

TRANSLATING RESUSCITATION RESEARCH INTO PRACTICE

By Judy Boehm, RN, MSN

Every year in November the American Heart Association holds its Scientific Sessions, during which basic, clinical, and population research is presented. One of the pre conferences is the Resuscitation Science Symposium (RESS), an international forum for fundamental, translational, clinical and population scientists and care providers to discuss recent advances related to treating cardiopulmonary arrest and life-threatening traumatic injury. I was able to attend these sessions and would like to share with you some of the research studies that were presented related to the topic of resuscitation so that you can evaluate them and consider applying new knowledge and techniques to clinical practice at the front lines of patient care. Abstracts can be found in *Circulation 2006, volume 114, supplement 2*. The number following the title is the abstract, as listed in this publication.

Research Studies Related to Whether the New 2005 AHA Guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care Improve the Effectiveness of CPR

Bystander Basic Life Support (BLS) and the European Resuscitation Council Guidelines 2005 (20) Rossier, B. et al. Med Univ Vienna; Vienna, Austria

Aim: To detect possible advantages through the simplifications made in the European Resuscitation Council (ERC) Guidelines 2005.

Methods: In an unblinded cross-over design, it was evaluated how well a random sample of people could adhere to the BLS steps according to the ERC Guidelines 2000 (group A) and Guidelines 2005 (group B), as well as the time to onset of chest compressions. Volunteers were recruited in a Center for Blood Donation of the Austrian Red Cross. After electronic randomization to starting as group A or B, the volunteers were taught a BLS sequence and given the opportunity to train until they felt confident before evaluation. A recording resuscitation manikin provided documentation.

Results: 60 people were included in the study, one individual dropped out after randomization. 15% of group A repeated the BLS steps completely, vs 41% in group B. The interval until onset of chest compressions differed significantly, 36.7 sec \pm 11.8 sec for group A vs 21.3 \pm 7.1 sec for group B ($p < 0.01$).

Conclusion: Results indicate that people can adhere to the BLS steps according to the ERC Guidelines 2005 more easily than according to the old guidelines.

Resuscitation Guidelines 2005 Improve CPR Effectiveness Parameters (22) Fleischhackl, R. et al. Med Univ of Vienna; Vienna Austria

Aim: To compare effectiveness parameters between the 2000 and 2005 Guidelines during training.

Methods: The primary outcome studied was the total number of chest compressions given in a five minute CPR simulation, and the secondary outcome was hands-off time. In this unblinded cross-over design, volunteers were electronically randomized to start in either group A who was taught the Guidelines 2000, or group B taught with the 2005 Guidelines.

Results: 50 people were included in the study; one dropped out after randomization. The total number of compressions differed significantly. Volunteers in group A performed 233 ± 51 compressions whereas volunteers in group B performed 347 ± 64 ($p < 0.01$). Hands-off time also differed significantly: 139 ± 15 sec in group A vs 107 ± 19 sec in group B during 5 minutes of simulated CPR ($p < 0.01$).

Conclusion: With the introduction of Guidelines 2005 important effectiveness parameters of CPR improved dramatically.

Thus, changes in the 2005 Guidelines result in improved CPR during training, as intended. All health care providers should know of the changes in the 2005 Guidelines by now and have incorporated them into their practice. Further research is needed to determine if these same changes in practice translate into better survival after cardiac arrest.

Research Studies Related to the Pauses that Occur with CPR

Long Pauses in Chest Compressions are Common during Advanced Life Support (ALS) Cardiopulmonary Resuscitation (4) Aufderheide, T.P. et al. Univ of Minnesota; Minneapolis, MN

Aim: To quantify the incidence and length of individual pauses in chest compression during out-of-hospital CPR.

Hypothesis: Long pauses (> 10 sec) are common during CPR in out-of-hospital CPR.

Methods: Following intubation, ECG and invasive femoral arterial BP were recorded prospectively during advanced life support CPR in a convenience sample of adult cardiac arrest victims in an urban emergency medical services (EMS) system. Pauses were identified retrospectively in the tracings by continuous, absent arterial BP waveforms during resuscitation.

Results: 22 patients were studied, with a total CPR time of 3.5 hours recorded. 284 pauses represented 32.7% of this time. Of these, 158 of the pauses were 1-2 sec in length, consistent with incorrectly performed synchronous ventilation after intubation. 84 pauses were >10 sec with a mean duration of 44.2 ± 4.2 sec. Pauses >10 sec accounted for 87.7% of total pause time.

Conclusion: Lengthy interruptions in chest compressions are a common error during out-of-hospital ALS CPR. Pauses were observed in all cases, accounting for >20 sec/min of no CPR.

Difficulty of Cardiac Arrest Rhythm Identification does not Correlate with Length of Chest Compression Pauses before Defibrillation (18) Abella, B.S. et al. University of Chicago Hosps; Chicago, IL

Background: Recent data suggest that long pauses in chest compressions prior to defibrillation are associated with reduced shock efficacy. The underlying reasons for these long pauses are unclear.

Aim: To determine whether pre-shock pause length during in-hospital resuscitations correlated with difficulty of rhythm identification or team performance factors.

Methods: Consecutive in-hospital cardiac arrest transcripts collected via an investigational CPR-sensing defibrillator were analyzed from 12/2002-12/2005 for pre shock pause durations. Advanced Cardiac Life Support (ACLS)-trained reviewers determined each rhythm and scored the difficulty of rhythm identification from 1 (most difficult to identify) to 5 (easiest to identify). Senior resident physicians (29) were then surveyed regarding pre-shock pause factors.

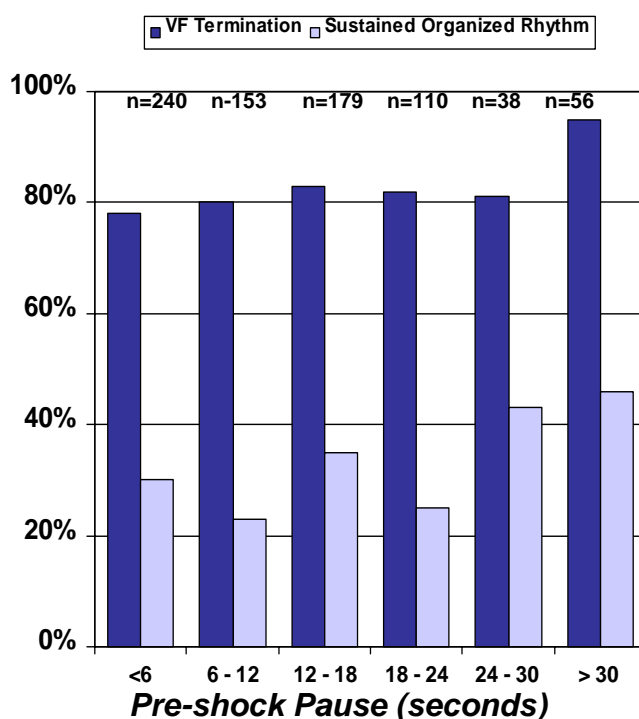
Results: 50 cases contained a total of 117 defibrillation attempts with a mean pre-shock pause in compressions of 17.8 ± 13.4 sec. When these 117 pauses were evaluated for ease of rhythm identification, longer pre-shock pauses were not associated with more difficult to identify rhythms, in fact the opposite was true. 21% of the senior residents attributed long pauses to lack of time sense during arrest, and 19.3% felt that confusion of task distribution secondary to room crowding hampered defibrillation.

The full study was published in *Critical Care Medicine* 2006;34(12):S427-S431 (Suppl).

Defibrillation Success is not Meaningfully Associated with Duration of the Pre-Shock Pause in Chest Compression (49) Koster, R.W., Walker, R.G., & Chapman, F.W. Academic Med Cntr; Amsterdam, The Netherlands and Medtronic Emergency Response Systems; Redmond, WA

Methods: Data were gathered from ventricular fibrillation (VF) cardiac arrest patients treated pre-hospital by ACLS responders using biphasic defibrillators. Electronic ECG and continuous transthoracic impedance data were used for each shock to determine VF termination (removal of VF for > 5 sec), return of a sustained organized rhythm (return of QRS complexes > 40 bpm within 60 sec), and duration of the pre-shock pause in chest compressions.

Results: A total of 776 shocks in 263 patients were analyzed. Logistic regression showed a very small but statistically significant increase in VF termination probability with increasing pre-shock pause duration. This effect disappeared when analysis was limited to pauses < 30 sec ($p=0.10$). There was no significant relationship between pause duration and return of an organized rhythm ($p=0.07$).



Lengthy pauses frequently occur in out-of-hospital CPR. Further research is needed into whether pre shock pauses affect the success of defibrillation, since Koster's report above is contradictory to recent research demonstrating that the probability of successful defibrillation decreases markedly with increasing pre-shock pause time. Rescuers and training programs should focus on minimizing the duration and frequency of activities that lead to these pauses. One suggestion is to emphasize that asynchronous ventilation should be performed following intubation. CPR quality should continue to be actively monitored for pauses during actual resuscitations, since it appears that human factors play a major role in these pauses. We need to seek methods to improve team function. Two recent papers that you might find of interest on this subject are:

- Ristagno, G., Gullo, A., Tang, W., & Weil, M. H. New cardiopulmonary resuscitation Guidelines 2005: Importance of uninterrupted chest compression. *Critical Care Clinics* 2006;22:531-538.
- Edelson, D. P. et al. Effects of compression depth and pre-shock pauses predict defibrillation failure during cardiac arrest. *Resuscitation* 2006;71:137-145.

Research Studies Related to the Interface between Defibrillation and CPR

Increasing CPR during Out-of-Hospital VF Arrest: Survival Implications of Guideline Changes (106) Rea, T.D. et al. Univ of Washington; Seattle, WA

Background: The King County two-tiered EMS system had decreased their time to defibrillation by 3 minutes with the introduction of automated external defibrillators (AED), yet their survival to discharge rate had not changed. A year prior to the publication of the *Guidelines 2005*, the EMS implemented protocol changes that provided a single shock without rhythm reanalysis, stacked shocks, or post-defibrillation pulse checks, while extending the period of CPR from 1-2 minutes.

Aim: To study whether survival would improve with this new protocol.

Methods: Persons suffering bystander-witnessed, out-of-hospital VF arrest due to heart disease were studied. Those in the prospective intervention group where the new defibrillation protocol was used (Jan 1, 2005-Jan 31, 2006) were compared with a historical control group (Jan 1, 2002-Dec 31, 2004). The EMS staff was trained in the new protocol in the fall of 2004 and AEDs were reprogrammed.

Results: Findings included:

- Survival to hospital discharge (primary outcome) was greater during the intervention compared to the control period (46% vs 33%, $p=0.008$).
- Better hospital survival during the intervention period corresponded to a greater proportion with return of circulation at the end of EMS care (74% vs 60%).
- Better hospital survival during the intervention period corresponded to a decrease in the interval from initial shock to start of CPR (7 sec vs 28 sec) based on electronic AED record review.

This research study was recently published in *Circulation* 2006;114:2760-2765.

Prompt Post-shock Chest Compressions Improve Outcome in a Model of Out-of-Hospital VF with Acute Myocardial Infarction (MI) (2661) Berg, R.A. et al. Univ of Arizona; Tucson, AZ

Background: Most victims of out-of-hospital VF cardiac arrest are defibrillated into a pulseless rhythm, and many of these arrests are associated with acute MI. When an AED is used, post-shock compressions are delayed 40-60 seconds during the requisite delays for automated rhythm analyses and shock advisories.

Aim: To compare 48-hour survival in a swine model with standard AED care vs a brief period of post-shock cardiac compressions.

Methods: After occluding the left anterior descending coronary artery, 5 minutes of untreated VF, and then a 200 joule biphasic shock, 50 swine were randomly assigned to standard AED care or 2 minutes of prompt post-shock compressions without regard to cardiac rhythm. Then the swine underwent simulated out-of-hospital resuscitation, followed by 2 hours of intensive care.

Results: Return of spontaneous circulation (ROSC) ($p=0.03$), survival at 48 hours ($p=0.04$), and good neurologic function ($p=0.08$) were statistically significantly improved in the prompt compression group.

Thus, the changes in the *Guidelines 2005* related to the interface of compressions and defibrillation result in better outcomes. All hospital staff should be apprised of these changes. The CPR team leader (or other designated individual) should monitor and coach actual resuscitation care.

Research Study Related to the Depth of Compressions

Assessing Capabilities and Attitudes among Paramedics during CPR on Manikins with Different Chest Stiffness (59) Odegaard, S. et al. Univ of Oslo; Oslo, Norway & London Ambulance Service; London, United Kingdom

Aim: To determine factors that lead to inadequate chest compression depth.

Methods: 40 pairs of paramedics and emergency medical technicians (EMTs) in London & Akershus ambulance services were asked to give 5 minutes of CPR on Laerdal Skillmeter Anne manikins with computer assisted feedback. Each pair was tested on 4 modified manikins with different chest properties set to represent the chest stiffness found in the patient population.

Results: All subjects performed CPR well within Guidelines recommendations on all 4 manikins in comparison to what was achieved during ACLS on patients (formerly studied). Findings included:

- Mean compression depth was 44 ± 3 mm on manikins vs 38 ± 6 mm with patients
- Mean compression rate was 101 ± 3 vs 109 ± 12 /min
- Ventilation rate was 7 ± 2 vs 11 ± 4 /min

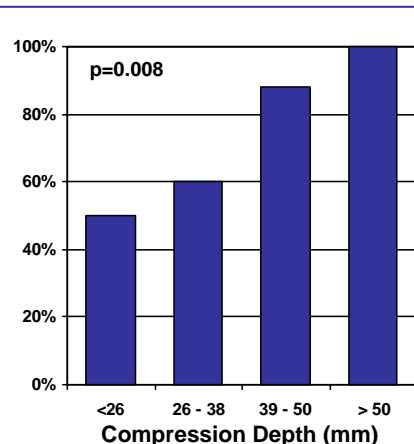
Results of a questionnaire showed that 60% of the subjects believed that too deep chest compressions could cause serious patient injury, and 43% thought that compressions within Guidelines' limits could cause such damage. 66% stated that it was their personal sense of correct depth that determined the depth they used. Breaking ribs made 54% feel very uncomfortable.

Conclusion: EMTs and paramedics were physically capable of compressing to Guidelines depth even on the stiffest manikin chests, yet did not achieve this on actual patients. They were afraid to injure the patient by compressing too deep, and trusted their own opinion of what is correct compression depth more than feedback.

Care providers will need to be convinced that the benefits of compressing deeper in terms of improved blood flow and successful outcome outweigh the injuries that may result. Edelson's prospective, multi-center study that was mentioned previously, found that for each 5 mm increase in compression depth during the 30 seconds immediately prior to defibrillation there was a two-fold increase in first shock success for in-patients and out-of-hospital patients in

cardiac arrest (Edelson, D.P. et al. Effects of compression depth and pre-shock pauses predict defibrillation failure during cardiac arrest. *Resuscitation* 2006; 71:137-145).

Since the highest first shock success was seen with compressions > 50 mm, an upper limit for depth is not yet known. Providing feedback to caregivers on the depth of compressions, especially if < 38 mm (1.5 inches), may be helpful during resuscitation.



Research Study Related to the Effect of Obesity on CPR

The Effects of Obesity on CPR Quality and Survival after Cardiac Arrest (56) Edelson, D. P. et al. University of Chicago Hosps; Chicago, IL

Background: The prevalence of obesity has risen drastically over the past two decades, yet CPR remains a “one size fits all” therapy. The Guidelines do not specify tailoring CPR for individual patient characteristics such as body habitus.

Methods: Data was prospectively analyzed from 76 adult patients undergoing CPR for whom body mass index (BMI) was available between Dec 2002 and Dec 2005. An investigational monitor/defibrillator equipped to measure compression characteristics during CPR was used.

Results: Of these 76 patients, 41 (54%) were average in size (body mass index [BMI] <30 kg/m²), 25 (33%) were obese (BMI ≥30, <40), and 10 (13%) were morbidly obese (BMI ≥40). There was no difference in rates of return of spontaneous circulation (ROSC) between average and obese patients but morbidly obese patients trended toward worse outcomes than patients with lower BMI (20% vs 39% ROSC; p=0.24). The fraction of cardiac arrest time during which no compressions were being administered was significantly higher in average-sized patients compared with patients whose BMI was ≥30 (27% vs. 17%; p=0.005). Morbidly obese patients trended towards receiving shallower chest compressions than smaller patients (42 mm vs. 45 mm, p=0.44).

Conclusion: Even though morbidly obese patients received less time without compressions, they tended toward worse outcomes. It is important to achieve recommended chest compression depth during CPR no matter the body size.

Research Studies Related to Defibrillation

Comparison of Serial Monophasic and Biphasic Shocks in Out-of-Hospital Cardiac Arrest (52) Mueller, D. et al. Campus Benjamin Franklin; Berlin, Germany

Aim: To compare the success of defibrillation shocks delivered via monophasic vs. biphasic defibrillators.

Methods: The protocol for the 2-tiered EMS system in Berlin was to deliver 3 stacked shocks for VF/ventricular tachycardia (VT), followed by 3 minutes of CPR and then another single shock. 223 patients received at least one shock with a monophasic waveform (LIFEPAK 300 AED). Energy settings for the monophasic AED were 200, 200, 360 joules for the stacked shocks, followed by 360 joules. Using the biphasic LIFEPAK 500 AED, with energy settings at 150, 200, and 360 joules, 224 patients received at least one shock.

Results:

- a. With the 1st shock, VF was terminated in 74% with the biphasic and 66% with the monophasic AED.
- b. With the 2nd shock, VF was terminated in 76% vs. 52%.
- c. With the 3rd shock, VF was terminated in 68% vs. 44%.
- d. With the 4th shock (after 3 minutes of CPR), VF was terminated in 83% (19 of 26 patients) vs. 48% (15 of 31 patients).

A coordinated rhythm was achieved in 25% of patients after each shock with both monophasic and biphasic AEDs. Also, the proportion of patients relapsing into VF from a coordinated rhythm or asystole was 40% with monophasic and biphasic after each shock.

Conclusion: Termination of VF in out-of-hospital cardiac arrest victims is constant with consecutive biphasic shocks, while it decreases with monophasic shocks. Moreover the efficacy of biphasic shocks remains at least stable after intermittent CPR whereas it further decreases with monophasic shocks. In this study though the termination rate with biphasic shocks was slightly superior to monophasic shocks, the rate was lower than reported in early studies.

Comparison of Biphasic and Monophasic Waveform Defibrillation for Out-of-Hospital Cardiac Arrest Cases with VF: Observations from a Large-Scale Population-Based Utstein Study in Japan (2080) Kajino, K. et al. J-PULSE investigators in Kyoto & Osaka, Japan

Aim: To compare the effects of biphasic vs monophasic defibrillation waveforms in terms of success of initial defibrillation and survival from out-of-hospital arrest.

Methods: Data was studied from patients with out-of-hospital VF arrests from Dec 1, 2003-April 30, 2004. 30 patients were treated with a monophasic AED, and 44 patients were treated using a biphasic AED.

Results:

	Monophasic	Biphasic	P value
Bystander CPR, % (n)	36.7 (11)	29.5 (13)	n.s.
From collapse to first defibrillation, min, median (quartile)	9.5 (6-14)	10.5 (8-15)	
From collapse to ROSC, min, median (quartile)	33 (26-41)	18.5 (11-46)	
Initial success of first defibrillation, % (n)	66.7 (20)	84.1 (37)	0.10
Return of spontaneous circulation, % (n)	26.7 (8)	56.8 (25)	<0.05
1-month survival, % (n)	7.4 (2)	31.7 (13)	<0.05
Neurologically intact survival, % (n)	3.6 (1)	22.7 (10)	<0.05

Conclusion: Outcomes from out-of-hospital VF were better in patients treated by biphasic AED than those treated by monophasic AED.

Automated External Defibrillators Do Not Reduce Time to First Shock in Patients who Present with Pulseless VT or VF during In-hospital Cardiac Arrest (53) Forcina, M. S. et al. William Beaumont Hosp; Royal Oak, MI

Hypothesis: For in-hospital VT/VF arrests the use of biphasic AEDs would allow floor nurses to deliver therapy before arrival of the CPR team thereby reducing time to first shock and increasing effectiveness of the first shock.

Methods: Inpatients at an 1100-bed tertiary care facility undergoing resuscitation were studied. Data was compared for 193 arrests when monophasic defibrillators were used vs. the later time when biphasic AEDs were in use for 224 arrests.

Results: Of the total patients, 58 had VF/VT as the initially recorded rhythm, and 154 had VF/VT at some during the resuscitation. There were no differences between the patient groups in terms of probability of receiving a shock, survival to end of resuscitation, 24 hour survival, or survival to discharge even though the time to first shock for *any* VF/VT was reduced by 3.3 minutes using an AED.

	Monophasic	Biphasic AED	P value
Initial VT or VF	22/193 (11.4%)	36/224 (16.3%)	0.17
Time to first shock (min)	2.9 ± 4.5	3.35 ± 5.9	0.99
Effectiveness of first shock	6/20 (30.3%)	10/34 (29.4%)	0.96
Any VT or VF	69/193 (35.8%)	85/224 (37.9%)	0.64
Time to first shock (min)	10.8 ± 8.9	7.5 ± 8.7	<Tc>0.016
Effectiveness of first shock	20/62 (32.3%)	17/78 (21.8%)	0.16

Conclusion: The authors suggest that there may be a time response window of < 7 minutes for successful defibrillation, beyond which biphasic AEDs show no advantage over monophasic defibrillators.

Institutional Characteristics Influence Self-Reported Time to Defibrillation in Patients with In-hospital Cardiac Arrest Due to Ventricular Tachyarrhythmia: A National Registry of CPR (NRCPR) Analysis (1776) Jones, N.J. et al. Univ of Michigan; Ann Arbor, MI

Hypothesis: Telemetry status and hospital size would be associated with the likelihood of receiving defibrillation within 3 minutes for patients with in-hospital cardiac arrest due to pulseless VF/VF.

Methods: Using data from 4238 adults with a first episode of VT/VF in the NRCPR, the authors categorized in-hospital patients based on their location (general medical beds without telemetry, general medical beds with telemetry and ICU beds) and the hospital size (small [<250], medium [$250-500$], and large [>500] and determined the likelihood of receiving defibrillation within 3 minutes.

Results: Defibrillation attempts within 3 minutes were found with 78.7% of patients in ICU, 62.6% in general beds with telemetry, and 53.7% in general beds without telemetry ($p<0.0001$). Small hospitals had reported defibrillation attempts within 3 minutes less often than larger-sized hospitals (61.5% in small hospitals vs. 67.9% in medium hospitals vs. 68.0% in large hospitals, $p=0.0006$).

Evaluation of a New, Lower Dose for Pediatric Defibrillation with Automated External Defibrillators (105) Berg, M.D. et al. Univ. of Arizona; Tucson, AR and Medtronic ERS

Background: The optimal AED dose for pediatric VF remains unknown. It's been previously reported that biphasic escalating doses of 50-75-86 joules were effective at terminating VF when using a Medtronic AED in pigs.

Hypothesis: A 35 joule pediatric shock dose would be safe and effective in pigs with prolonged VF when compared with adult doses.

Methods: Following 7 minutes of untreated VF, 24 piglets were randomized to receive either biphasic shocks at 35-35-35 joules or 50-75-86 joules via pediatric-sized pads or adult shock at 200-300-360 joules via adult pads. Resuscitation was per pediatric BLS protocol to 20 minutes, then pediatric ALS protocol to 27 minutes.

Results:

Defib Dose Group (joules)	# of Piglets	# of Shocks Prior to 1st Defibrillation	Cumulative Dose (J/kg)	% ↓ in 4-hour LVEF from Baseline	4-hour Survival	24-hour Good Neurological Outcome
35-35-35	8	5.9 ± 6.3	12.2 ± 10.4	10 ± 21%	7	7
50-75-86	8	2.4 ± 1.4	12.9 ± 15.1	7 ± 30%	7	6
200-300-360	8	1.1 ± 0.4	14.5 ± 7.5	32 ± 18%	8	3

Conclusions: Outcomes were similar for this lower dose and the previously proven 50 joule pediatric AED dose. Compared to the adult dose, both attenuated doses tended to be associated with less myocardial dysfunction and better 24-hour outcome. Although this lowest dose required more shocks than the adult dose, our results suggest that this new, lower dose would be safe and effective for children.

Does it Pay to Place the Pads? Use of External Defibrillator Pads after an MI in the Transport Environment (23) Pinkham-Reidy, C. Duke Univ Hosp; Durham, NC

Background: At present, there is no aero medical community standard addressing which MI patients require defibrillator pad placement prior to transport. A survey of Duke Life Flight nurses revealed a wide variation in clinical practice. The patient cost per defibrillator pad at Duke University Hospital is >\$350.

Methods: The medical records of all acute MI patients transported between June 1, 2003 and May 31, 2005 were retrospectively studied.

Results: 102 out of 341 patients (30%) had defibrillator pads placed on them, 98 of these being placed prior to transport. 27 of these were defibrillated prior to transport, 2 of who required further defibrillation during transport and one required pacing during transport. Two additional patients had pads placed during transport but they were not used. Pads were in place on only 6 patients (5.8%). The total cost of all pads placed during the study without established guidelines was \$35,7000, whereas the cost of those actually used was \$2100.

Conclusion: The number of patients who actually required pads for treatment was small. If pads were placed only at the time when needed, an annual cost savings of more than \$16,000 could be realized.

Most research findings support the fact that defibrillation with biphasic defibrillators is more effective than with those with a monophasic waveform in terms of shock conversion and patient outcome. But Kudenchuk recently found no statistically significant differences in outcome that could be ascribed to use of one waveform over another (Kudenchuk, P.J. et al. Transthoracic incremental monophasic versus biphasic defibrillation by emergency responders [TIMBER]. *Circulation* 2006;114:2010-2018). What differentiated his study was that he used defibrillators from the same manufacturer which were blinded as to waveform and included VF of longer duration in the field. It is important that institutions standardize on one make and model of defibrillator as they replace their monophasic defibrillators with biphasic. Further investigation is needed on why in the study at William Beaumont Hospital, the use of AEDs did not reduce time to first shock for initial VF/VT as expected. Since time to defibrillation is known to affect survival, quality improvement efforts should be targeted to small hospitals and the number of un-monitored beds. Manufacturers of defibrillators should each perform research to determine the best energy settings for their biphasic AEDs in order convert VF in children, yet cause least myocardial depression. Finally, before all air transport units stop placing defibrillator pads on patients in consideration purely of their cost, it should be examined how difficult it is to place these pads on the patient in a helicopter when they are needed and whether the resultant time delay affects patient outcome.

Research Studies Related to New Technology for Resuscitation

A CPR Assist Device Increased Emergency Department Admission and End Tidal (Et) CO₂ Partial Pressures during Treatment of Out-of hospital Cardiac Arrest (2664) Swanson, M. et al. Volusia County Government; DeLand, FL

Aim: The EVAC Ambulance, serving Volusia County, evaluated the impact of using the AutoPulse vs manual CPR on EtCO₂ and patient survival to ED admission during out-of-hospital cardiac arrest.

Methods: The AutoPulse was used with 269 patients by paramedics until ROSC or death declared. The manual CPR comparison group contained 607 patients. All treatment followed the AHA 2000 Guidelines.

Results: CPR with AutoPulse increased short-term survival overall significantly compared to manual CPR (28% vs. 18%, p=0.001). EtCO₂ was significantly improved at 4 sequential time points following intubation using the AutoPulse (23 ± 1 , 23 ± 1 , 24 ± 2 , 27 ± 3 mm Hg), compared to manual CPR (18 ± 1 , 18 ± 1 , 18 ± 1 , 18 ± 2 mm Hg).

Conclusion: Treatment with the AutoPulse showed a significant increase in short-term survival and EtCO₂ was higher at every time point compared to manual CPR.

More information can be learned about the AutoPulse at the ZOLL web site:
<http://www.zoll.com/product.aspx?id=84>

Analysis of Sudden Cardiac Arrests during Wearable Defibrillator Use (1771)

Szymkiewicz, S.J. et al. Otto von Guericke Univ; Madgeburg, Germany and ZOLL-LIFECOR

Aim: To study the use and efficacy of a new wearable cardioverter defibrillator (ZOLL LifeVest 3000).

Methods: ECG recordings from the LifeVest were reviewed, along with customer call reports, from Jan 2005-April, 2006. The device records 30 seconds prior to and 15 seconds following termination of VT/VF. For asystole the ECG is recorded for 5 minutes prior to the determination.

Results: There were 47 cardiac arrests in 33 patients - with VT in 38, VF in 2, asystole in 7, and electromechanical dissociation (EMD) in 1. All events were detected and recorded by the LifeVest with the exception of EMD. All VT/VF events were treated successfully (converted out of VT/VF and either conscious ER arrival or no need for additional care). Two patients were shocked for sustained VT while awake. 84% were treated within 60 seconds. Median time to shock from arrhythmia onset was 44 seconds. 4 of 7 patients with asystole survived. Patients consisted of ICD explants or surgical delays (76%), prior VT/VF (15%), post-MI/Coronary Artery Bypass Graph with low ejection fraction (15%), genetic sudden cardiac arrest (9%), non-ischemic cardiomyopathy (3%), or unknown (3%).

Conclusion: The majority of sudden cardiac arrest in this population was due to VT/VF (84%). When in use the LifeVest successfully treated 100% of VT/VF. Overall sudden cardiac arrest (unshockable rhythms included) survival was 87%.

To learn more about the LifeVest, visit the ZOLL web site at:
<http://www.zoll.com/product.aspx?id=902>

Use of an Impedance Threshold Device Improves Survival in a Suburban EMS System (108)
Vartanian, et al. Cypress Creek EMS; Spring, TX.

Hypothesis: Adding an impedance threshold valve (ResQPOD[®]) to standard BLS and ALS resuscitation efforts will improve short-term survival in patients with out-of-hospital cardiac arrest from all causes when compared to historical controls.

Methods: 104 patients were prospectively treated with the ResQPOD, and survival results were compared to 143 patients from 8/04-7/05 when this device was not in use. Age, gender, and EMS response time (~ 8 minutes) were evenly matched between groups. The ResQPOD was used on all patients in cardiac arrest no matter the etiology who were >1 year of age. It was applied 10 minutes after the 911 call, typically first on a facemask and then moved to an endotracheal tube if the patient was intubated.

Results: ROSC rates were 59% in the ResQPOD group compared to 45% in the historical controls (p=0.03). Neurologically intact hospital discharge rates improved from 10% in the control patients to 17% in the ResQPOD patients (p=ns). There were 4 patients who presented with asystole who survived and were intact neurologically at discharge compared to none in the control group.

Conclusion: ROSC increased by 29% in the ResQPOD group, and neurologically intact discharge rates improved by >50%. The survival rates were the highest in the 30-year history of the Cypress Creek EMS system.

The ResQPOD was given a Class IIa recommendation by the American Heart Association in the 2005 Guidelines. A recent study [Auferhede, T. P. & Lurie, K. G. Vital organ blood flow with the impedance threshold device. *Critical Care Medicine* 2006;34(12):S466-S473 (Suppl)] reviews cardiopulmonary resuscitation hemodynamics and vital organ blood flow in animal models with the use of the ResQPOD and correlates these findings with the results of human clinical trials.

Research needs to be performed with all technology advances to ensure that not only is its use feasible, but that it produces better hemodynamics during resuscitation and improved short and long-term survival.

Research Studies Related to Therapeutic Hypothermia

Clinical Application of Mild Therapeutic Hypothermia – the European Resuscitation Council (ERC) Hypothermia after Cardiac Arrest Registry (8) Arrich, J. and the Hypothermia after Cardiac Arrest Study Group investigators. Dept of Emergency Medicine; Wien, Austria

Background: The ERC Hypothermia after Cardiac Arrest Registry (HACA-R) was founded to reflect the state of the art in the use of hypothermia in the post-resuscitative care of patients suffering cardiac arrest within Europe.

Results: Between March 2003 and June 2005 data on 650 patients was entered. Of all patients it was noted:

- 462 (79%) received therapeutic hypothermia
- 347 (59%) were cooled with an endovascular device
- 114 (19%) received other cooling methods like ice packs, cooling blankets, and cold fluids

The median cooling rate was 1.1° C per hour. Of all hypothermia patients, 15 (3%) had an episode of hemorrhage and 28 (6%) had at least one episode of arrhythmia within 7 days after cooling. Therapeutic hypothermia could not be identified as the cause of any serious adverse events.

Conclusion: The rate of adverse events with therapeutic hypothermia was lower compared to preceding randomized controlled trials while cooling rates were quicker.

Incidence of Seizures in Comatose Cardiac Arrest Survivors Undergoing Therapeutic Hypothermia (1782) Castro, J. et al. Various US medical centers

Aim: To describe the incidence of electroencephalographically (EEG) documented seizure activity in comatose patients who survived cardiac arrest and underwent therapeutic hypothermia.

Methods: 28 patients who survived in- and out-of-hospital cardiac arrest received therapeutic hypothermia using the Arctic Sun™ Temperature Management System from Nov 2004 through Oct 2005 and had an EEG to document presence of seizure activity.

Results: Seizure activity was noted in 9 subjects (30%). 6 subjects were found to have EEGs consistent with status epilepticus. Due to the small sample size, seizure activity did not have a statistically significant relationship with clinical outcome.

Conclusion: In this preliminary study seizures were found much more frequently in cardiac arrest survivors undergoing therapeutic hypothermia than initially expected. Performing initial EEGs in comatose cardiac arrest survivors undergoing therapeutic hypothermia may be beneficial for early detection and treatment of post-anoxic seizures.

Is Therapeutic Hypothermia After Cardiac Arrest Harmful for Diabetic Patients? (11)

Ploj, T. et al. Univ Med Cntr; Ljubljana, Slovenia

Hypothesis: Survival improvement with therapeutic hypothermia is better in non-diabetic patients than in diabetic.

Methods: A group of 83 consecutive cardiac arrest patients treated with therapeutic hypothermia between Dec 2003 and Dec 2005 was compared to a group of 70 consecutive historical controls not treated with hypothermia from Jan 2001 to Nov 2003. Hypothermia significantly reduced mortality (-28.7%) in non-diabetic patients and non-significantly increased mortality (+20.8%) in the diabetic patients. Mortality was similar between the two groups prior to the induction of the hypothermia protocol, however after implementation of the protocol the mortality was significantly higher among diabetic patients. Morning glucose levels were comparable before and after implementation of hypothermia. Those with diabetes did not have more hypothermia-associated complications. Causes of death were similar between diabetic and non-diabetic patients.

Conclusion: Therapeutic hypothermia does not improve survival in the diabetic patient.

Intra-Resuscitation Hypothermia Improves Short-Term Survival in Prolonged Porcine VF
(1777) Menegazzi, J. et al. Univ of Pittsburgh; Pittsburgh, PA

Hypothesis: Pigs with hypothermia induced prior to (PRE group) arrest and during (DUR group) resuscitation would have improved rates of survival when compared to pigs with normothermia (NORM group).

Methods: 30 swine (23-30 kg) had VF electrically induced and untreated for 8 minutes, and 10 were randomly placed in each study group. Hypothermia was induced by rapid IV infusion of ice-cold saline (30 ml/kg) five minutes before VF in the PRE group, and at the start of resuscitation in the DUR group. The NORM group got 30 ml/kg of body-temperature saline at the start of the resuscitation. After 8 minutes of VF in all groups, CPR was given for 2 minutes, then epinephrine and vasopressin and propranolol were administered, followed by 3 more minutes of CPR. The first shock was given at 13 minutes of VF.

Results:

	PRE group	DUR group	NORM group
Temperature at 8 minutes of VF	34.8	38.3	37.9
Temperature at 13 minutes of VF	35.8	34.9	37.9
ROSC	5/10	7/10	4/10
Short-term survival at 20 minutes	5/10	6/10 (p=0.30)	3/10

Conclusion: Intra-resuscitation cooling doubled short-term survival compared to NORM.

Abstracts were presented at the Resuscitation Science Symposium on several new techniques for cooling: EMCOOLS[®] blanket (abstract #9), KTEK-3 extracorporeal cooling device (#7), and a flexible surround ice water suit (#80). We know that therapeutic hypothermia induced after resuscitation leads to improved survival rates, and the above study with swine indicates that cooling during resuscitation may also lead to better outcomes though this must be studied in humans. Complications related to the cooling are few, though seizures are an unrecognized hazard. Finally, the use of therapeutic hypothermia in diabetic patients does not produce the same improved outcomes, so a different hypothermia protocol may be needed for them.

Conclusion

As you review the abstracts presented at the AHA Sessions, remember that one study does not a change in practice make. Evaluate the sample size, methodology of the studies and soundness of the conclusion as you contemplate a change in practice based on research findings and perform a literature review of related studies.

Those of us interested in resuscitation research are excited to hear about the formation of the Resuscitation Outcomes Consortium (ROC). It was created to evaluate the treatment of people with out-of-hospital cardiac arrest or life-threatening injury. ROC consists of 10 U. S. and Canadian Regional Clinical Centers and a Data Coordinating Center. These centers provide the structure for conducting large trials of promising scientific and clinical advances designed to improve resuscitation outcomes. The ROC investigators collaborate with EMS system providers in their regions to evaluate existing or new therapies. To learn more about ROC visit their web site at www.uwctc.org and click on ROC. Three studies are currently in progress:

- Epistry Database

The working group is to develop the rationale and methods for a standard reliable and valid epidemiologic databank of out-of-hospital cardiac arrest and life-threatening cases as it relates to in-hospital outcomes.

- Hypertonic Saline

Study 1 seeks to determine the impact of hypertonic resuscitation on survival for blunt or penetrating trauma patients in hypovolemic shock. Study 2 seeks to determine the impact of hypertonic resuscitation on 6-month neurologic outcome for blunt trauma patients with severe traumatic brain injury. The 3 arms in each study will compare the use of 7.5% saline/6% dextran 70, 7.5% saline alone, and normal saline as the initial resuscitation fluid administered to these patients in the pre hospital setting.

- ROC PRIMED (Prehospital Resuscitation using an Impedance Threshold Valve and Early vs Delayed Analysis)

This will be a large clinical trial testing two strategies to increase blood flow during resuscitation. One study involves use of the impedance threshold valve. The second involves initiating resuscitation with a 3-minute period of manual compressions and ventilations before rhythm analysis (Analyze Later), rather than at least 50 manual compressions (approximately 30 seconds) before rhythm analysis (Analyze Early).