Code Talkers 2017

William Brady, MD
University of Virginia
wjbrady@virginia.edu

Corey Slovis, MD
Vanderbilt University
corey.slovis@vanderbilt.edu

Cardiac Arrest 2017

Resuscitation & Post-arrest Management

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

William Brady, MD
University of Virginia
wjbrady@virginia.edu

Corey Slovis, MD
Vanderbilt University
corey.slovis@vanderbilt.edu

Disclosures Brady & Slovis

NONE

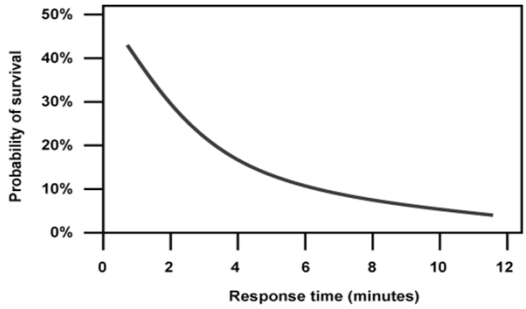
What we will discuss today…

1. **Lay provider care**
   - Social media 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

Lay Provider Care

What's all the fuss about this lay provider care? Why not just take them to the hospital ASAP?

Survival in Cardiac Arrest
Time to Therapy is Key



What makes a difference…

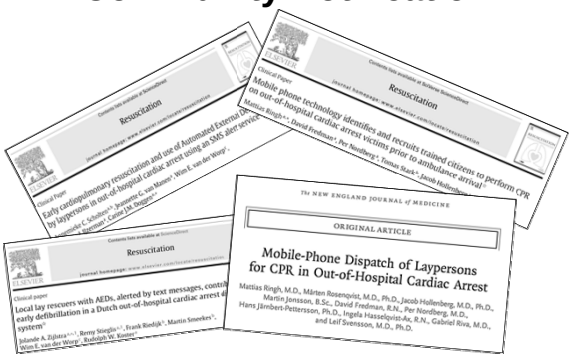
- **Early intervention**
- **Chest compressions**
- **Defibrillation**
- **Particularly in cardiogenic cardiac arrest**
- **ER….EMS….Bystander & Lay Provider**

Community Notification

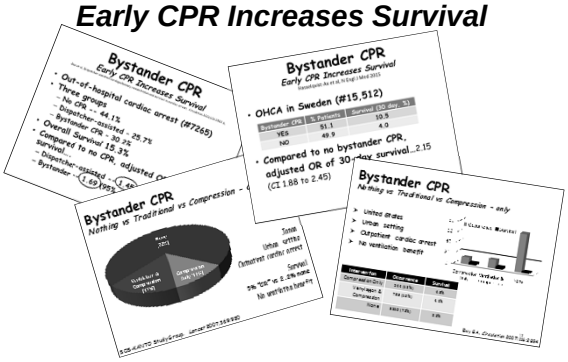
- **Smartphone-based technology**
- **Operated by 911 centers**
- **Intent**
  - Reduce time to compressions
  - Reduce time to AED

- **Largely endorsed by public safety agencies**
- **No EMS-based complaints**

Community Notification



Bystander CPR
Early CPR Increases Survival



Bystander CPR

- **Compressions vs ventilations vs both**
  - Compression-only similar to superior
- **Some form is highly important**
- **Reasonable to use compression-only**
- **Outcome altering**
  - Survival rate increased
  - Improved neurologic outcome increased

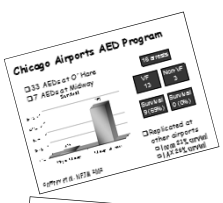
Bystander CPR

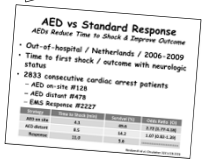
Study	Survival
Standard basic life support vs. continuous chest compressions only in out-of-hospital cardiac arrest	None 2.5%, CPR 4.3%, OD 1.72
Chest Compression–Only CPR by Lay Rescuers and Survival From Out-of-Hospital Cardiac Arrest	CPR 10-15%
Effectiveness of Bystander-Initiated Cardiac-Only Resuscitation for Patients With Out-of-Hospital Cardiac Arrest	None 2.5%, CPR 4.3%, OD 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	OD 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%, OD 1.78

Automatic External Defibrillator

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

Automatic External Defibrillator





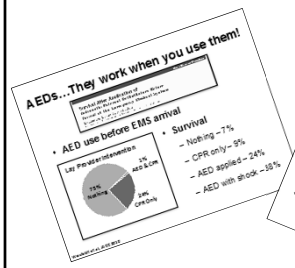
Early Studies

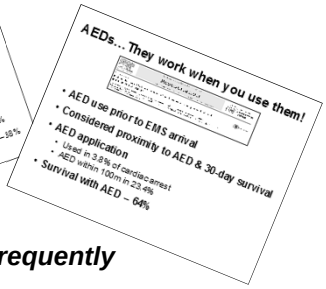
- Airports, gambling casinos, & general community
- Greatly reduced time to 1st shock
- Improved outcome

Automatic External Defibrillator
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%

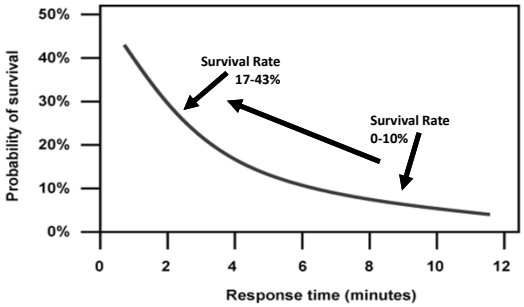
AEDs…They work when you use them!





AEDs are used infrequently by lay providers

Survival in Cardiac Arrest
Time to Therapy is Key



Lay Provider Care

- Social media to alert lay providers of near-by cardiac arrest
- Bystander CPR, preferably compression-only
- Automatic external defibrillator use
- …and Dispatcher, pre-arrival CPR instructions

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. Villa, A.M. Brienza, P. Desvigne-Nickens, P.C. Gray, R. Gray, N. Seals, R. Straight, and P. Dorian, for the Resuscitation Outcomes Consortium Investigators*

New Engl J Med 2016; online April 4

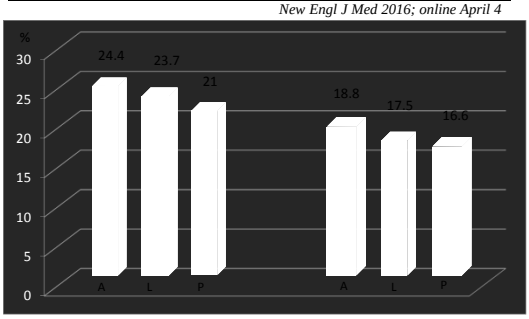
What is the best antiarrhythmic for shock resistant VF/pVT: Amiodarone vs Lidocaine vs Placebo?

- 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; online April 4



Survival | Mod Rankin ≤ 3

ORIGINAL ARTICLE

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

New Engl J Med 2016; online April 4

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

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

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 ≤ 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

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/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

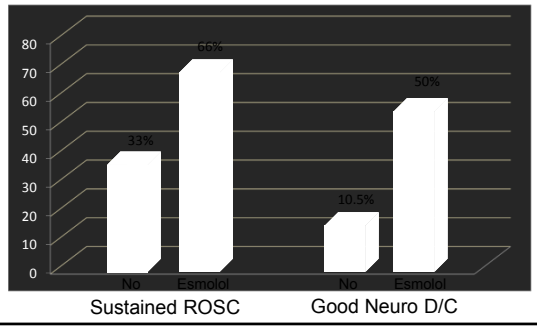
Resuscitation 2014;85:1337-1341

Is Esmolol effective in refractory VF/VT?

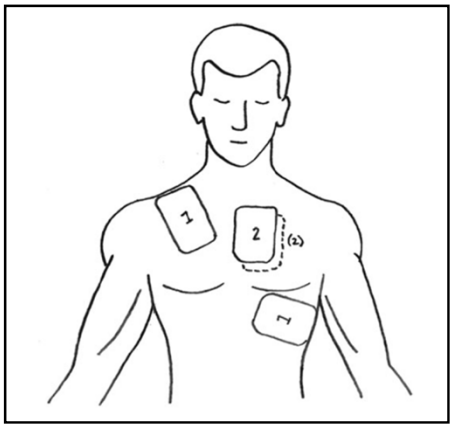
- Retrospective ED study
- All EMS to ED arrivals
- All s/p 3 shocks, 3 doses Epi, 300mg Amio
- Compares Esmolol vs no Esmolol

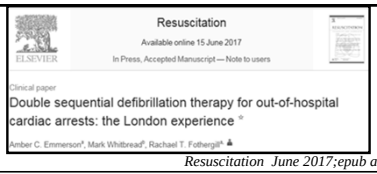
Esmolol for Refractory VF/VT
Sustained ROSC and Good Neuro D/C

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

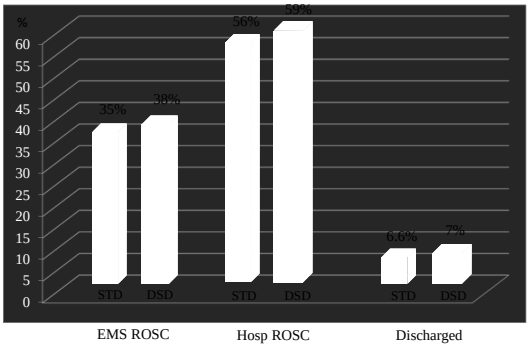
Resuscitation June 2017;epub ahead of print

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;epub ahead of print



Double Sequential Defibrillation
Take Homes

- 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

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

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

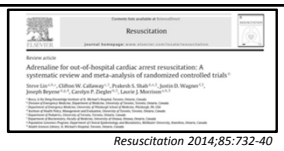
Mark S. Link, Chair; Lauren C. Berkow; Peter J. Kudenchuk; Henry R. Halperin; Erik P. Hess; Vivek K. Moitra; Robert W. Neumar; Brian J. O'Neil; James H. Paxton; Scott M. Silvers; Roger D. White; Demetris Yannopoulos; Michael W. Donnino

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 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 2014;85:732-40

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

NO!!

Effectiveness of Prehospital Epinephrine Administration in Improving Long-term Outcomes of Witnessed Out-of-hospital Cardiac Arrest Patients with Initial Non-shockable Rhythms

Jun Tomio, MD, PhD, Shinji Nakahara, MD, PhD, Hideto Takahashi, PhD, Masao Ichikawa, PhD, Masamichi Nishida, MD, PhD, Naoto Morimura, MD, PhD, and Tetsuya Sakamoto, MD, PhD

Abstract

Objective. We evaluated the association between prehospital ... patients with PEA, and with higher overall survival (2.38% vs. 1.04%; OR, 2.34; 95%, CI, 1.82-3.00) and neurologically

Prehosp Emerg Care 2017;21:432-41

Does epinephrine affect survival and/or neurologic outcomes in Asystole and PEA?

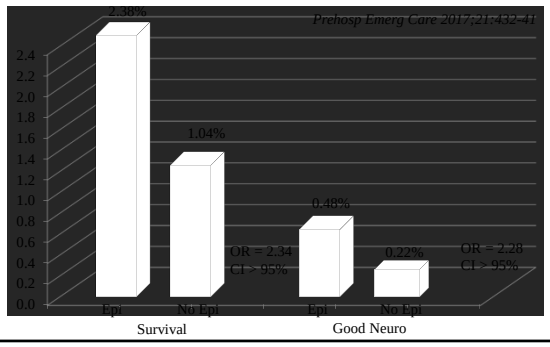
- Japanese national database 2008-2012
- Used propensity matched pairs of patients
- 8,906 AS* paired and 7,451 pairs in PEA*
- Used time to epi, age and severity to pair
- Evaluated both survival and good neuro

**Only bystander witnessed arrests*

Asystole

Survival and Good Neuro Outcomes

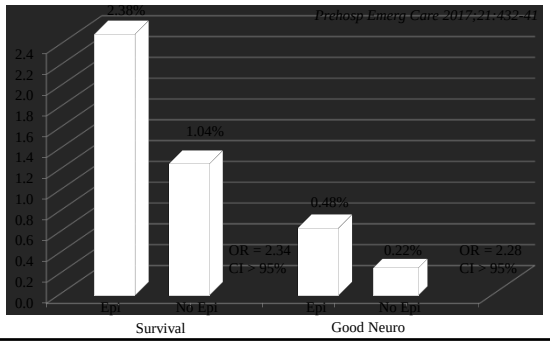
Epinephrine vs No Epinephrine



PEA

Survival and Good Neuro Outcomes

Epinephrine vs No Epinephrine




Contents lists available at ScienceDirect
Resuscitation
journal homepage: www.elsevier.com/locate/resuscitation
Clinical paper
Adrenaline (epinephrine) dosing period and survival after in-hospital cardiac arrest: A retrospective review of prospectively collected data
Sam A. Warren, Ella Huszti, Steven M. Bradley, Paul S. Chan, Chris L. Bryson, Annette L. Fitzpatrick, Graham Nichol, for the American Heart Association's Get With the Guidelines-Resuscitation (National Registry of CPR) Investigators

Resuscitation 2014;85:350-8

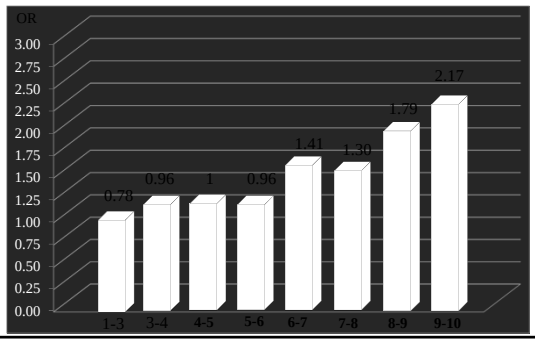
Does dosing interval of epinephrine affect survival in CPR?

- 20,909 adult pts, 505 GWTG hospitals
- Looked at survival vs dosing interval
- Adjusted via multi-variate analysis
- Most common intervals were 4-5 and 5-6 min

Epinephrine Dosing Intervals (min)

Adjusted Odds Ratio for Survival

Resuscitation 2014;85:350-8




Contents lists available at ScienceDirect
Resuscitation
journal homepage: www.elsevier.com/locate/resuscitation
Clinical paper
Epinephrine dosing interval and survival outcomes during pediatric in-hospital cardiac arrest
Derek B. Hoyme, Sonali S. Patel, Ricardo A. Samson, Tia T. Raymond, Vinay M. Nadkarni, Michael G. Gaies, Dianne L. Atkins, for the American Heart Association Get With the Guidelines–Resuscitation Investigators

Resuscitation 2017;117:18-23

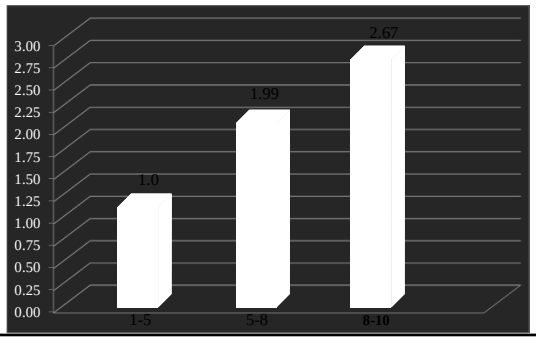
Does spacing out epinephrine more than PALS/ACLS recommends affect pediatric CPR outcomes?

- 1,630 pediatric in-hospital arrests
- Intervals of 1-5, 5-8 min and 8-10 min evaluated
- Multi-variate analysis used to control co-morbidities
- Separately analyzed vasopressor use pre-arrest

Epinephrine Dosing Intervals (min)

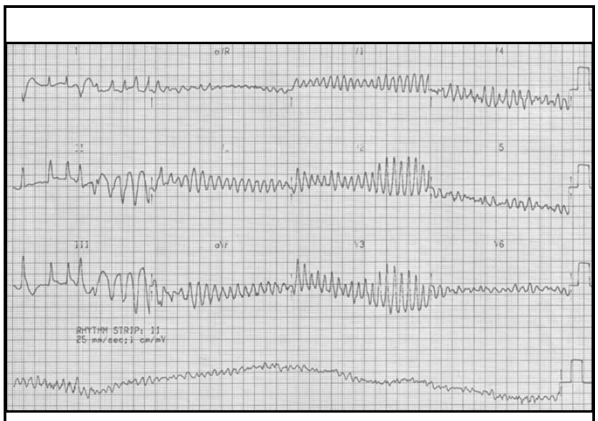
Adjusted Odds Ratio for Survival

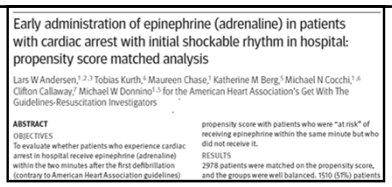
Resuscitation 2017;117:18-23



Epinephrine Dosing Interval Take Homes

- Although ACLS guideline say Q 3-5, it appears that spacing epinephrine doses out to up to 8-10 minutes may be optimal
- This is a violation of current guidelines
- No randomized study exists
- Give less not more





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 3] 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

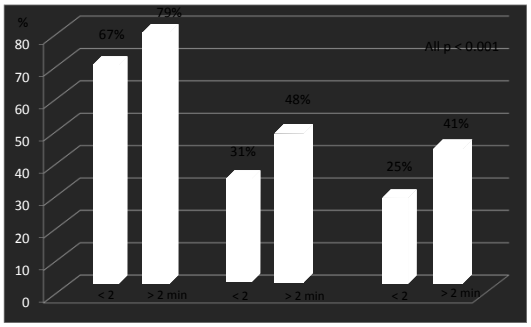
BMJ 2016;353:1577-87

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!

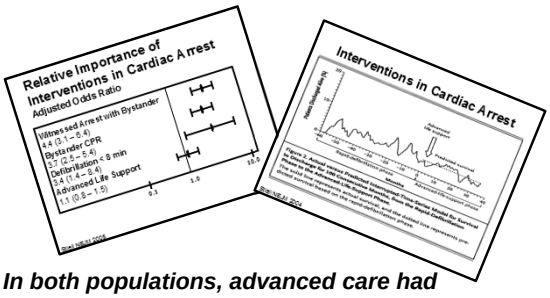
Summary of Epi in CPR Take Homes

- Epinephrine's role in CPR still not clear
- Give early in non-VF arrest to optimize good outcome
- ROSC and good neuro outcomes are improved when epi is given earlier vs later in CPR
- Wait for 2nd shock for epi in VF/pVT
- Give less not more as arrest progresses

Airway Management

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

Management
Basic vs Advanced Care



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

Airway Management

- **Prior teaching…**Focused on the "ABC's"
  - Favored ETT…early & in all
- **Alphabet no longer starts with "A"...**The "CAB's"
  - Cardiogenic vs non-cardiogenic
- **Cardiogenic -** Sudden with oxygen "reserve" & little acidosis
  - "Less early" airway
- **Non-cardiogenic -** Gradual with progressive hypoxia & acidosis
  - Earlier airway

Airway Management
Placement of Invasive Airway

Placement of Invasive Airway
Prehospital Endotracheal Intubation
Kajino et al. Resuscitation 2014;85:677.

- Utstein registry (2007) -- #109,461
- Considered ROSC @ event & neuro status @ 1 month

Outcome	OR [95 CI]
ROSC	0.61 [0.54-0.69]
Neuro Status	0.47 [0.38-0.57]

- **Placement of invasive airway is not associated with favorable outcome**

"Placement of invasive airway is not associated with a favorable outcome."

Placement of Invasive Airway
Prehospital Endotracheal Intubation
Hasegawa et al. JAMA 2013;310:2107

- EMS setting in Japan - 649,654 events
  - Outcomes: Primary - favorable neuro status @ 1 month; secondary - survival @ 1 month
  - 57% BVM & 43% advanced airway (6% ETT & 37% SGA)
  - Adjusted for all appropriate variables
- **Adjusted OR for neuro intact survival for advanced airway placement - 0.38 (95% CI 0.37-0.40)**
- **Results similar for ETT & SGA, individually**

"…any type of advanced airway management was associated with decreased odds of neuro-intact survival."

Airway Management
Placement of Invasive Airway

Placement of Invasive Airway
Prehospital Endotracheal Intubation
Kajino et al. Resuscitation 2014;85:677.

- **CARES Registry:** #10,691 OHCA
- **ETT vs SGA vs BLS (none)**
- **Outcomes:** ROSC, survival to admit / discharge, neuro-intact survival at D/C

Outcome	ETT vs SGA	None vs Advanced
ROSC	1.35	---
Survival to Admit	1.36	1.31
Survival to D/C	1.41	2.96
Neuro-Intact Survival to D/C	1.44	4.24

"…survival was higher …for patients who received no advanced airway…"

Placement of Invasive Airway
Prehospital Endotracheal Intubation
Hariri et al. Resuscitation 2015;93:96

- **1994-2008:** #1294 OHCA
- **ETT vs SGA vs BLS**
- **Odds ratio for survival to hospital D/C –** 4.5 for BLS to advanced airway

"…when compared to BVM ventilation, advanced airways were associated with decreased survival to hospital discharge…"

Airway Management
Placement of Invasive Airway

Placement of Invasive Airway
Prehospital Endotracheal Intubation
Kiyohara et al. Crit Care 2015;19:318

- **Mecklenburg, NC EMS:** 1,142 OHCA
- **Considered ROSC & survival to hospital D/C relative to # of ETT attempts**
- **Outcomes**
  - ROSC - no attempts 2.33 vs 1 successful attempt
  - Hospital D/C – no attempts 5.46 vs 1 successful attempt

"…individuals most likely to have ROSC & survival to hospital discharge were those who did not have a reported ETI attempt…"

Placement of Invasive Airway
Hospitalized Patients #25,006

- **Invasive airway during resuscitation**
  - Mean time to placement 5.9 minutes
- **Outcomes:** early vs late airway inserton

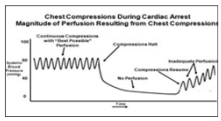
Event	Occurrence	Adjusted Odds Ratio
ROSC	50.3% (49.7-51.0)	0.98 (0.95 – 1.01)
Survival to 24 hr	35.7% (35.1-34.3)	0.94 (0.88 – 0.99)
Survival to D/C	15.3% (14.8-15.8)	---

- **No increase in ROSC**
- **MINIMAL increase in 24 hr survival**
- **Not sustained at D/C**

Wang Resuscitation 2015;91:182

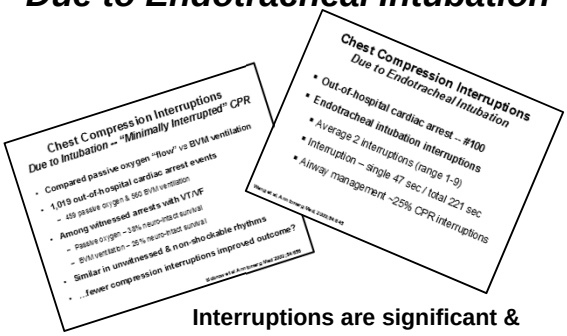
"…no increase in ROSC but a minimal increase in 24 hr survival which was not sustained…"

Compression Interruptions



- ***Resuscitatus interruptus***
- **Negatively impacts outcome**
- **Without compressions, no perfusion is occurring**
- **Airway management accounts for longest interruption**
- **Basic vs advanced care impact**

Compression Interruptions *Due to Endotracheal Intubation*



Interruptions are significant & negatively impact outcome

Airway Management

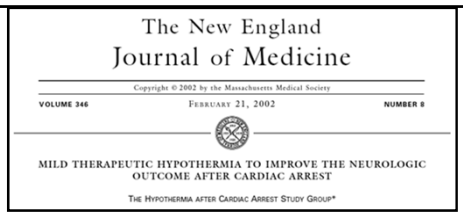
- **Shockable vs non-shockable rhythms**
- **Early vs late airway management**
- **Invasive vs BVM**
- **Avoid interruptions, particularly early, due to airway management**

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 <u>and</u> 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

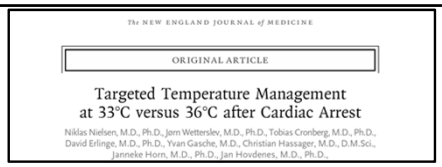
Copyright © 2002 by the Massachusetts Medical Society

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

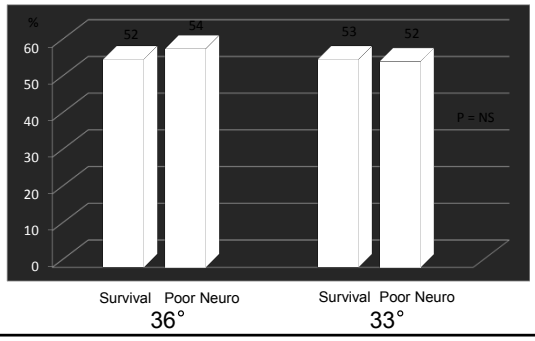
Niklas Nielsen, M.D., Ph.D., Jørn Wetterslev, M.D., Ph.D., Tobias Cronberg, M.D., Ph.D., David Erlinge, M.D., Ph.D., Yvan Gasche, M.D., Christian Hassager, M.D., D.M.Sci., Janneke Horn, M.D., Ph.D., Jan Hovdenes, M.D., Ph.D.,

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%)*

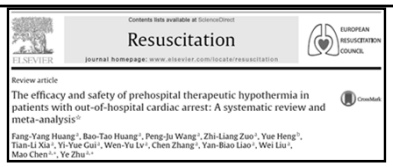
Hypothermia vs Normal Temp
Survival and Neuro Outcomes

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˚


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

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

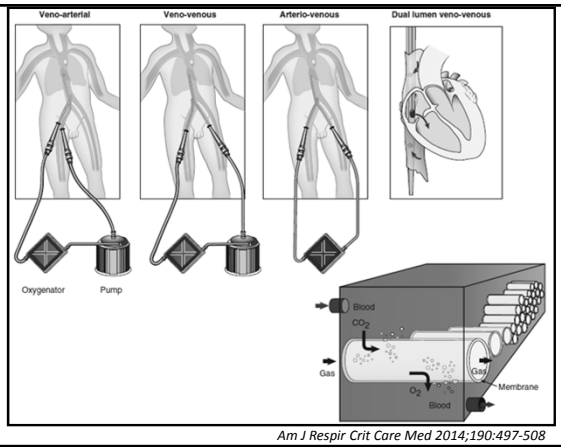
Does ECMO have a role in CPR?

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,b,c], Aidan Burrell[a,b], Peter Cameron[a,b], De Villiers Smit[a], David M. Kaye[a,b,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

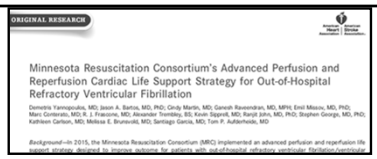
Survival Improvement with ECLS

(CPC 1-2) *Resuscitation 2016;103:106-16*

- Chen 2008 ↑2.3 x (12.3 vs 28.8)
- Shin 2011 ↑ 3.6 x (7.8 vs 28.2)
- Meekawa 2013 ↑5.0 x (6.4 vs 32.1)
- Sakamoto 2014 ↑8.2 x (1.5 vs 12.3)

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 ED


ORIGINAL RESEARCH

Minnesota Resuscitation Consortium's Advanced Perfusion and Reperfusion Cardiac Life Support Strategy for Out-of-Hospital Refractory Ventricular Fibrillation

J Am Heart Assoc 2016;5:e003732

- Rapid ECLS for VF/pVT
- ECLS s/p 3 shocks + amio in 18 pts
- 911 to CCL 60 min + 6 min for ECMO
- No significant complications
- 50% good neuro outcomes 9/18

CARDIOLOGY/CONCEPTS

Development and Implementation of a Comprehensive, Multidisciplinary Emergency Department Extracorporeal Membrane Oxygenation Program

Joseph E. Tonna, MD*; Craig H. Selzman, MD, FACS; Michael P. Mallin, MD; Brigham R. Smith, MD; Scott T. Youngquist, MD, MSc; Antigoni Koliopoulou, MD; Frederick Welt, MD; Kathleen Diane Stoddard, RN, BSN, CCRN; Rami Nirula, MD, MPH, FACS; Richard Barton, MD; James Franklin Fair III, MD; James C. Fang, MD, FACC, FAHA; Stephen McKellar, MD, MSc

Annal Emerg Med 2017;70:32-40

- Teamwork required: from EMS to ICU
- ED, Cardiology, CT Surgery, Nursing, Perfusion Services
- Provides step by step developmental blueprint
- Costs and supplies enumerated

Bill, this is my last question…

What are your thoughts on PCI post arrest?

This is not a new thing!

STEMI After ROSC

Fibrinolysis or PCI +/- Hypothermia

*"**Survival** at 6 months was **54%** with **46%** demonstrating good **neurologic function"***

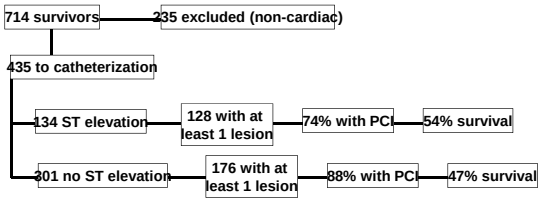
*"…initially comatose patients **survived 51%** of hospitalizations with **good neurological status** in **29%"***

*"…**55%** of the TH group compared to non-TH group were **discharged with good neurological outcome**"*

Garot Pvet al *Circulation* 2007 | Knafelj et al *Resuscitation* 2007 | Richling et al *Am J Emerg Med*, 2007

STEMI After ROSC

- **Prehospital cardiac arrest -- #714 survivors (Paris)**
- **Retrospective review**
- **Immediate PCI in ST elevation & non-ST elevation cases**



Dumas et al, Cardiovasc Interv 2010

Contents lists available at ScienceDirect
Resuscitation
journal homepage: www.elsevier.com/locate/resuscitation
EUROPEAN RESUSCITATION COUNCIL
Review article

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[f], Matthew J. Levy[g], Kevin G. Seaman[e], Jon Mark Hirshon[d]

Resuscitation 2016;108:54-60

Is PCI indicated s/p VF/pVT arrests if no STEMI on 12-lead?

- Systematic review and meta-analysis
- 11 articles involving 2,885 pts.
- STEMI pts ↑3 x for transport to CCL
- Evaluated "STEMI" in CCL if no STEMI on ECG

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[f], Matthew J. Levy[g], Kevin G. Seaman[e], Jon Mark Hirshon[d]

Resuscitation 2016;108:54-60

- 71.9% of STEMI on ECG pts had an acute culprit lesion
- 32.2% of "non-STEMI" ECG pts had an acute culprit lesion

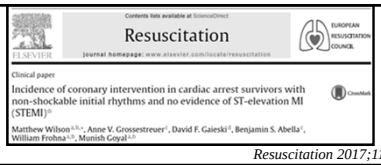
Immediate CCL s/p VF/pVT Arrest

Resuscitation 2016;108:54-60

- Improves survival by a factor of 3.7 (CI 1.31-10.70) regardless of STEMI or no STEMI on ECG
- ↑ survival by 30% if no STEMI on ECG

VF/pVT Arrests on CCL Take Homes

- Not a randomized trial
- Potential referral bias
- Another in a series of studies
- All show CCL improves survival
- All show up to 30% of "no STEMI" is a STEMI
- Go to the lab!


Contents lists available at ScienceDirect

Resuscitation

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

Clinical paper

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

Resuscitation 2017;113:83-6

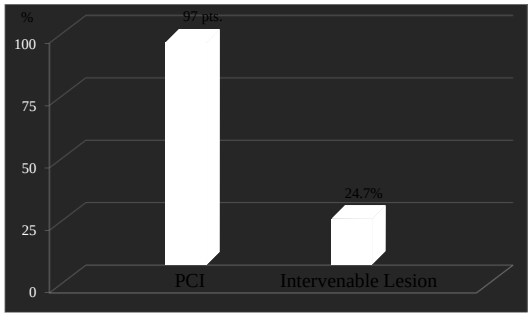
How common is an intervenable coronary lesion in pts who obtain ROSC s/p arrest from a non-shockable rhythm?

- 1,396 ROSC pts, 18 centers, retrospective review
- 879 of ROSC pts had AS or PEA
- 141 underwent angiography
- 31% (44 / 141) had ~~STEMI~~ PCI

97 patients who obtained ROSC s/p AS or PEA went to angiography even though no ST elevation on post-ROSC ECG

Incidence of Intervenable Lesion at PCI s/p ROSC AS or PEA – No STEMI on ECG

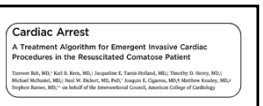
Resuscitation 2017;113:83-6



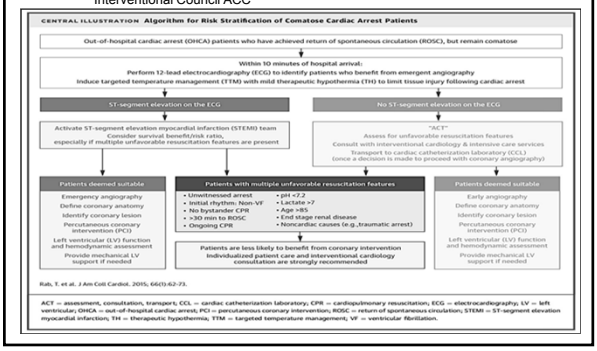
STEMI Management after ROSC

JACC 2015;66:63

Interventional Council ACC


Cardiac Arrest

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


CENTRAL ILLUSTRATION Algorithm for Risk Stratification of Comatose Cardiac Arrest Patients

Out-of-hospital cardiac arrest (OHCA) patients who have achieved return of spontaneous circulation (ROSC), but remain comatose

Within 10 minutes of hospital arrival:
Perform 12-lead electrocardiography (ECG) to identify patients who benefit from emergent angiography
Induce targeted temperature management (TTM) with mild therapeutic hypothermia (TH) to limit tissue injury following cardiac arrest

ST-segment elevation on the ECG

Activate ST-segment elevation myocardial infarction (STEMI) team
Consider survival benefit/risk ratio,
especially if multiple unfavorable resuscitation features are present

Patients deemed suitable
Emergency angiography
Define coronary anatomy
Identify coronary lesion
Percutaneous coronary intervention (PCI)
Left ventricular (LV) function and hemodynamic assessment
Provide mechanical LV support if needed

No ST-segment elevation on the ECG

"ACT"
Assess for unfavorable resuscitation features
Consult with interventional cardiology & intensive care services
Transport to cardiac catheterization laboratory (CCL)
(once a decision is made to proceed with coronary angiography)

Patients with multiple unfavorable resuscitation features
- Unwitnessed arrest
- Initial rhythm: Non-VF
- No bystander CPR
- >30 min to ROSC
- Ongoing CPR
- pH <7.2
- Lactate >7
- Age >85
- End stage renal disease
- Noncardiac causes (e.g.,traumatic arrest)

Patients are less likely to benefit from coronary intervention
Individualized patient care and interventional cardiology consultation are strongly recommended

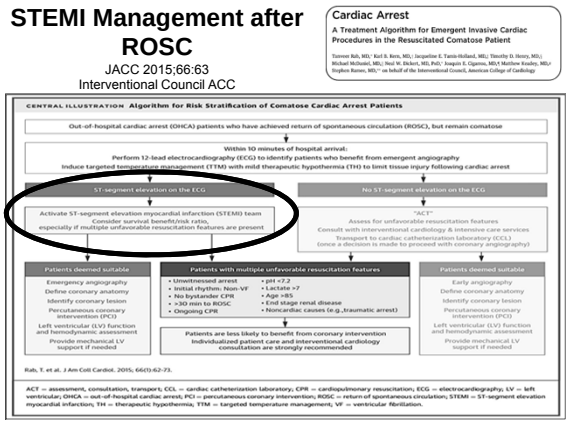
Patients deemed suitable
Early angiography
Define coronary anatomy
Identify coronary lesion
Percutaneous coronary intervention (PCI)
Left ventricular (LV) function and hemodynamic assessment
Provide mechanical LV support if needed

Rab, T. et al. J Am Coll Cardiol. 2015; 66(1):62-73.

ACT = assessment, consultation, transport; CCL = cardiac catheterization laboratory; CPR = cardiopulmonary resuscitation; ECG = electrocardiography; LV = left ventricular; OHCA = out-of-hospital cardiac arrest; PCI = percutaneous coronary intervention; ROSC = return of spontaneous circulation; STEMI = ST-segment elevation myocardial infarction; TH = therapeutic hypothermia; TTM = targeted temperature management; VF = ventricular fibrillation.

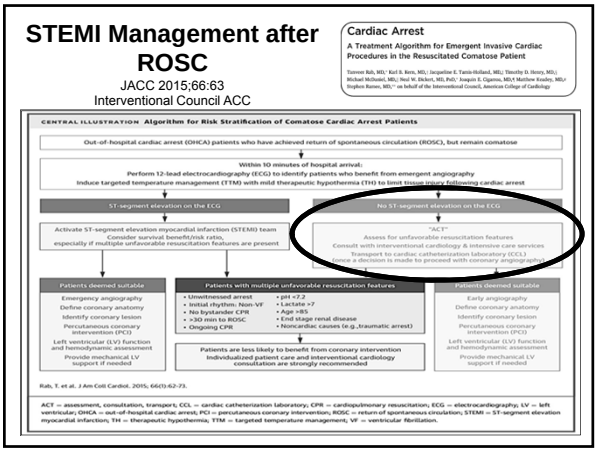
STEMI Management after ROSC

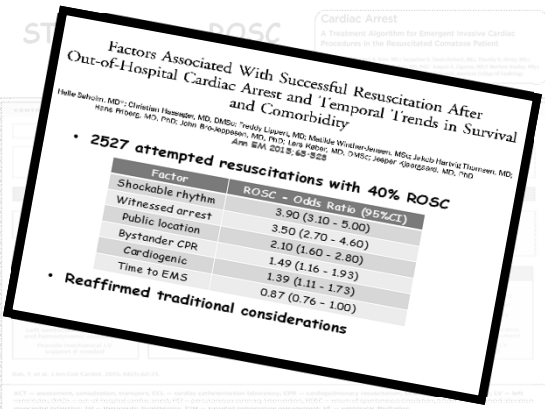
JACC 2015;66:63
Interventional Council ACC



STEMI Management after ROSC

JACC 2015;66:63
Interventional Council ACC





Factors Associated With Successful Resuscitation After Out-of-Hospital Cardiac Arrest and Temporal Trends in Survival and Comorbidity

Helle Suhoiln, MD; Christian Hassager, MD, DMSc; Teddy Lippert, MD; Maiilde Winther-Jensen, MSc; Jakob Hartvig Thomsen, MD; Anne Friberg, MD, PhD; John Brø-Jeppesen, MD, PhD; Lars Køber, MD, DMSc; Jesper Kjærgaard, MD, PhD

Ann EM. 2015;65:523-529

- 2527 attempted resuscitations with 40% ROSC

Factor	ROSC - Odds Ratio (95%CI)
Shockable rhythm	3.90 (3.10 - 5.00)
Witnessed arrest	3.50 (2.70 - 4.60)
Public location	2.10 (1.60 - 2.80)
Bystander CPR	1.49 (1.16 - 1.93)
Cardiogenic	1.39 (1.11 - 1.73)
Time to EMS	0.87 (0.76 - 1.00)

- Reaffirmed traditional considerations

STEMI After ROSC

- Greatest benefit in STEMI with VT/VF
- s/p VT/VF without STEMI also benefits
- Potential benefit in AS/PEA, if cardiogenic…
- STEMI NOT REQUIRED to identify PCI candidates

In summary…

- **Early care is vital…hospital, EMS & lay provider**
- **The "code meds" – niche application**
- **Airway management**
  - Shockable vs non-shockable rhythms
  - Early vs non early
  - Interruptions…
- **Post-ROSC care**
  - Basic is key
  - Advanced in certain patients – PCI, TTM, & ECMO

The bottom line you ask…

- **One approach does not fit all resuscitation events**
- **Tailor your approach to your patient & the individual scenario**

That's it…thanks!

William Brady
wjbrady@virginia.edu

Corey Slovis
corey.slovis@vanderbilt.edu