

THE UNIVERSITY OF ARIZONA
Sarver Heart Center

MAJOR CLINIC

**Cardiocerebral Resuscitation:
 A New Approach to Cardiac Arrest**

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Conflict of Interest

Relevant Financial Relationships
 None

Off Label Usage
 None

American Heart Association
 BLS Guideline Committee Volunteer

**Sarver Heart Center
 Resuscitation Research Group**




Objectives

- Discuss the **keys** to successful resuscitation
- Introduce a **different** approach to OHCA
- Define **Cardiocerebral Resuscitation (CCR)**
- Present the AZ **CCR** system-wide results

Out-of-Hospital Cardiac Arrest (OHCA)

- Critical EMS function
- Quantifiable EMS function
- Test of entire EMSS
- Surrogate marker for success of EMS
- **We can save lives!**



Where Can EMS Make A Difference in Outcomes?

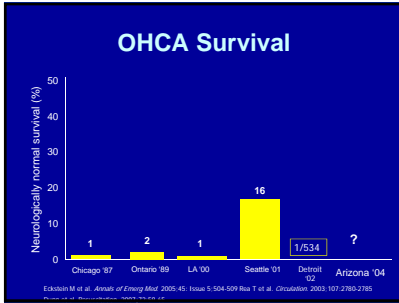
- Cancer
- Pneumonia
- AIDS
- Kidney Disease
- Diabetes
- Alzheimer's
- **NOT YET**

- **Cardiac Arrest**
- **Major Trauma**
- **ST-Elevation MI**
- **Acute Stroke**
- **YES**

JAMA

In the absence of early defibrillation, until **very recently** OHCA survival rates have not improved

1974 1980 1992 2008



Regional Variation in Out-of-Hospital Cardiac Arrest Incidence and Outcome

Conclusion: In this study involving 10 geographic regions in North America, there were significant and important regional differences in rate of out-of-hospital cardiac arrest incidence and outcome.

Interruptions to Chest Compression during OHCA Resuscitation

- Endotracheal intubation
- Assessing patient (e.g. repeatedly)
- Mouth-to-Mouth ventilation
- Central line placement
- Changing rescuers
- Defibrillation, particularly use of AEDs

Interruptions to Chest Compressions During OHCA

	First 5 Minutes	Entire Effort	P
Time with CCs, %	40±21	43±18	NS
Time without CCs, %	60±21	57±18	NS
Longest period with CCs, seconds	65 (46, 84)	122 (68, 206)	0.0001
Average period with CCs, seconds	46 (30, 67)	55 (43, 74)	NS
Longest period without CCs, seconds	95 (70, 147)	172 (109, 246)	0.0001
Average period without CCs, seconds	56 (41, 87)	57 (40, 78)	NS

Valenzuela et al. Circulation 2005

Hyperventilation during CPR

Aufderheide et al. Circulation 2004; 109:1960-5

Hyperventilation during CPR

- 13 out-of-hospital cardiac arrest patients
- Ventilation rate measured during CPR

Average ventilation rate = 37 ± 3 per minute (range 15-49)

Aufderheide et al. Circulation 2004; 109:1960-5

Three-Phase Model of Resuscitation

Weisfeldt ML, Becker LB. JAMA 2002; 288:3035-8

Defibrillation vs. CPR First (< 5 minute response time)

Wik et al. JAMA 2003; 289:1389-95

Defibrillation vs. CPR First (> 5 minute response time)

Wik et al. JAMA 2003; 289:1389-95

JAMA January 19, 2005

Quality of Cardiopulmonary Resuscitation During Out-of-Hospital Cardiac Arrest

Levy RN, Wu P, et al. *Journal of the American Medical Association*. 2005; 293:1015-23.

Objective: To measure the quality of out-of-hospital cardiopulmonary resuscitation as assessed by adherence to CPR guidelines.

Design and Setting: An analysis of the quality of out-of-hospital cardiopulmonary resuscitation in 1000 patients who were resuscitated by emergency medical services in Cook County, Illinois, from 1997 to 2002.

Results: The overall quality of out-of-hospital cardiopulmonary resuscitation was poor. Compliance with the 2000 American Heart Association guidelines for CPR was low. The most common deviations from the guidelines were inadequate depth and rate of chest compressions and inadequate ventilation.

Conclusion: The overall quality of out-of-hospital cardiopulmonary resuscitation was poor. Compliance with the 2000 American Heart Association guidelines for CPR was low. The most common deviations from the guidelines were inadequate depth and rate of chest compressions and inadequate ventilation.


Out-of-hospital CPR quality

Table 3. Performance of CPR During the First 5 Minutes and Entire Episode of CPR*

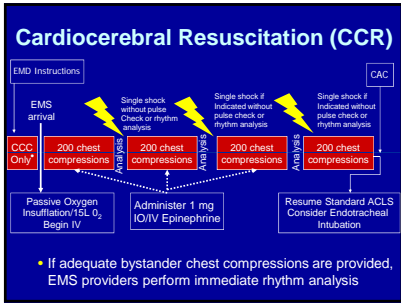
	First 5 Minutes of CPR	Entire Episode of CPR
No flow (n = 176)	49 (21)	48 (18)
NR ₅ , %	42 (18)	38 (17)
Compressions (n = 478)	60 (29)	64 (28)
Depth (median, mm)	39 (20)	37 (18)
Depth per episode, mm	39 (19)	34 (16)
30-45 mm with complete release	27 (20)	26 (20)
Too deep (>51 mm, median CPR)	0 (0.0)	0 (0.0)
Too shallow (<38 mm)	59 (27)	62 (28)
Incomplete release, median (IQR), %	0 (0-1)	0 (0-2)
Duty cycle, %	41 (25)	42 (14)
Ventilation (n = 103)	8 (4.0)	11 (4.7)

Wik et al., 2005

Current CPR Quality: Summary



1. Frequent pauses
2. Hyperventilation very common
3. Defibrillate during Circulatory Phase
4. Shallow chest compressions



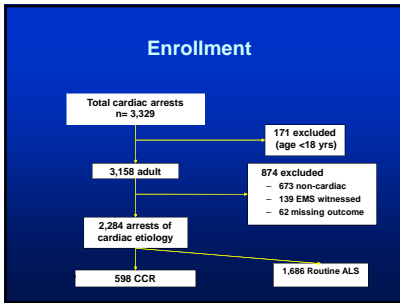
Hypothesis

OHCA victims in Arizona receiving **Cardiocerebral Resuscitation** would have higher survival rates than victims receiving routine **Advanced Life Support**

- ### Methods
- Observational analysis from the prospectively collected **SHARE** database
 - IRB approval from the University of Arizona
 - 61 EMS agencies in Arizona with varying:
 - EMS system design
 - Geography and response intervals
 - Training schedules
 - Patient demographics

- ### Methods: Data Collection and Training
- Utstein style database
 - October 2004 to August 2007
 - 11 of 61 (18%) elected to change to CCR
 - Train-the-trainer program
 - January 2005 to April 2007
 - ~3,000 EMT (B) and (P) trained

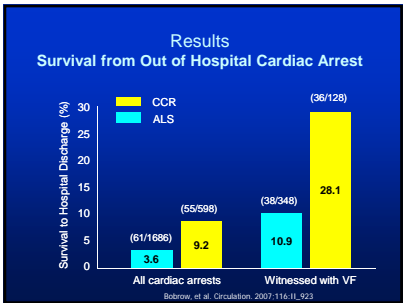
- ### Compliance Criteria for CCR
- Delayed ETI for 3 cycles of 200 CCs and rhythm analysis
 - 200 pre-shock chest compressions
 - Attempted epinephrine within 10 mins
 - 200 post-shock chest compressions



Results Characteristics of OHCA Victims

Characteristic	CCR (n=598)	ALS (n=1,686)
Mean age, years (SD)**	66.1 (15.5)	67.9 (15.0)
Males, % (n)	68.7 (411)	65.1 (1,198)
Home location, % (n)*	76.1 (455)	70.3 (1,194)
Bystander CPR performed, % (n)	39.3 (235)	39.3 (663)
Witnessed, % (n)	45.2 (270)	44.1 (744)
Ventricular fibrillation, % (n)	32.6 (195)	30.3 (510)
EMS dispatch to arrival time interval, mean minutes (SD)	5.2 (2.2)	5.6 (3.2)
Witnessed collapse to defibrillation time interval, mean minutes (SD)	13.7 (6.9)	13.3 (7.6)

SD = Standard deviation *p<0.05 **p<0.01



Discussion: Possible Beneficial Effects of CCR


- Minimize interruptions of marginal forward blood flow during resuscitation efforts
- Minimize hyperventilation during resuscitation
- Delay in advanced airway interventions may enable providers to focus on compressions and earlier epinephrine administration

Conclusion

Widespread implementation of **Cardiocerebral Resuscitation** resulted in a significant improvement in adult OHCA survival compared with routine Advanced Life Support care over the same time period in Arizona

Arizona EMS

"Statewide Survival From Out-of-Hospital Cardiac Arrest Improves with Widespread Implementation of **Cardiocerebral Resuscitation**"



American Heart Association
Best Resuscitation Abstract
Scientific Sessions 2007



JAMA

- Part I – Before & after comparison of two largest EMS systems in the state
- Part II – Protocol compliance analysis of 10 other EMS systems in the state

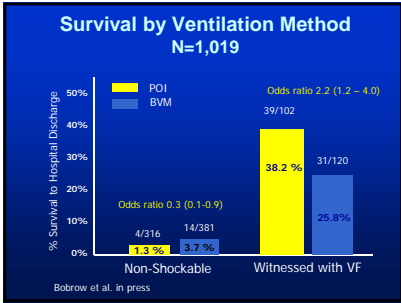
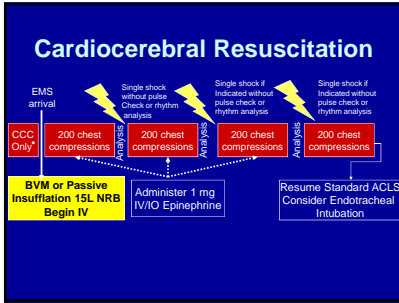
Table 6. Cerebral Performance Category (CPC) Scores Among Survivors^a

CPC Score	Did Not Receive MICR (n = 69)	Received MICR (n = 60)
1	20 (40.8)	18 (51.4)
2	20 (40.8)	10 (28.6)
3	7 (14.3)	7 (20.0)
4	2 (4.1)	0
5	0	0

Abbreviation: MICR, minimally interrupted cardiac resuscitation.
^aSee "Methods" section for explanation of CPC scores 1 through 5. Some participants were missing a CPC score (20 who did not receive MICR and 25 who received MICR).

Limitations

- Not a RCT
- Possible Hawthorne effect
- Limited electronic waveform data



Key Questions Remain:

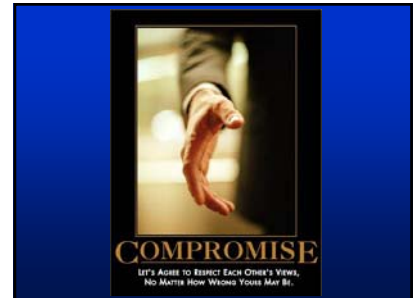
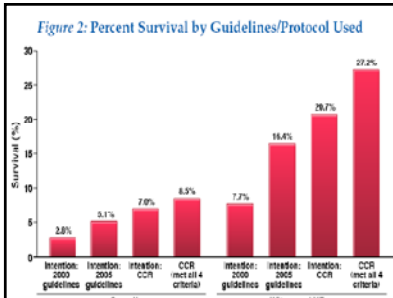
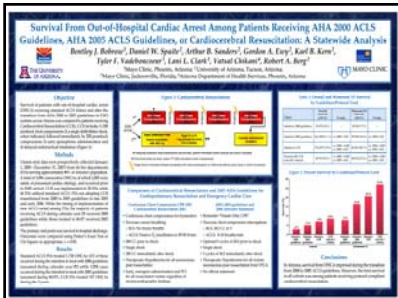
- Perhaps witnessed VF but what about unwitnessed VF, non-shockable rhythms?
- When is active ventilation necessary?
- Should there be two protocols?
- What part of the CCR protocol is most critical?



Before enlightenment, chop wood and carry water

After enlightenment, chop wood and carry water

- Zen saying

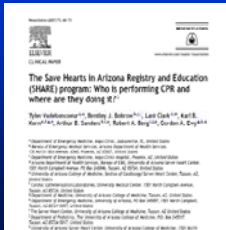


SHARE Program Initiative for Excellence in Resuscitation

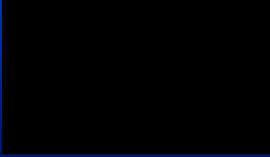
- **Cardiocerebral Resuscitation**
- **Be A Lifesaver (Lay individuals)**
- 2. ACLS Algorithm – Paramedics
- 3. Post Arrest Care (Pre-arrival & In-hospital)

Bystander CPR > than doubled chance of survival

Bystander CPR only occurred in 25% of arrests



- Hands-Only Video



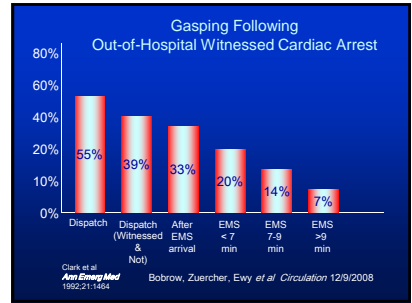
Resuscitation Science

Gasping During Cardiac Arrest in Humans Is Frequent and Associated With Improved Survival

Benkay E, Bobrow, MD, Melissa Zuercher, MD, Cynthia A. Ewy, MD, Luis Clark, BS, Yusef Chikara, MD, Dan O'Rourke, BS, SMD/EP, Andre B. Sanders, MD, Ronald W. Hwang, DVM, Robert A. Berg, MD, Karl B. Kern, MD

Background: The incidence and significance of gasping after cardiac arrest in humans are controversial. Manual and Mouth-to-Mouth approaches have used. The first was a retrospective analysis of consecutive witnessed out-of-hospital cardiac arrests from the Phoenix Fire Department Regional Dispatch Center that did not determine the presence of gasping were after collapse. The second was a retrospective analysis of 1219 patients with out-of-hospital cardiac arrest in Arizona documented by emergency medical system (EMS) first-responders to determine the incidence of gasping after arrest in relation to the human EMS arrival times. The primary outcome measure was survival to hospital discharge. An analysis of the Phoenix Fire Department Regional Dispatch Center records of witnessed and unwitnessed out-of-hospital cardiac arrest with attempted resuscitation found that 44 of 121 (37%) of all arrested patients had gasping. An analysis of 1219 EMS-attended, unwitnessed, out-of-hospital cardiac arrests demonstrated that the presence or absence of gasping correlated with EMS arrival time. Gasping was present in 36 of 109 patients (33%) who survived after EMS arrival, in 74 of 361 (20%) when EMS arrival time < 7 minutes, in 36 of 145 (25%) when EMS arrival time was 7 to 9 minutes, and in 27 of 136 (20%) when EMS arrival time was > 9 minutes. Survival to hospital discharge occurred in 54 of 109 patients (50%) who gasped and in 66 of 362 (18%) who did not indicate odds ratio, 1.4, 95% confidence interval, 1.2 to 1.6. Among the 481 patients who received bystander cardiopulmonary resuscitation, survival to hospital discharge occurred among 36 of 177 patients who gasped (20%), versus only 36 of 481 among those who did not gasp (8%) (odds ratio, 3.1, 95% confidence interval, 2.3 to 4.4).

Conclusions: Gasping or observed breathing is common after cardiac arrest but decreased rapidly with time. Gasping is associated with increased survival. These results suggest that the recognition and importance of gasping should be taught to bystanders and emergency medical dispatchers so as to avoid delays from false-terminating resuscitation efforts when appropriate. *JAMA*. 2008;299:1800-1805.



	Gasping (n)	Survival	
		n (%)	OR (95% CI)
All cardiac arrests (n = 1,218)	No (1,027)	80 (7.8%)	1.0
	Yes (191)	54 (28.3%)	3.4 (2.2-5.2)
Bystander CPR Performed			
Yes (n = 481)	No (404)	38 (9.4%)	1.0
	Yes (77)	30 (39.0%)	5.1 (2.7-9.4)
No (n = 737)	No (290)	42 (6.7%)	1.0
	Yes (73)	24 (21.1%)	2.4 (1.2-4.3)

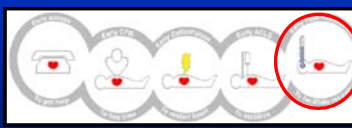


SHARE Program Initiative for Excellence in Resuscitation

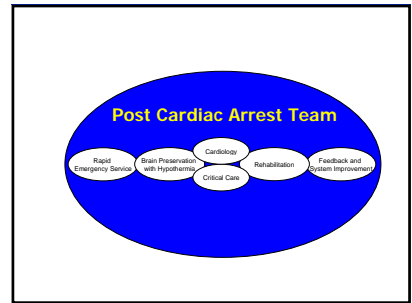
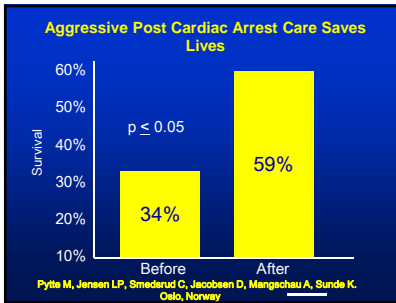
Cardiocerebral Resuscitation

1. Be A Lifesaver (Lay individuals)
2. ACLS Algorithm – Paramedics
3. Post Arrest Care (Pre-arrival & In-hospital)

Therapeutic Hypothermia



<http://www.med.upenn.edu/resuscitation/Hypothermia.htm>





What's at Stake?

- 5,000 SCA/YR in Arizona
- At least 1,000 VF OHCA
- 2004 statewide VF survival rate of 7% = 70 lives
- 2007 statewide VF survival rate of 34% = 340 lives
- **At least 270 Lives Per Year!**

Future of Cardiac Arrest Research (Translational/Clinical Research)

- Optimized hypothermia - timing, temp, method, duration, rewarming
- Controlled reperfusion
- Neuroprotective pharmacology
- Brain monitoring
- Prognostication of futility

Summary

- High quality CPR and standardized post cardiac arrest care are attainable
- Minimizing interruptions to chest compressions is critical
- Every community should track their outcomes
- Cardiocerebral Resuscitation is one option to consider to improve outcomes

Thank you

- Our goal is for Arizona to have the highest survival rate in the world for cardiac arrest victims.



www.azshare.gov

Acknowledgement

We are grateful to all the EMS providers in the state of Arizona participating in the SHARE program.

This presentation is dedicated to the Firefighters and Paramedics who risk their lives everyday to save others.

