Name	Date	Employer

Note: Completion of these questions is worth one (1) CE hour (as this module was primarily psycho-motor simulated cardiac arrest team resuscitation). This may be submitted without penalty until November 30, 2016.

1	What 3 places on the body does rigor mortis first occur?	
2	Complete the quote from Dr. Ortinau, "*Of all the medical emergencies where we (EMS) make a difference, for most we just get the ball rolling….*"	
3	In cardiac arrest, what 2 things are "known" to improve outcome?	
4	In cardiac arrest, what 2 things have NOT been shown to improve outcome?	
5	List the 5 components of quality CPR.	
6	Are compression rates higher than 120, or less than 100, associated with a decreased likelihood of survival? Why?	
7	Why is releasing completely important?	
8	When using the ResQPOD impedance threshold device what compression rates are associated with best outcome?	
9	Are there improved cardiac arrest outcomes, when using mechanical CPR devices, compared to manual CPR?	
10	In pit crew cardiac arrest resuscitation, what are the 5 roles?	
11	What should be done if only 2 rescuers are on the scene of a cardiac arrest?	
12	Where should defib pads/paddles be placed?	
13	What are 2 acceptable reasons to interrupt chest compressions?	
14	Is it important to minimize pre-shock and post-shock pauses in compressions?	
15	Should patients be moved with CPR in progress?	
16	Why should an OP/NPA be inserted prior to beginning BVM ventilation?	
17	When using the ResQPOD/ITD when is it more important to maintain a tight face-mask seal - during compressions or ventilations?	

18	What are 5 ways capnography is helpful during cardiac arrest resuscitation?	
19	In cardiac arrest resuscitation, which has the higher priority – vascular access & medication administration or advanced airway placement?	
20	While one PM is obtaining vascular access (IO/IV) what can other PM's be doing to assist?	
21	When during cardiac arrest resuscitation can placement of an advanced airway be considered?	
22	What is persistent/refractory VF?	
23	If VF persists after 3-4 defibrillations, what should be done?	
24	What are causes of PEA?	
25	List 5 assessment/interventions appropriate for PEA?	
26	List 4 aspects of post-ROSC care.	
27	What should be done post-ROSC if pt is hypotensive?	
28	Is therapeutic hypothermia still highly recommended by the AHA? Why was it removed from pre-hospital care?	
29	Is re-arrest common? What type of re-arrest is most common? What can be done to promptly detect it?	
30	What should be documented on an ePCR for a cardiac arrest patient?	

July 2016 – Continuing Education

Cardiac Arrest "Pit-Crew" Team Resuscitation

Diana Neubecker RN BSN PM
NWC EMSS In-Field Coordinator

Objectives - Related to cardiac arrest resuscitation:

1. Discuss new knowledge.
2. Review selected key elements.
3. Identify & demonstrate treatment priorities.
4. Practice team "pit-crew" approach skills.
5. Improve documentation.

Crew finds pt non-breathing & pulseless with unmovable jaw, so performs surgical cric

Rigor Mortis

- At death muscles relax, then stiffen
- Begins in 2-6 hrs, in the **eyelids, neck, and jaw**; then spreads to other muscles, last in fingers & toes
- Onset varies w/ temp, age, physical condition and build
- After 24-hrs muscles relax and flaccidity develops
- Infant/child may not show rigor due to sm. muscle mass

Cardiac Arrest Resuscitation

"Of all the medical emergencies where we (EMS) make a difference, for most we just get the ball rolling.

In cardiac arrest, we own it. We are the ones that make a difference. Initial care, what we do in the field, determines outcome more than anything else."

John M. Ortinau, MD, FACEP
NWC EMSS Medical Director

Do NOT delay something "known" to improve outcome, to do something NOT known to improve outcome

- **"Known" to improve outcome**
  - Quality CPR
  - Defibrillation
- **"Might" improve outcome**
  - Medications, especially if given early
- **NOT shown to improve outcome**
  - Advanced airway
  - Transport w/ CPR in progress

Quality CPR

1. **Rate** (at least 100, but less than 120)
2. **Depth** (2 - 2¼ ")
3. **Release completely**
4. **Minimize interruptions**
5. **Do NOT hyperventilate**

Metronome – USE ONE!

- Monitor
- Smartphone
- Device

Avoid too Fast Compressions

"data show that survival peaks with a chest compression rate around 120/min, with rates of 120/min or higher or less than 100/min being associated with a decreased likelihood of survival.

…rates were greater than 120/min in nearly one third of cases."

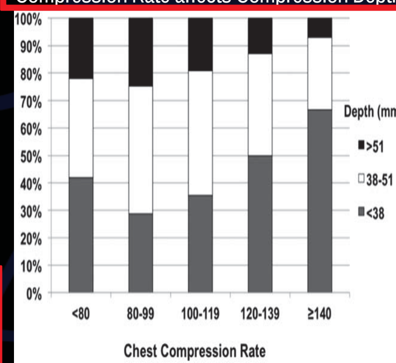
Principal mechanisms thought to be responsible for producing blood flow during chest compressions:
1) direct cardiac compression
2) ↑ intrathoracic pressure

Forward blood flow depends on venous blood filling the heart & lungs during diastole/release phase of chest compression.

If release phase is too brief, blood available for forward flow during compression may be decreased.

May explain findings that rates faster than 120/min are associated w/ decreased survival, as are rates less than 100/min.

Compression Rate affects Compression Depth



Chest compression rate versus chest compression depth. The *stacked bar graph* shows distribution of three categories of chest compression depth (< 38mm indicated in *gray*, 38–51mm *white*, > 51mm *black*) across categories of compression rates (< 80, 80–99, 100–119, 120–139, and ≥ 140 chest compressions/min) (n = 6,399; chi-square test, p < 0.0001).

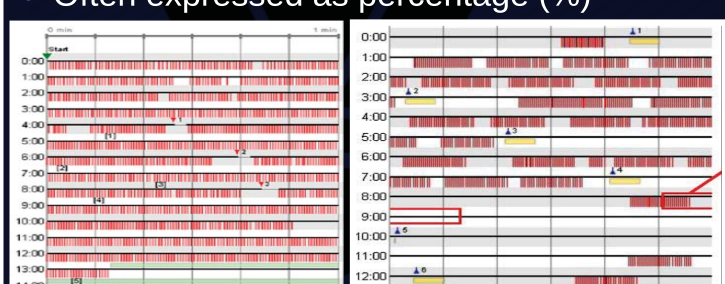
RELEASE Completely

- Do **NOT** lean on chest
- Assure chest recoils completely after compressions
- Pressure between compressions creates positive intrathoracic pressure - which decreases heart & coronary artery refilling w/ blood

Real Time CPR Feedback

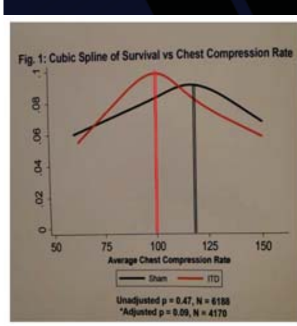
Chest Compression Fraction (CCF)

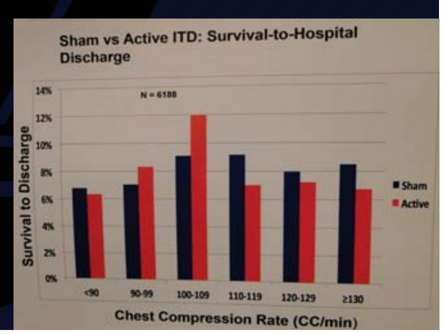
- Proportion of each minute interval during which chest compressions are provided
- Associated with survival
- Often expressed as percentage (%)



ResQPOD Impedance Threshold Device

- Circulation enhancing device
- "Works" during compressions
- Best outcome when compression rate 100-110/min





What's the story with the RQP ITD?

2015 AHA Guidelines ↓ level of recommendation

Study: 8718 pts, 4345 sham, 4373 functioning ITD, did not show a benefit from ITD.

No differences in adverse events (pulmonary edema, airway bleeding) between the groups.

AHA Recommendation: Routine use of the ITD as an adjunct during conventional CPR is not recommended. Class of Recommendation indicates that evidence did not demonstrate benefit or harm associated with the ITD when used as an adjunct to conventional CPR.

A Trial of an Impedance Threshold Device in Out-of-Hospital Cardiac Arrest

Resuscitation

Quality of CPR: An important effect modifier in cardiac arrest clinical outcomes and intervention effectiveness trials

Demetris Yannopoulos, Tom P. Aufderheide, Benjamin S. Abella, Sue Duval, Ralph J. Frascone, Jeffrey M. Goodloe, Brian D. Mahoney, Vinay M. Nadkarni, Henry R. Halperin, Robert O'Connor, Ahamed H. Idris, Lance B. Becker, Paul E. Pepe

Published after 2015 Guidelines written

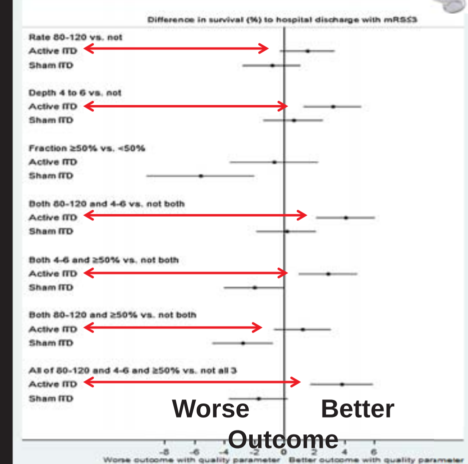
With "acceptable" CPR, there is a difference

Categorized as "acceptable" ranges:

- Rate: 100 ± 20% (80–120)
- Depth: 5 cm ± 20% (4–6 cm)
- **Compression fraction ≥50%**

45% had "acceptable" CPR

"This analysis supports the notion that the quality of CPR needs to be taken into account during randomized controlled trials of interventions for cardiac arrest. Our analysis of the prospectively collected, well-defined ROC-PRIMED dataset showed statistically significant and clinically important interactions between the quality of CPR provided, the study interventions, and survival to hospital discharge with favorable neurological outcome."



If "acceptable" quality CPR, when using RQP/ITD, there is improvement in neuro intact survival

Table 5
Rates of ROSC and survival of patients receiving acceptable quality of CPR (rate 80–120 ccpm, depth 4–6 cm, fraction ≥50%), and those not receiving acceptable quality CPR (none of rate 80–120 ccpm or depth 4–6 cm or fraction ≥50%), stratified by treatment arm.

	Acceptable quality CPR			Unacceptable quality CPR		
	Sham (n = 827)	Active (n = 848)	p-Value	Sham (n = 1061)	Active (n = 1012)	p-Value
ROSC	213 (25.8)	233 (27.5)	0.43	244 (23.0)	230 (22.7)	0.88
Survival to hospital discharge	53 (6.4)	81 (9.6)	0.018	75 (7.1)	53 (5.2)	0.082
Discharged alive with mRS ≤3	34 (4.1)	61 (7.2)	0.0064	62 (5.8)	34 (3.4)	0.0071

Values are n (%).

If "unacceptable" quality CPR, better to not use the RQP/ITD

"Unacceptable"

- Rate less than 80, or greater than 120
- Depth less than 4 cm, or greater than 6 cm
- Compression fraction less than 50%

Resuscitation

Editorial

Resuscitation highlights in 2015

"5.3. Mechanical CPR A systematic review of randomized trials of mechanical chest compression devices found no advantage to the routine use of mechanical chest compression devices for OHCA (survival to discharge/30 days (average odds ratio (OR) 0.89, 95% CI 0.77, 1.02) and survival with good neurological outcome (average OR 0.76, 95% CI 0.53, 1.11). *Gates S, Quinn T, Deakin CD, Blair L, Couper K, Perkins GD. Mechanical chest compression for out of hospital cardiac arrest: systematic review and meta-analysis. Resuscitation 2015;94:91–7.*

Per-protocol analysis of the LINC trial observed similar four-hour survival rates between mechanical and manual CPR (23.8% vs. 23.5%, risk difference −0.35%, 95% CI −3.1 to 3.8, p = 0.85). *Rubertsson S, Lindgren E, Smekal D, et al. Per-protocol and pre-defined popu-lation analysis of the LINC study. Resuscitation 2015;96:92–9.*

A prospective evaluation of mechanical CPR in Vienna noted worse neurological outcomes in those receiving mechanical CPR. *Zeiner S, Sulzgruber P, Datler P, et al. Mechanical chest compression does not seem to improve outcome after out-of hospital cardiac arrest. A single center observational trial. Resuscitation 2015;96:220–5.*

These findings reinforce the ILCOR and ERC recommendations against their routine use."

Resuscitation. 2015 Nov;96:220-5.

Mechanical chest compression does not seem to improve outcome after out-of hospital cardiac arrest. A single center observational trial.

Zeiner S, Sulzgruber P, Datler P, Keferböck M, Poppe M, Lobmeyr E, van Tulder R, Zajicek A, Buchinger A, Polz K, Schrattenbacher G, Sterz F.

AIM: Recently three large post product placement studies, comparing mechanical chest compression (cc) devices to those who received manual cc, found equivalent outcome results for both groups. Thus the question arises whether those results could be replicated using the devices on a daily routine.

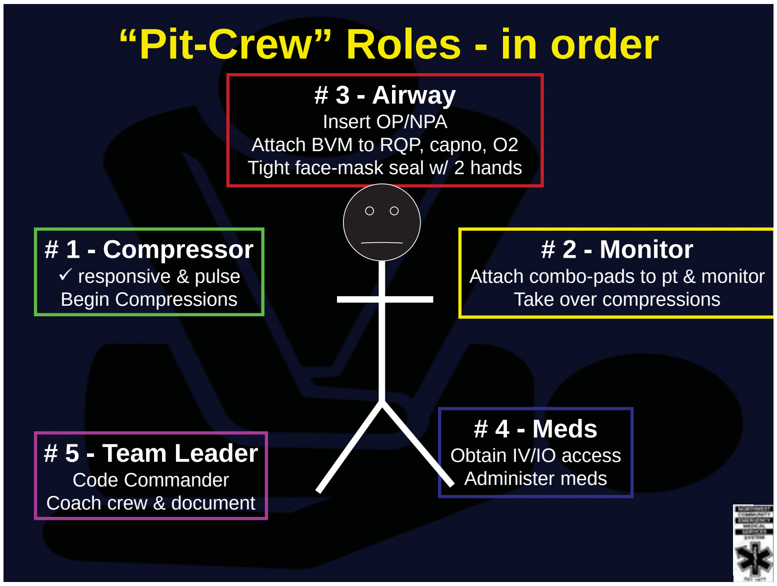
METHODS: We prospectively enrolled 948 patients over a 12 months period. Chi-Square test and Mann-Whitney-U test were used to assess differences between "manual" and "mechanical" cc subgroups. Uni- and multivariate Cox regression hazard analysis were used to assess the influence of cc type on survival.

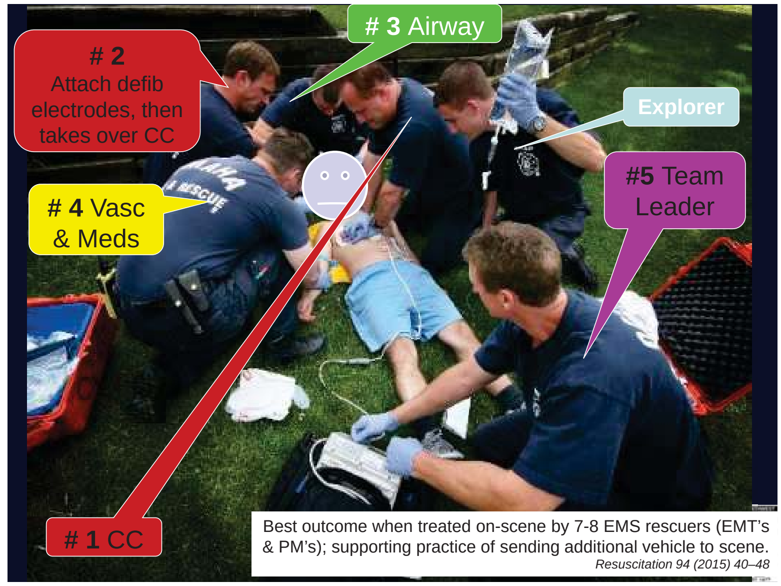
RESULTS: A mechanical cc device was used in 30.1% (n=283) cases. Patients who received mechanical cc had a significantly worse neurological outcome - measured in cerebral performance category (CPC) - than the manual cc group (56.8% vs. 78.6%, p=0.009). Patients receiving mechanical cc were significantly younger, more were male and were more likely to have bystander CPR and an initially shock-able ECG rhythm. There was no difference in the quality of CPR that might explain the worse outcome in mechanical cc patients.

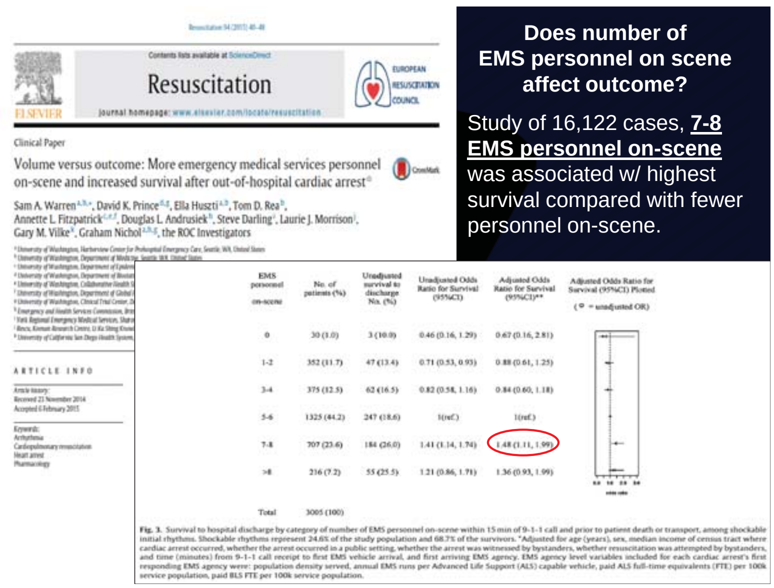
CONCLUSION: Even with high quality CPR in both, manual and mechanical cc groups, outcome in patients who received mechanical cc was significantly worse. The anticipated benefits of a higher compression ratio and a steadier compression depth of a mechanical cc device remain uncertain. In this study selection for mechanical cc was not standardized, and was non-random. This merits further investigation. Further research on how mechanical cc is chosen and used should be considered.

"Pit-Crew"

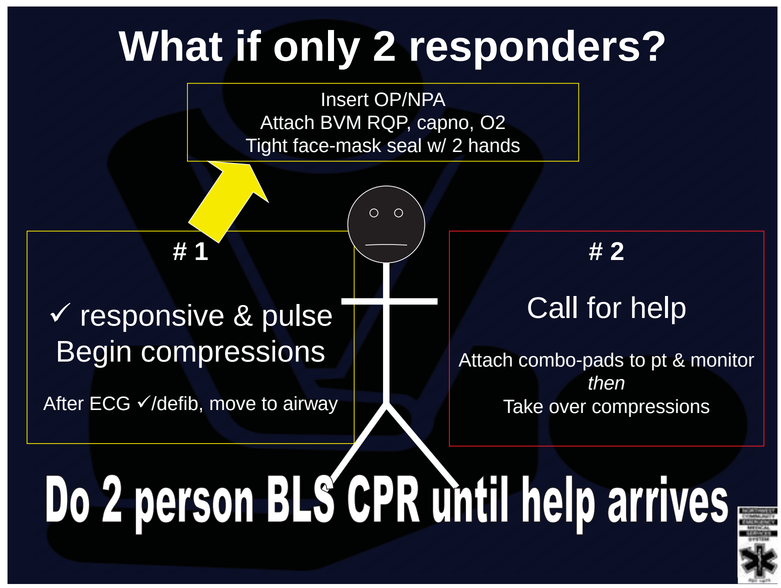
Seconds make a Difference

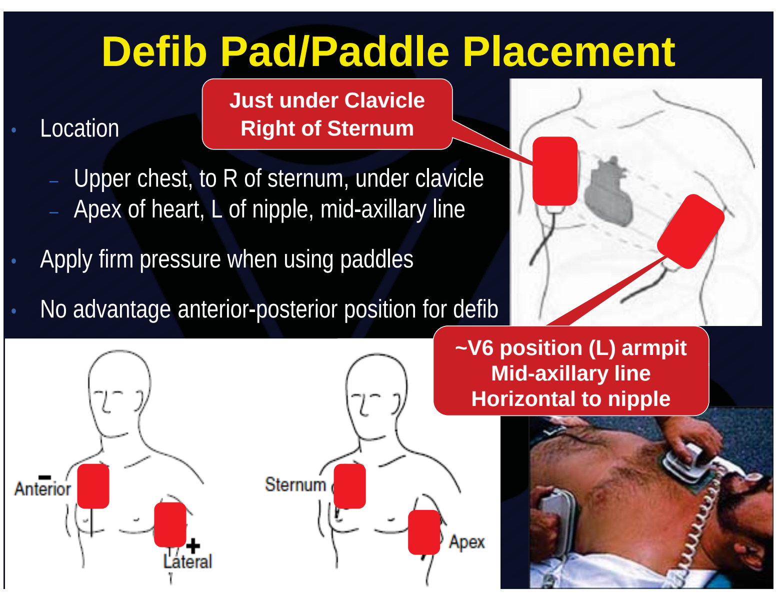


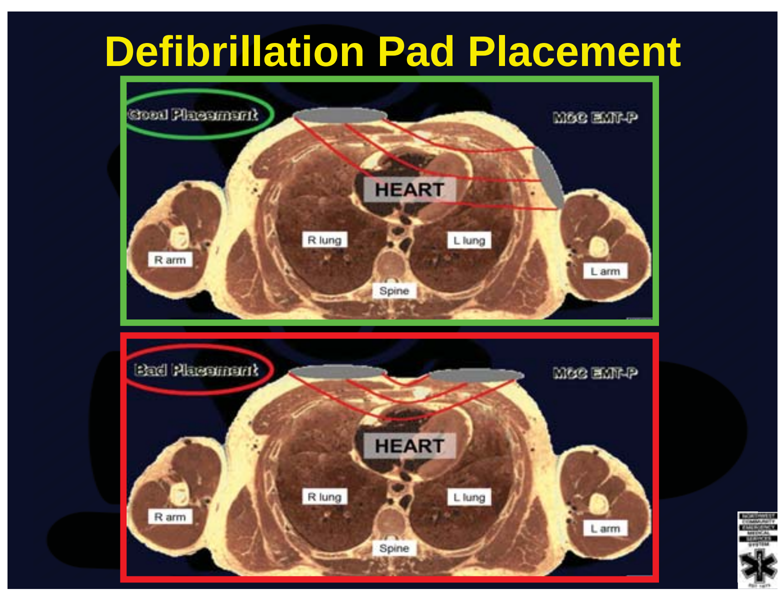




EMS personnel on-scene	No. of patients (%)	Unadjusted survival to discharge No. (%)	Unadjusted Odds Ratio for Survival (95%CI)	Adjusted Odds Ratio for Survival (95%CI)**
0	30 (1.0)	3 (10.0)	0.46 (0.16, 1.29)	0.67 (0.16, 2.81)
1-2	352 (11.7)	47 (13.4)	0.71 (0.53, 0.93)	0.88 (0.61, 1.25)
3-4	375 (12.5)	62 (16.5)	0.82 (0.58, 1.16)	0.84 (0.60, 1.18)
5-6	1325 (44.2)	247 (18.6)	1(ref.)	1(ref.)
7-8	707 (23.6)	184 (26.0)	1.41 (1.14, 1.74)	1.48 (1.11, 1.99)
>8	216 (7.2)	55 (25.5)	1.21 (0.86, 1.71)	1.36 (0.93, 1.99)
Total	3005 (100)			







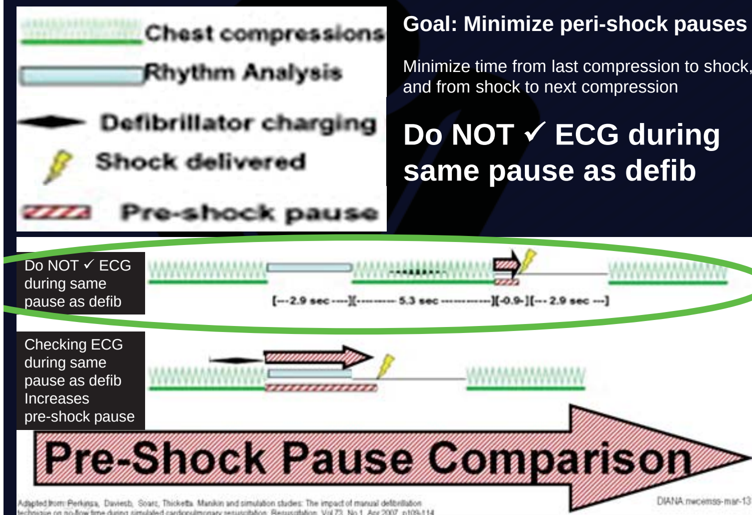
Chest Compressions (CC)

Acceptable reasons to interrupt compressions

1. ✓ **ECG every 2 minutes** (goal less than 5 sec)
   Should it be shocked? Is it organized?

   Change compressor at the same time
   If reliever NOT in place/ready to take over – speak up!

2. **Defibrillate** (goal less than 5 sec)



Goal: Minimize peri-shock pauses

Minimize time from last compression to shock, and from shock to next compression

Do NOT ✓ ECG during same pause as defib

Should pts be moved w/ CPR in progress?

NO (unless very unique situation), interrupts & decreases CPR quality

OPA/NPA & BVM Ventilation

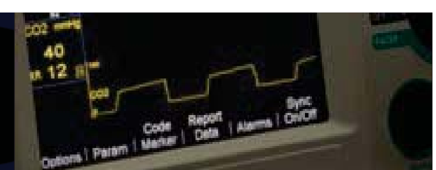
Insert OP/NPA before beginning BVM ventilation to minimize gastric distention, vomiting & aspiration

Use 2-hand method before adv. airway to maintain tight face-mask seal esp. w/ RQP/ITD during compressions

Ventilation

- **Hyperventilation is Lethal**
  - Watch both RATE and VOLUME
- Do **NOT** squeeze bag right before:
  - ECG ✓ (can cause artifact)
  - Defibrillation (↓ effectiveness)

Capnography

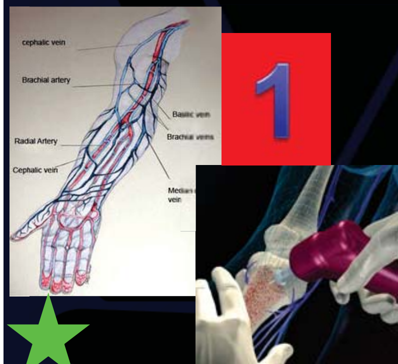


✓ every 2 minutes to:

1. Confirm airway patency & ventilation
2. Prevent hyperventilation (shows ventilation rate)
3. Monitor compression quality
4. Predict ROSC (before pulse detected)
5. Identify when ROSC unlikely

NEW – Priority Emphasis

Complete vascular access & 1st round meds
before preparing for adv. airway placement



Vascular Access - ASAP

Dedicate additional personnel, if available to help

1. ID vascular access site (IV or IO)
2. Prep site w/ CHG/IPA
3. Prep 10mL NS flush, if IO
4. Prime connecting tubing, if IO
5. Prep IVF & tubing
6. Insert & secure IO (or IV)
7. Prep epinephrine
8. Prep amiodarone
9. Place IVF in pressure infuser, if IO

Medications

- 1st med all pulseless = vasopressor
  Prepare/administer epinephrine ASAP
- Prepare meds in advance,
  so ready when time to give
- Give based on last ECG
  do NOT delay until next ECG ✓
- Follow w/ 20-50 mL IVF bolus
  If extremity IV: elevate x 20 sec


ORIGINAL CONTRIBUTIONS

PROBABILITY OF RETURN OF SPONTANEOUS CIRCULATION AS A FUNCTION OF TIMING OF VASOPRESSOR ADMINISTRATION IN OUT-OF-HOSPITAL CARDIAC ARREST

Michael W. Hubble, MBA, NREMT-P, Christopher Johnson, BS, EMT-P, Jamie Blackwelder, BS, EMT-P, Kevin Collopy, BA, NREMT-P, Sara Houston, BS, EMT-P, Melisa Martin, MHS, EMT-P, Delbert Wilkes, EMT-P, Jonina Wiser, BS, EMT-P

PREHOSPITAL EMERGENCY CARE 2015;19:457–463

INTRODUCTION

Sudden cardiac death accounts for more than half of all coronary heart disease deaths in the United States,

457

We found that time to vasopressor administration is significantly associated with ROSC, and the **odds of ROSC declines by 4% for every 1-minute** delay between call receipt and vasopressor administration.


The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MAY 5, 2016 VOL. 374 NO. 18

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

ABSTRACT

The survival rate was also higher among amiodarone recipients than placebo recipients with EMS-witnessed arrest, a risk difference of 21.9 percentage points (95% CI, 5.8 to 38.0; P=0.01).

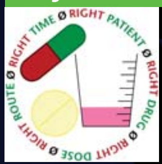
Amiodarone
possibly most beneficial
if given early

Scenario – Prep Meds Before Need

Time	EtCO2	ECG	DF	Med Administration	What med person doing?
0004	29	VF	120j		Prepare Epi, give ASAP, then prepare amiodarone
0006	33	AS		Epi 1mg	Prep next epi
0008	42	VF	150j	Amio 300mg	Give amio, then prep next amio
0010	37	IVR		Epi 1mg	Give epi, then prep next epi
0012	29	AS			
0014	41	VF	200j	Epi 1mg & Amio 150mg	Give epi & amiodarone Then prep next epi
0016	39	IVR			
0018	45	IVR		Epi 1mg	Give epi & then prep next epi
0020	44	VF	200j		
0022	38	AS		Epi 1mg	Give epi & then prep next epi
0024	40	AS			
0026	41	VF	200j	Epi 1mg	Give epi & the prep next epi
0028	64	AS			
0030	56	ST			Get dopamine out while BP ✓

Medication Double Cross-Check

Beyond the Rights…..



Check meds
w/ another PM
prior to giving

Advanced Airways (ETI, KLTSD)

- No evidence to support early placement
- Preoxygenate for at least 3 min prior
- Consider after epi & amiodarone (if VF) given
- Insert sooner - if unable to BVM
- Avoid interrupting compressions

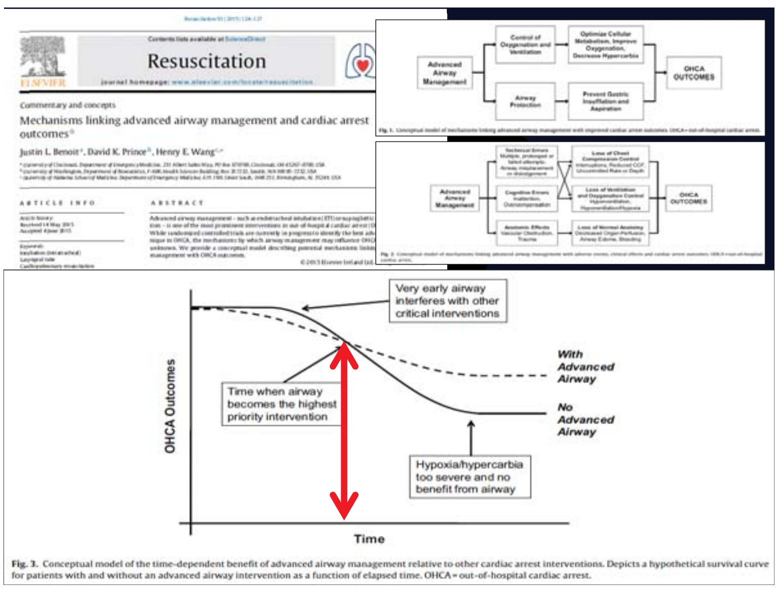
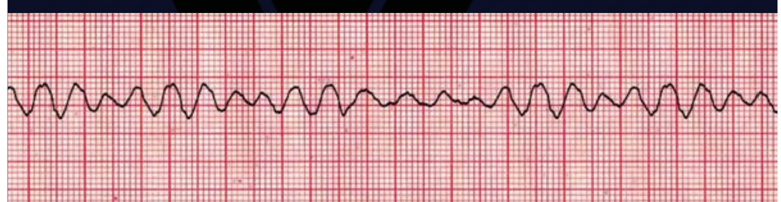


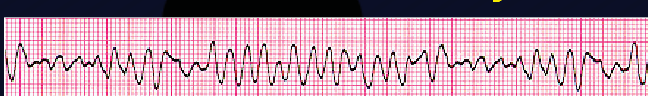
Fig. 3. Conceptual model of the time-dependent benefit of advanced airway management relative to other cardiac arrest interventions. Depicts a hypothetical survival curve for patients with and without an advanced airway intervention as a function of elapsed time. OHCA = out-of-hospital cardiac arrest.

Ventricular Fibrillation (VF)

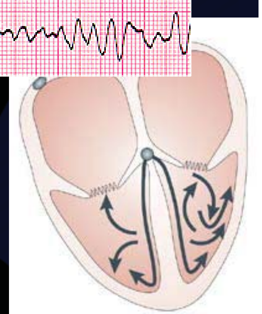
- **"Recurrent" VF**
  - Other rhythms between episodes of VF
- **"Refractory/Persistent" VF**
  - VF despite multiple defibrillation attempts



Persistent/Refractory VF



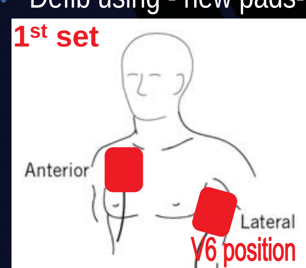
- Defib goal - stop electrical activity, to allow normal pacemakers to function
- VF has different vectors
- While anterior-lateral placement works for most VF….
- If it does not, changing pad placement has been shown to be effective

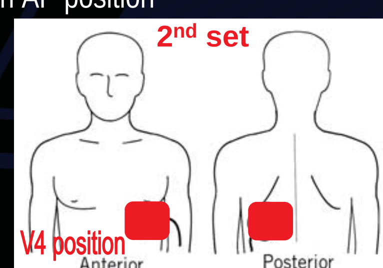


Persistent/Refractory VF

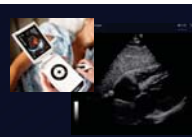
After ~3rd or 4th defibrillation

- Leaving original (anterior-lateral) electrodes in place
  - Apply fresh/new set defib pads in Anterior-Posterior position
    - Minimize compression interruption placing posterior pad
  - Switch cable from 1st set to 2nd set electrodes
- Defib using - new pads- in AP position





Pulseless Electrical Activity



- PEA is not a rhythm; any rhythm can be PEA
- PEA can be fast or slow; wide or narrow
- "Pseudo" vs true PEA (cannot [yet] determine in field)
- 55% had mechanical activity ("pseudo PEA") and a much higher rate survival to discharge. Flato UA, Paiva EF, Carballo MT, Buehler AM, Marco R, Timerman A. Echocardiography for prognostication during the resuscitation of intensive care unit patients with non-shockable rhythm cardiac arrest. Resuscitation 2015;92:1–6.

- Hypo**VOLEMIA**
- Hyp**OXIA**
- Hypo**GLYCEMIA**
- Hydrogen ion
- Hypo/hyper**KALEMIA**
- Hypo**THERMIA**

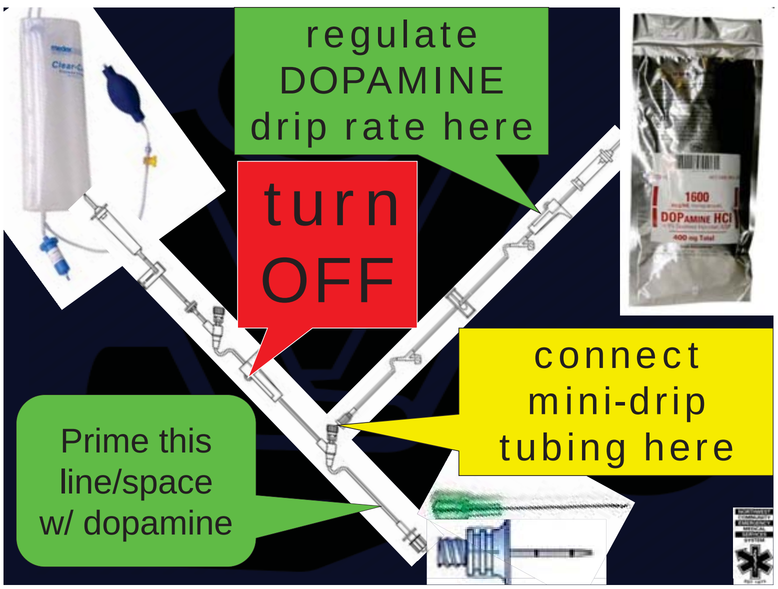
- Tension pneumo
- Toxins
- Tamponade
- Thrombosis
- Trauma

- **IV**
  - begin rapid IVF bolus
  - using pressure infuser
- **Glucose ✓**
  - ? hypoglycemia
- **Lungs ✓**
  - ? tension pneumo
- **Oxygen ✓**
  - ? airway, O2 supply
- **PMH & meds ✓**
  - ? renal failure, toxins

Post ROSC Care

1. Monitor closely
2. BP support HIGH priority; maintain heart & brain perfusion
   - ✓ & support BP/MAP
   - If hypotensive:
     - Administer IVF until Dopamine ready
     - Begin DOPAMINE, titrate to response
     - Start additional IV, if needed

3. Do NOT hyperventilate - even if ↑ $ETCO_2$
4. Acquire 12L



American Heart Association

GUIDELINES CPR ECC 2015

Therapeutic Hypothermia

- **Not harmful; Still highly recommended by AHA**
- **Removed from prehospital SOP's because no evidence of benefit when given prior to hospital arrival**
- **Was distracting from other priorities in prehospital care (BP support, 12L ECG)**

2015 Recommendations — We recommend that comatose (ie, lack of meaningful response to verbal commands) adult patients with ROSC after cardiac arrest have TTM (Class I, LOE B-R for VF/pVT OHCA; Class I, LOE C-EO for non-VF/pVT (ie, "nonshockable") and in-hospital cardiac arrest)....Of note, there are essentially no patients for whom temperature control somewhere in the range between 32o C and 36o C is contraindicated.

Hypothermia in the Prehospital Setting - When cooling maneuvers were initiated in the prehospital setting, neither survival nor neurologic recovery differed for any of these trials alone or when combined in a meta-analysis.... Current evidence indicates that there is no direct patient benefit from these interventions and that the intravenous fluid administration in the prehospital setting may have some potential harm, albeit with no increase in overall mortality.

Rearrest

- Re-arrest occurs in ~38%, most often in first 10 minutes
- Most common type: PEA (so ECG rhythm may not change)
- Risk w/ re-arrest: Not detected quickly, not treated aggressively
- Detected quickly & treated aggressively; does not worsen outcome!
- Keep finger on pulse; watch O2 sat pleth on monitor to detect

Documentation – Key Points

- **Document ECG & EtCO2 - every 2 minutes**
  - Not BP & pulse; not checked every 2 min
  - Pulse is a palpable pulse (not HR on ECG)
- **CPR started when started and stopped** due to ROSC or TOR (termination of resuscitation)
  - Not every 2 minutes with rhythm check
- O2 sat should not be documented during CPR
  - Number is meaningless without a pulse

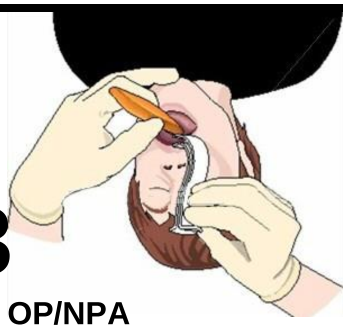
time		Consider	
	Compressions started	□ HypoVOLEMIA (IVF 20mL/kg)	□ Tension pneumo
	ECG monitor/defib electrodes on	□ HypoGLYCEMIA (✓glucose)	□ Toxins
	Airway: OPA/NPA in place	□ HypOXIA (✓O2)	□ Tamponade
	BVM ventilation w/ oxygen	□ Hypothermia	□ Thrombosis
	RQP/ITD & Capnography on BVM	□ Hypo/hyperkalemia	□ Trauma
	Vascular Access IO-IV	□ H ion/ACIDOSIS	

time	ETCO2	ECG rhythm	Defib J	Med given	Notes

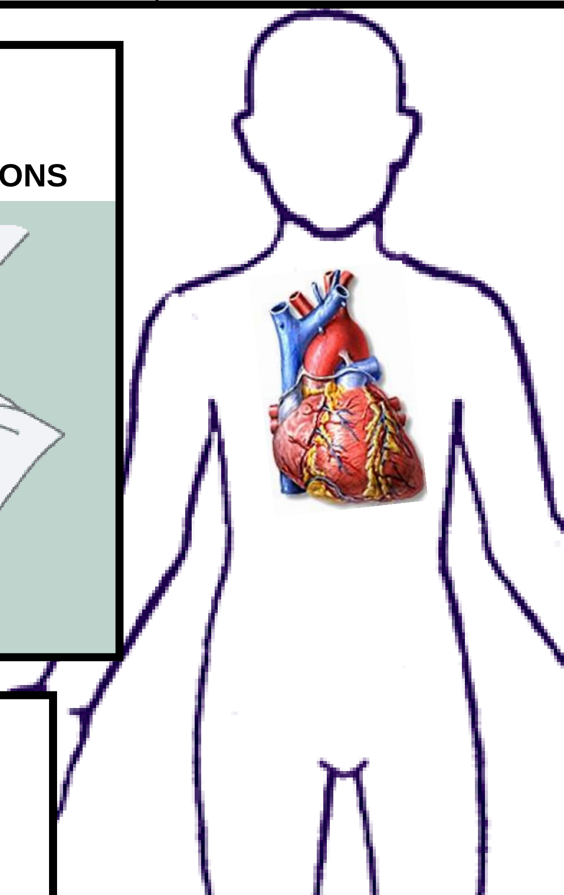
ROSC

- ☐ Check & support BP
- ☐ If hypotension: IVF bolus while prep dopamine
- ☐ Monitor VS & ECG closely
- ☐ Check O2 sat
- ☐ 12-L ECG

3



Insert OP/NPA
Attach RQP/ITD & capnography to BVM w/ O2
Maintain tight 2-hand face-mask seal during compressions & ventilations
Compressor squeezes bag, after compression sets, **until advanced airway placed**

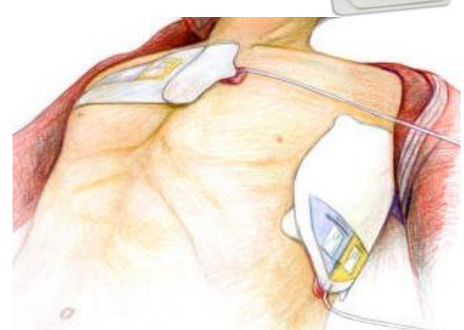


1

begin CHEST COMPRESSIONS

2

TURN ON MONITOR & ATTACH ELECTRODES/DEFIB PADS
(Will relieve compressor)



4

Establish IV/IO
Administer MEDICATIONS

5

TEAM LEADER
Code Commander

NORTHWEST COMMUNITY EMERGENCY MEDICAL SERVICES SYSTEM
EST 1972

DIANA:pit-crew team-resuscitation