Matthew J. Levy[e], Kevin G. Seaman[e], Jon Mark Hirshon[e]

PCI indicated if VT/VF & no STEMI on ECG?

- **Culprit lesion found…**
  - …in 71.9% if STEMI on ECG
  - …in 32.2% if no STEMI on ECG
- **PCI improves survival by a factor of 3.7 (CI 1.31-10.70)**
  - …regardless of STEMI or no STEMI on ECG
  - Survival increase by 30% in "no STEMI on ECG" patients

Resuscitation 2016;108:54-60

PCI after ROSC

Incidence of coronary intervention in cardiac arrest survivors with non-shockable initial rhythms and no evidence of ST-elevation MI (STEMI)

Matthew Wilson, Anne V. Grossestreuer, David F. Gaieski, Benjamin S. Abella, William Frohna, Munish Goyal

How common is <u>intervenable coronary lesion</u> with <u>non-shockable rhythm</u>?

- **1396 ROSC patients, 18 centers, retrospective**
- **879 patients with asystole or PEA**
- **141 underwent angiography**
  - 69% with no STEMI
  - 25% had lesion with PCI

Resuscitation 2017;113:83-6

PCI after ROSC

Is <u>Coma a Contra-indication</u> to PCI?...NO

- **Shockable rhythm / no STEMI #269** Hollenberg, Resuscitation, 2014
  - Multicenter (US) retrospective study with TH…comatose patients
  - 45% CCL early with 66% survival, early CCL → increased survival
  - Conclusion – "*In comatose survivors of cardiac arrest, early cardiac catheterization is associated with significantly decreased mortality.*"
- **ROSC with CCL & TH #886** Angeletti, G Ital Cardiol, 2014
  - Single center (Italy) retrospective review
  - 24 comatose ACS patients - 16 surviving to D/C w/ good neuro status
  - Conclusion – "*PCI is feasible & associated with acceptable outcome in the majority of comatose survivors…*"

PCI after ROSC

What is <u>Long-term Outcome in Older Adults</u> with ROSC & PCI?

Long-Term Post-Discharge Risks in Older Survivors of Myocardial Infarction With and Without Out-of-Hospital Cardiac Arrest

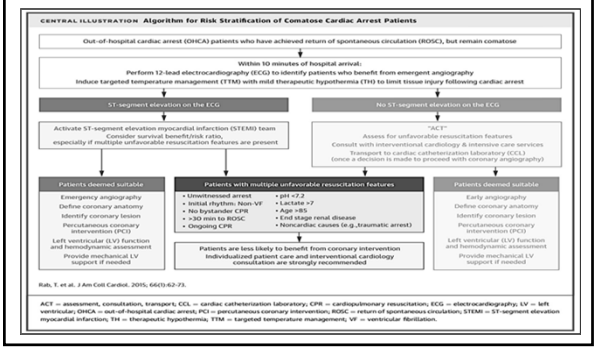
Christopher B. Fordyce, MD, MSc; Tracy Y. Wang, MD, MHS, MSc; Anita Y. Chen, MS; Laine Thomas, PhD; Christopher B. Granger, MD; Benjamin M. Scirica, MD; Timothy D. Henry, MD; Graham C. Wong, MD, MPH; Krishnan Ramanathan, MBBS; Carolina M. Hansen, MD; Kristian Kragholm, MD; Eric D. Peterson, MD, MPH; Monique L. Anderson, MD

*"…older patients with MI [and OHCA] **<u>did not have higher 1-year mortality</u>** or health care use rates compared with those MI survivors without OHCA. These findings … support efforts to **<u>improve initial survival rates of older patients</u>** with MI and OHCA."*

PCI after ROSC

JACC 2015;66:63
Interventional Council ACC

Cardiac Arrest
A Treatment Algorithm for Emergent Invasive Cardiac Procedures in the Resuscitated Comatose Patient



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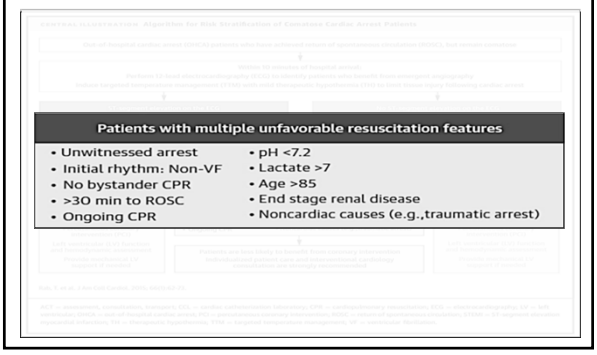

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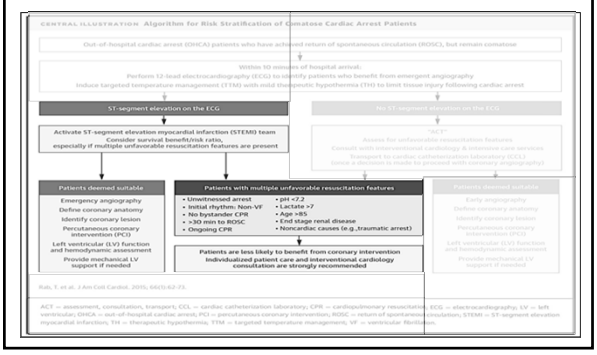

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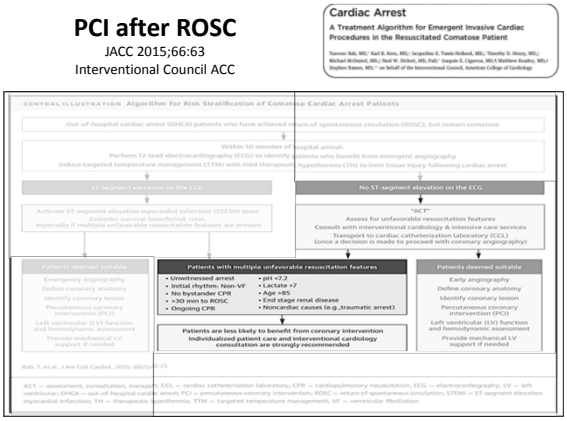
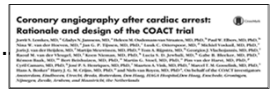


Take Homes
PCI After ROSC

- **Shockable rhythms…**
  - STEMI greatest benefit
  - no STEMI also benefits
- **Nonshockable, if cardiogenic…some benefit**
- **Coma NOT a contra-indication**
- **Can be performed with TTM**
- **Long-term outcome is favorable**
- **Largely retrospective data…**
- **Prospective trial in progress……**


Coronary angiography after cardiac arrest: Rationale and design of the COACT trial

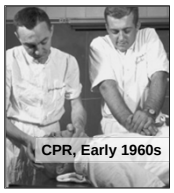
In summary…

- **Early care is vital…lay provider, EMS, & hospital**
- **The "code meds" – minor, not major, contribution**
- **Airway management – any benefit?**
  - Shockable vs non-shockable rhythms
  - Early vs non early
  - Avoid interruptions…
- **Post-ROSC care**
  - Basic is key & mandatory
  - Advanced in certain patients – PCI, TTM & ……ECMO

The bottom line you ask…

- **One approach does not fit all**
- **Tailor your approach**

That's it…thanks!


CPR, Early 1960s

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