Conclusions: Overall survival was 2.7 times higher in the CCR group compared to the overall ACLS group (29/99) vs. 11.1% (30/271), p<0.001. Odds ratios were adjusted for age, gender, location, bystander CPR performed, % witnessed, % VF and EMS dispatch to arrival time. The odds of overall survival was 2.7 times higher in the CCR group compared to the overall ACLS group (95% CI 1.7,4.4), and 3.0 times higher in the CCR subgroup of witnessed VF (95% CI 1.6,5.6).

CONCLUSION: Survival of patients with OOHCA in Arizona was significantly better in fire departments utilizing the cardiocerebral resuscitation protocol than in fire departments utilizing ACLS. Implementing the cardiocerebral resuscitation protocol on a large scale is feasible and saves lives.

Inducing Hypothermia During Resuscitation Improves Return Of Spontaneous Circulation In Prolonged Porcine Ventricular Fibrillation

James M Menegazzi, Jon C Ritterberger, Brian P Sutfinotto, Eric S Logue, David D Salcido, Lawrence D Sherman; Univ of Pittsburgh, Pittsburgh, PA

Introduction: Induced hypothermia has been shown to improve survival and neurologic outcomes for ventricular fibrillation (VF) cardiac arrest. Clinical studies have not begun inducing hypothermia until after return of spontaneous circulation (ROSC). The effects of cooling during the resuscitation are not well-studied. We hypothesized that inducing hypothermia at the start of resuscitation would increase the rates of ROSC and short-term survival (20 minutes) in an established porcine model of prolonged VF. We compared intra-resuscitation hypothermia (IRH) with a normothermic control group (CTL). Methods: We anesthetized and instrumented 28 domestic swine (mean mass 26.5±2.4 kg) with EEG, esophageal temperature, and micromanometer-tipped aortic and right atrial catheters. We then randomly assigned them to IRH and CTL groups (n=14 each). VF was electrically induced and untreated for 8 minutes. Then resuscitation was begun with mechanical chest compression and ventilation. Hypothermia was induced by rapid IV infusion of ice-cold normal saline (30 mL/kg) at the start of resuscitation in the IRH group. The CTL group was anesthetized and maintained at body-temperature saline at the start of resuscitation. After 8 minutes of VF, two minutes of CPR was followed by delivery of drugs (epinephrine 0.1 mg/kg, vasopressin 40 U, and propranolol 1.0 mg) and 3 more minutes of CPR (first rescue shock at 13 minutes of VF). ROSC (cystolic BP above 80 mmHg for one minute continuously) and survival were recorded, as was total fluid given and hematocrits. Temperatures are reported in degrees C. Rates were compared with 2-tailed Fisher’s exact test, with alpha ≤0.05. Results: Baseline temperatures at 8 minutes VF did not differ (IRH=37.9° and CTL=37.9°). ROSC occurred in 12/14 (86%) IRH animals and in 6/14 (43%) CTL, with p=0.046. Survival occurred in 8/14 (57%) IRH animals and 4/14 (36%) CTL, with p=0.15. Total fluid volumes given and hematocrits did not differ between groups. Conclusions: IRH doubled the rate of ROSC compared to CTL. There was a non-significant 58% relative improvement in short-term survival. In this porcine model, rapid infusion of ice-cold saline quickly cooled during resuscitation.

Bone Marrow Mesenchymal Stem Cells Infused Intravenously after Cardiac Resuscitation Improves Cerebral Function

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Background: Allogeneic bone marrow mesenchymal stem cells (MSCs) differentiate into neurons. In the present study, we investigated the effects of intravenous infusion of MSCs following successful resuscitation on post-resuscitation neurological outcomes. Hypothesis: MSCs, when infused intravenously following initial resuscitation, reduce the severity of post-resuscitation cerebral dysfunction. Methods: Ventricular fibrillation was induced and untreated for 6 min in 20 male Sprague-Dawley rats weighing 450–550g. CPR, including chest compressions and mechanical ventilation, was performed for 6 min prior to attempted defibrillation. All animals were resuscitated. Two hours later, animals were randomized to receive a bolus injection of either 5 x 10^6 MSCs labeled with PKH26 in phosphate buffer solution (PBS) or PBS as placebo into the right atrium. Survival, adhesive removal, motor test and the Neurological Severity Score (NSS) were measured weekly for a total of 5 weeks. MSCs were assigned them to IRH and CTL groups (n=14 each). VF was electrically induced and untreated for 8 minutes. Then resuscitation was begun with mechanical chest compression and ventilation. Hypothermia was induced by rapid IV infusion of ice-cold normal saline (30 mL/kg) at the start of resuscitation in the IRH group. The CTL group was anesthetized and maintained at body-temperature saline at the start of resuscitation. After 8 minutes of VF, two minutes of CPR was followed by delivery of drugs (epinephrine 0.1 mg/kg, vasopressin 40 U, and propranolol 1.0 mg) and 3 more minutes of CPR (first rescue shock at 13 minutes of VF). ROSC (cystolic BP above 80 mmHg for one minute continuously) and survival were recorded, as was total fluid given and hematocrits. Temperatures are reported in degrees C. Rates were compared with 2-tailed Fisher’s exact test, with alpha ≤0.05. Results: Baseline temperatures at 8 minutes VF did not differ (IRH=34.9° and CTL=37.9°). ROSC occurred in 12/14 (86%) IRH animals and in 6/14 (43%) CTL, with p=0.046. Survival occurred in 8/14 (57%) IRH animals and 4/14 (36%) CTL, with p=0.15. Total fluid volumes given and hematocrits did not differ between groups. Conclusions: IRH doubled the rate of ROSC compared to CTL. There was a non-significant 58% relative improvement in short-term survival. In this porcine model, rapid infusion of ice-cold saline quickly cooled during resuscitation.

The Survival Rate from Out-of-Hospital Cardiac Arrest is Superior with Passive Oxygen Insufflation Compared to Active Assisted Ventilation

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OBJECTIVE: Experimental evidence suggests that excessive volume and rates of positive pressure ventilation during resuscitative efforts for out-of-hospital cardiac arrests (OOHCA) may be deleterious. The optimal ventilation technique for OOHCA, including method, timing, rate, and total volume, have not been determined. We sought to compare survival rates of adults with OOHCA receiving cardiocerebral resuscitation (CCR) between those receiving passive oxygen insufflation and those receiving oxygen via active bag-valve-mask (BVM) ventilation. METHODS: The Save Hearts in Arizona Registry and Education (SHARE) program collected Utstein style data on consecutive adults with OOHCA from 11 different fire departments in Arizona utilizing CCR between May 2005 and December 2006. Passive resuscitation was defined as an oropharyngeal airway device, and high flow oxygen at 15 L/min provided via a non-rebreather facemask without assisted ventilation while active ventilation was defined as BVM ventilation by paramedics at a recommended rate of 60/min. The primary outcome was survival to hospital discharge in all arrests and for the subgroup with witnessed ventricular fibrillation (VF). Outcomes were obtained from the Office of Vital Statistics as well as local hospitals and were compared using chi square testing; alpha <0.05.

RESULTS: 442 adult OOHCA received CCR and were consecutively enrolled. Standard characteristics did not differ between the passive insufflation and active ventilation groups. 142/442 (32%) received passive insufflation and 300/442 (68%) received BVM ventilation. Overall survival did not differ between the passive insufflation group and the active ventilation group (12.7% (18/142) vs. 8% (24/300), p > 0.05). Survival for witnessed VF was significantly higher in the passive insufflation group compared to the active ventilation group (48.6% (17/35) vs. 20.0% (12/60), p < 0.01). The odds of survival was 7.2 times higher in the passive insufflation group when compared to the active ventilation group (95% CI 2.4,21.6).

CONCLUSION: The survival rate of adults with witnessed VF OOHCA was superior in victims receiving passive oxygen insufflation than in victims receiving active ventilation during cardiocerebral resuscitation.

CPR Fraction Prior to Defibrillation Determines Survival in Prehospital Cardiac Arrest in the Resuscitation Outcomes Consortium (ROC) Epistry

James Christenson, Douglas Andrusiek, Univ of British Columbia / BC Ambulance Service, Vancouver, Canada; Siobhan P Everson-Stewart, Peter J Kudenchuk, Univ of Washington, Seattle, WA; John A Stiell, Univ of Ottawa, Ottawa, Canada; Daniel P Davis, Univ of California, San Diego, San Diego, CA; Tom P Auferheide, Med College of Wisconsin, Milwaukee, WI; Ahmed Adris, Texas Univ, Dallas, TX; John A Stiuller, Gresham Fire & Emergency Services, Gresham, OR; Ian Stiell, Univ of Ottawa, Ottawa, Canada; Resuscitation outcomes Consortium Investigators;

Introduction: In 2005, the American Heart Association recommended increased “hands-on time” during cardiology pulmonary resuscitation (CPR) based on animal research and small case
series. This study estimated the effect of increasing CPR fraction (proportion of resuscitation time with active CPR) on survival in a cohort of patients with out-of-hospital ventricular fibrillation or ventricular tachycardia (VFVT). Methods: Patients were selected from the ROC Epistry who had a confirmed VF/VT cardiac arrest that was not witnessed by Emergency Medical Services (EMS), received no public access defibrillation shock prior to EMS arrival, and had impedance recordings of CPR before the first shock. The proportion of each minute with active CPR, from defibrillator pad application until the first shock, was measured from the electronic resuscitation record by skilled readers who were blinded to hospital discharge outcome. The effect of increasing CPR fraction on survival to hospital discharge was adjusted for age, sex, bystander CPR, public location, interval from 911 call to defibrillator activation, chest compression rate, and ROC community. Results: Of 7963 EMS-treated cases of cardiac arrest without public access defibrillation, 1893 had an initial rhythm of VFVT and 283 of those had electronic tracings and confirmed outcome. Mean age was 63 years and 81% were male. Bystanders performed CPR on 51% and 41% arrested in a public location. Outcomes and odds ratios (OR) with 95% confidence intervals (CI) of survival are shown from lowest to highest category of CPR fraction. Conclusions: This study provides preliminary evidence that increasing CPR fraction is associated with increased survival from VFVT cardiac arrest. Though the study was observational, relatively small, and able only to measure CPR fraction after pad application, these findings suggest that provision of minimally interrupted CPR has direct clinical impact on survival afterVF cardiac arrest.

### Table: CPR Fraction

<table>
<thead>
<tr>
<th>n</th>
<th>0–20%</th>
<th>21–40%</th>
<th>41–60%</th>
<th>61–80%</th>
<th>81–100%</th>
</tr>
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<tr>
<td>Survived to Discharge (%)</td>
<td>6 (8.6%)</td>
<td>10 (21.7%)</td>
<td>11 (19.6%)</td>
<td>20 (27.4%)</td>
<td>13 (34.2%)</td>
</tr>
<tr>
<td>Unadjusted OR</td>
<td>Ref</td>
<td>2.96 (1.00, 8.21)</td>
<td>2.61 (0.30, 7.56)</td>
<td>4.02 (1.51, 10.74)</td>
<td>5.54 (1.90, 16.20)</td>
</tr>
<tr>
<td>Adjusted OR</td>
<td>95% CI</td>
<td>Ref</td>
<td>4.38 (1.11, 17.28)</td>
<td>2.04 (0.52, 8.02)</td>
<td>3.45 (0.90, 13.23)</td>
</tr>
</tbody>
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### Resuscitation Science Symposium: Best Original Resuscitation Science (Moderated Poster Session and Reception)

### Saturday Evening

**Room W224**

**Abstracts 6 – 60**

#### Timing Of Major Adverse Cardiac Events During Endurance Races.

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**Background**: Major adverse cardiac events (MACE) in endurance exercise are usually due to underlying and unsuspected heart disease. We present an analysis of the timing MACE that have occurred in endurance races over the past 6 years. **Methods**: We investigated clinical data of athletes who developed MACE during three national endurance races and were admitted to our hospital. Each year, 10–15 Olympic nominees participate. **Results**: In 6 years (2002–2007), a total of 94,000 athletes had participated in three prestigious cycling or half marathon races. 77% of the participants was male with a mean age of 40 years. In 6 athletes a MACE occurred (males, mean age 48 yrs): one athlete died suddenly despite extensive CPR. Three athletes had a myocardial infarction and underwent primary PCI; one collapsed due to enzymes. Two athletes were successfully defibrillated at the event’s site with an external defibrillator. All events occurred in the last quarter distance of the race or after the finish. This figure shows the timing of MACE in endurance races. **Conclusion**: the incidence of MACE during endurance races is very low. All MACE’s occurred in last quarter distance of the race or after the finish. A rapid available external defibrillator at the event’s site can be life-saving and may enhance the safety of endurance sport events.

#### Direction of Signal Recording Affects Amplitude Based Measures of Ventricular Fibrillation in Humans Undergoing Defibrillation Testing During ICD Implantation

Julia H Indik, Craig M Peters, Richard L Donnerstein, Peter Ott, Karl B Kern, Robert A Berg; Univ of Arizona, Tucson, AZ

**Introduction**: A shock applied to prolonged ventricular fibrillation (VF) is less likely to result in a perfusing rhythm than if applied early. Waveform analysis may indicate the duration of VF and the likelihood of defibrillation success, and if such analysis is to be relied upon, we need to understand the errors that may result from variations in AED patch placement. We analyzed VF from patients undergoing implantable cardioverter-defibrillator implantation. **Methods**: VF was induced in 26 patients with ischemic cardiomyopathy and 19 patients with dilated cardiomyopathy and recorded in six limb leads. Frequency characteristics (mean, median, dominant and bandwidth) were computed as well as amplitude-based measures of slope (median of absolute difference of voltage every 5 ms) and AMSA (summed product of frequency and amplitude). Characteristics were compared by ANOVA, with repeated measures by lead. **Results**: Frequency characteristics were similar in all leads. However, slope and AMSA were significantly affected (<0.001) by lead for both cardiomyopathy groups. In particular, for ischemic cardiomyopathy patients between leads I and II (a change in the frontal plane of 40 degrees), slope varied from 0.008: 0.001 mV to 0.012: 0.001 mV (mean ± SEM, p < 0.001) and AMSA varied from 29.4 ± 3.2 to 49.3 ± 2.6 V m Hz (p < 0.001). There were no significant differences between ischemic and dilated cardiomyopathy patients. **Conclusion**: Amplitude based measures of VF are significantly affected by recording direction. This investigation implies that AED patches must be consistently and correctly placed if amplitude-based measures are used to decide whether to deliver a defibrillatory shock.

#### What is the Frequency of Inappropriate of Emergency Department Catheterization Laboratory Activation For Patients with Potential ST Elevation MI?

Michael C Kontos, Michael Kurz, Charlotte S Roberts, Sarah Joyner, Laura Kreisa, Joseph P Ornato, George W Vetelovec; Virginia Commonwealth Univ, Richmond, VA

**Background**: To decrease door to balloon time (D2B) for STEMI patients (pts), it is recommended that the Emergency Department (ED) activate the cardiac catheterization laboratory (Cath Lab) directly through a simultaneous group STEMI page that includes the Cath Lab staff and interventionalist. Anecdotal evidence suggests that inappropriate activation is infrequent; however quantitative data is lacking. **Methods**: We assessed the frequency and outcomes of ED STEMI pages to determine the number who had a true STEMI, those who had ECG findings worrisome for but not meeting STEMI criteria, and the frequency of MI. A pt was considered a “false alarm” if emergent cath was not done and MI was excluded. Angiographic findings and outcomes were also evaluated. **Results**: Over a 1 year period, ED activation of the Cath Lab via the STEMI page occurred 98 times. There were 61 (62%) pts with a true STEMI, of whom only two did not have an emergent cath (2 not done because of sepsis and acute stroke[(Table)]. A total of 32 (33%) pts had ECG findings concerning for but not meeting STEMI criteria, of whom 31 (97%) underwent emergent cath, with PCI performed in 10 (32%). In 5 pts (5%), the Cath Lab was de-activated after further assessment, and would have been considered “false alarms”. **Conclusions**: A significant number of ED STEMI Cath activations are for pts who do not meet standard STEMI criteria. However, most have suggestive ECG findings benefiting from emergent angiography, and have either significant disease, undergo PCI, and/or are diagnosed with non-STEMI. Only a small percentage (5%) are clear “false alarms”. This data further support current recommendations for ED Cath Lab activation for potential STEMI pts.

#### Ammonia as a Marker of Neurological Outcomes in Patients with Out-Of-Hospital Cardiac Arrest

Asuaka Kasai, Ken Nagao, Kimio Kikushima, Kazuhiro Watanabe, Takeo Mukohyama, Yoshitomo Tominaga, Katsuhisa Toda, Nobutaka Chiba, Mitsuhi Ishii, Taketomo Soga, Kei Nishikawa, Harumi Ikeda, Yutaka Tateda, Tsukasa Yagi, Surugadai Nihon Univ Hosp, Tokyo, Japan

**BACKGROUND**: Excessive accumulation of ammonia (NH3) induces neuronal metabolic derangements, promotes astrocyte swelling and perturbs cerebral nitric oxide metabolism which can mediate some of the pathophysiologic changes. Although studies have shown that there was a correlation between increase in blood NH3 level and hepatic encephalopathy, few studies were available for patients with out-of-hospital cardiac arrest. We therefore evaluated NH3, as a biochemical marker of neurological outcome. **METHODS**: We conducted a prospective clinical
study of patients with out-of-hospital cardiac arrest that followed Utstein style reporting guidelines. Blood samples to measure the NH₃ concentration were taken from a vein before drug administration in the emergency room (normal range of NH₃ 12 to 66 μg/dL). The primary endpoint was a favorable neurological outcome at the time of hospital discharge. RESULTS: Of the 461 patients with out-of-hospital cardiac arrest, 291 adult patients were eligible. The NH₃ level ranged from 10 to 400 μg/dL, with a mean (±SEM) of 208 ± 133 μg/dL, and a median of 186 μg/dL, and 25th and 75th percentile values of 79 and 337 μg/dL, respectively. Of those, 20 (7%) had a favorable neurological outcome at the time of hospital discharge, and the NH₃ level was lower among such patients than among those with unfavorable neurological outcomes (a median, 46 μg/dL vs. 205 μg/dL, p = 0.0001). The adjusted odds ratio for a favorable neurological outcome after NH₃ level was 0.98 (95% CI, 0.97–0.99; p < 0.0005), and the NH₃ level was more accurate than any components of the chain of survival. The neurological prognostic value of NH₃ level at a cut off of 87 μg/dL was 79%. The negative predictive value of NH₃ level at levels of more than 189 μg/dL was 100%. In patients with return of spontaneous circulation (ROSC) after out-of-hospital cardiac arrest witnessed by bystanders, there was a significant positive correlation between the NH₃ level and time interval from cardiac arrest to ROSC (R = 0.54, p < 0.0001). CONCLUSIONS: We demonstrated that NH₃ level on arrival at the emergency room in patients with out-of-hospital cardiac arrest and reliably predicted neurological outcome. NH₃ is a new candidate marker of neurological outcome after cardiac arrest.

The Influence Of Sex On Endogenous Adenosine Production And The Occurrence Of Ventricular Fibrillation During Myocardial Ischemia

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Background: Endogenous adenosine (ADO) is cardioprotective during acute ischemic insult. Myocardial ischemia can cause ventricular arrhythmias and is used to induce ventricular fibrillation (VF) in some animal models of cardiac arrest. Recent evidence suggests that sex may influence VF decay and the rate of ROSC in porcine VF. We sought to determine the effect of animal sex on ADO production and the occurrence of VF during left anterior descending artery (LAD) occlusion in dogs. Our null hypothesis was there would be no difference between male and female animals. Methods: This was a secondary analysis of previously published data from an IACUC approved protocol. Twenty-nine anesthetized mongrel dogs (15 M, 14 F) were prepared in a standard fashion. Hemodynamic parameters were monitored continuously during the experiment. Blood from the great cardiac vein was sampled for endogenous ADO concentration at baseline and at 1, 2, 3, 5, 7, and 10 minutes of LAD occlusion. Plasma ADO concentration was determined by radioimmunoassay. Group comparisons were assessed using descriptive statistics. Students t-tests or Mann-Whitney U tests were used for dichotomous variables. Proportions with 95% confidence intervals were calculated for the AUC and the rate of VF induction. Results: Baseline characteristics between the two groups were the same. VF occurred in 14 of the 29 animals in the primary study, with ADO concentration being significantly higher in females. Conclusion: Females had significantly higher ADO levels and the occurrence of VF was not significantly different between males and females. Further clarification of the influence of sex on endogenous ADO in ischemia-induced VF is needed. Meanwhile, investigators using an ischemia model of VF may want to control for animal sex.

Medical Emergency Teams Reduce Unexpected Cardiac Arrests, But Not Overall Hospital Costs Per Case

Harish Manyam, Michael S Cratty; Allegheny General Hosp, Pittsburgh, PA

Introduction: Medical emergency teams (MET) have been developed to meet the growing needs of hospitalized patients. Medical emergency teams have been shown to reduce unexpected cardiac arrests, unexpected ICU transfers, length of stay (LOS), and inpatient mortality. However, there is no data on overall hospital cost per case with the addition of a MET team. Hypothesis: We hypothesized that the addition of a MET to our hospital would reduce our hospital costs per case by reducing unexpected cardiac arrest. Methods: A MET was developed at our 714-bed teaching hospital in March 2006. Our goal was to perform a retrospective analysis of hospital costs per case related to cardiac arrest and MET responses before and after establishment of a MET team. The first comparison group included unexpected cardiac arrests for a 6-month period from March 2005-September 2005 before establishment of the MET team. The second group included unexpected cardiac arrest patients and patients seen by the MET team that required unexpected transfer to the ICU for a similar 6-month period from March 2006-September 2006 after development of the MET team. Results: Group 1 from 2005 included 76 unexpected cardiac arrest patients and Group 2 from 2006 included 48 unexpected cardiac arrests and 95 unexpected transfers to the ICU. Both groups had similar overall severity scores of 1.7. Overall we had a 37% reduction in unexpected cardiac arrests, and the MET team had a 32% reduction in unexpected ICU transfers. Of the medical emergency team at our hospital decreased unexpected cardiac arrests, but did not decrease mean total cost per case for patients suffering unexpected cardiac arrests and unexpected ICU transfer during activation of the medical emergency team.

Pulmonary Hemodynamics in Neonatal Lambs with Pulmonary Hypertension - Effect of Resuscitation with 21% versus 100% Oxygen

Satyan Lakshminrusima, Daniel D Swartz, Sylvia F Gugino, Karen A Wynn, Rita M Ryan, SUNY, Buffalo, NY; Robin H Steinhorn, Northwestern Univ, Chicago, IL; James A Russell; SUNY, Buffalo, NY

The optimal level of O₂ supplementation during neonatal resuscitation is controversial. We recently published data that resuscitation with 21% or 100% O₂ for 30 min results in similar decreases in pulmonary vascular resistance (PVR) in normal newborn lambs (Pediatr Res in press). However, the effect of resuscitation with 21% or 100% O₂ on pulmonary hemodynamics in lambs with in utero pulmonary hypertension (PH) is not known. Methods: PH was induced in fetal lambs by antenatal ductal ligation at 126 d of gestation (term ~ 145 d). Lambs were delivered 9 d later by C-section and ventilated with 21% O₂ or 100% O₂ for 30 min. Control lambs without PH were ventilated similarly for comparison (n = 4–7 in each group). The lambs...
were instrumented to measure PVR prior to delivery. After 30 min, lambs with PH were ventilated with 50% O₂ and pulmonary vasodilator responses to inhaled NO 20 ppm were evaluated. Results: PVR was significantly higher in lambs with PH compared to control. The decrease in PVR was similar by 30 min in 21% and 100% O₂ resuscitated control lambs. In contrast, 100% O₂ resuscitation resulted in a significantly greater decrease in PVR in lambs with PH (fig A). However, 100% O₂ resuscitation impaired subsequent decrease in PVR in response to inhaled NO in both control and PH lambs (fig B).

Conclusions: 100% O₂ resuscitation results in a greater decrease in PVR but impairs subsequent pulmonary vasodilatation to NO in lambs with PH. Speculation: Ventilation of PH lambs with 100% O₂ significantly increases lung isostatone levels (AUROC 2006 174 12.1372). We speculate that a similar increase in reactive oxygen species following 100% O₂ resuscitation interferes with the vasodilator response to NO.

Electrocardiographic Characteristics for Automated External Defibrillator Algorithms are Different between Children and Adults

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Introduction: An AED is recommended for children <8 years if the rhythm detection algorithm has been validated in children with extensive testing. The purpose of our study was to determine if there were significant differences among ECG characteristics between pediatric vs. adult patients. Methods: Digitized recordings of NSR were obtained from PhysioNet’s archives and the ZOLL pediatric database. Rhythms were divided into 9-sec strips, creating 820 samples from 103 patients <10 years (children) and 71 patients >18 years (adult). Rate, QRS signal amplitude, (SA) and conduction (COND) were analyzed. The rate and SA were determined using R-R interval detection and baseline to peak QRS measurements, respectively. COND was defined as the maximum QRS complex slope following the first major deflection, representing the rate of ventricular activation. Results: There were statistical differences between pediatric and adult rhythm characteristics of rate, SA, and COND. (Fig 1) Heart rate for children was significantly higher than adult (113 ± 25 bpm vs 80 ± 16 bpm, P<0.001). Conversely, SA for pediatric subjects was significantly lower than adult subjects (1.2 ± 0.6 mV vs 2.2 ± 0.8 mV, P<0.001), as was COND (35.2 ± 18.0 mV/m vs. 54.0 ± 29.0 mV/m, P<0.001). Conclusions: The results showed significant differences between adult and pediatric ECG characteristics in rate, SA, and COND. These differences may result in inaccurate rhythm detection during AED use if the algorithm detection validation program did not include pediatric rhythms. This study confirms the recommendation that an AED rhythm algorithm should be validated with ECG strips obtained from children.

Fig. 1 Comparison of NSR characteristics between adult and pediatric rhythms. *P<0.001

Subsequent VF is Associated with Better Outcomes from Out-of-Hospital Cardiac Arrests with Initial Non-shockable Rhythms—population-based Utstein Study in Japan

Kentarou Kajino, Osaka Univ Graduate Sch of medicine, Suita, Japan; Taku Iwami, Kyoto Univ, Kyoto, Japan; Robert A Berg, The Univ of Arizona College of Medicine, Tucson, AZ; Masahiko Nitta, Osaka Med College, Takatsuki, Japan; Yasuyuki Hayashi, Senri Critical Care Med Ctr, Suita, Japan; Tatakuya Nishikuri, Senri Critical Care Med Ctr, Izumisano, Japan; Hiroshi Nomori, National Cardiovascular Ctr, Suita, Japan; Hisashi Ikuechi, Osaka Gen Med Ctr, osaka, Japan; Takashi Kawamura, Kyoto Univ Sch of Public Health, Kyoto, Japan; Atsushi Hiraide, Kyoto Univ Graduate Sch Faculty of Medicine, Kyoto, Japan; Daimu Tatsuki, Hiroshi Tanaka, Takeshi Shimazu, Hisashi Sugimoto; Osaka Univ Graduate Sch of medicine, Suita, Japan

OBJECTIVE: To compare survival rates from out-of-hospital cardiac arrest (OHCA) with an initial non-shockable rhythms according to whether they remained in a non-shockable rhythm or converted to shockable rhythms. METHODS: Design: Population-based cohort study. Subjects: Witnessed OHCA cases of cardiac etiology with pulseless electrical activity (PEA) or asystole as initially recorded rhythm. Main outcome measure: Neurologically favorable one-month survival. We enrolled all adult (age ≥18 years) patients with witnessed OHCA of cardiac etiology who were treated by the emergency medical services (EMS) in Osaka, Japan, from January 1 to December 31, 2005, by means of the Utstein Style. Resuscitation was performed according to the AHA guideline 2000. Survival indicators were compared between patients with sustained non-shockable rhythm (No-shock group) and patients with subsequent VF/VT and electrical shock (Shock group) using logistic regression. RESULTS: Of 3191 OHCA of cardiac etiology, 824 witnessed cases had PEA or asystole as initially recorded rhythm. Of the 824, 742 (90%) remained in a non-shockable rhythm at each evaluation throughout the resuscitation while 82 (10%) eventually converted to VF/VT and were shocked by EMS personnel. Neurologically favorable one-month survival was significantly greater in the Shock group (9.4% versus 0.8%, p<0.001). Subsequent VF/VT was a significant predictor (OR, 5.4; 95%CI, 1.38–20.9) of neurologically favorable survival after adjustment for potential confounders. CONCLUSIONS: Among these patients with OHCA and initial non-hockable rhythm, subsequent VF/VT was associated with better outcomes.

Ambulance Paramedics Interrupt Chest Compressions And Delay Defibrillation After Taking Over From Lay Rescuers With An Automated External Defibrillator

Jocelyn Berdowski, Ron J Schulten, Rudolph W Koster; AMC, Amsterdam, The Netherlands

Introduction: There are no guidelines for transition of care from rescuers with AED to paramedics with ongoing CPR. After disconnection of the AED, the time of the next shock as advised by the AED and the actual shock given by paramedics. Results: Results are shown in table 1. Of the 245 cases, 73 cases had a shockable rhythm during take over, 141 a non-shockable rhythm and 31 patients hadReturn of Spontaneous Circulation. A shock was delivered too early or too late in 68 of 73 patients. Four patients were never defibrillated. Conclusion: Disconnection of the AED by professionals interrupts the treatment protocol of the AED, delaying time of defibrillation by almost two minutes. Premature defibrillation leads to decrease in CPR time. The optimal moment of disconnecting the AED should be described in new guidelines.
### Effects of Stomach Inflation on Hemodynamic and Pulmonary Function During Cardiopulmonary Resuscitation in Pigs

Peter Paal, Andreas Neuarter, Michael Loeld, Daniel Petbich, Holger Herff, Achim von Goedecke, Karl H Lindner, Volker Wenzel; Innsbruck Med Univ, Innsbruck, Austria

**Background:** Stomach inflation during cardiopulmonary resuscitation (CPR) is frequent. The purpose of this study was to evaluate effects of different levels of stomach inflation on hemodynamic and pulmonary function during CPR in a porcine model. **Methods:** After 4min of ventricular fibrillation, randomization to 0, 5, or 10L of stomach inflation was performed in 21 pigs. Baseline support CPR was then initiated for 3min, followed by a combination of epinephrine (0.3mcg/kg) and high-flow oxygen (10L/min) and returned to baseline support CPR and a combination of ventilation, vascular access, and defibrillation. Results: Significant (P < 0.05) decreasing static pulmonary compliance [52 (38–58), 19 (8–32), and 12 (7–15) mL/cmH2O, respectively], and significantly increasing mean airway pressure during mechanical ventilation [14 (12–15), 26 (20–66), and 40 (13–46) cmH2O]. Arterial partial pressure of oxygen and carbon dioxide were significantly lower with 5L than with 0L and 10L of stomach inflation, but comparable between 5 and 10L of stomach inflation [378 (88–440), 58 (47–113), and 54 (43–126) mmHg, respectively]. Similarly, arterial partial pressure of carbon dioxide was significantly lower with 5L when compared with 5 and 10L of stomach inflation [30 (24–38), 41 (34–51), and 56 (45–88) mmHg, respectively]. Return of spontaneous circulation rates were significantly different (P < 0.05).**

### NT-proBNP Elevations in Adult Respiratory Distress Syndrome Strongly Predict Morbidity and Mortality: An Analysis from the Molecular Epidemiology of ARDS Study

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**Introduction:** Patients with ARDS suffer from a syndrome of marked cardiopulmonary derangement, including right ventricular strain and noncardiogenic pulmonary edema. We hypothesized that N-terminal pro-brain natriuretic peptide (NT-proBNP) levels would be elevated in ARDS, and serve as a marker of prognosis in this setting. **Methods:** Patients were diagnosed with ARDS according to the American-European Consensus Committee definition. Blood was taken within the first 72 hours of ARDS onset and assayed for NT-proBNP. Associations between NT-proBNP and presence/severity of sepsis, as well as ICU resource utilization were identified. Patients were followed for the primary outcome of 60-day mortality. Multivariable logistic regression and Cox proportional hazards models were constructed including variables selected using backwards elimination, clinical relevance, and significant interactions. **Results:** 177 patients were enrolled and analyzed. There were 70 deaths in the study, including 41 (23%) patients with NT-proBNP concentrations to be expected AED shock in sec

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<tr>
<th>Shockable</th>
<th>Premature shock</th>
<th>Non shockable</th>
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<tr>
<td>(n = 41)</td>
<td>(n = 27)</td>
<td>(n = 141)</td>
</tr>
<tr>
<td>Median time interval between connection of mDFB and expected AED shock in (sec)</td>
<td>53 (1,197)</td>
<td>71 (20,140)</td>
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<tr>
<td>Median time interval between connection of mDFB and expected AED analysis in (sec)</td>
<td>86 (0,100)</td>
<td>25 (0,77)</td>
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**Table 1: Shock delay and CPR interruption, divided in shockable and non shockable rhythms**

**Conclusions:** NT-proBNP is a sensitive and specific marker of morbidity and mortality in ARDS patients, and should be evaluated as an important marker of prognosis in ARDS.
The Systemic Inflammatory Response Syndrome Following Cardiac Surgery

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The systemic inflammatory response syndrome (SIRS) is the leading cause of morbidity & mortality in the critically ill. It is associated with a 50% reduction in 5 year life expectancy. SIRS is defined as 2 of the following criteria: heart rate >90, respiratory rate >20 or P<0.4, temperature <36 or >38°C, white cell count >>14 or <4 x10^9/L. These criteria are used to stratify patients for specific therapies & in research to define intervention groups. Cardiac surgery is associated with systemic inflammation. The validity of the SIRS criteria have never been formally evaluated post cardiac surgery. We undertook to describe the incidence of SIRS post cardiac surgery & relate this to outcome. Methods: We retrospectively analysed prospectively collected data from 2764 consecutive admissions following cardiac surgery (coronary bypass grafting 1425, valve surgery 763, combined procedure 252, other 324). The number of criteria met simultaneously within 1 hour epochs was recorded for the entire admission. Results: 96.4%, 57.9% & 12.2% of patients met at least 2, 3 or 4 criteria respectively within 24hrs of admission. The temperature criterion was least observed (78.8%), mortality was 2.67%. Length of stay exceeded 3 days in 18.5% of patients. The capacity of the criteria to predict mortality & prolonged ICU stay is presented in the table. Discussion: Nearly all patients fulfilled the standard 2 criteria definition of SIRS within 24hrs of admission. This definition does not adequately define the subgroup of patients with greater systemic inflammation, mortality or length of stay. Thus, some clinical manifestations of inflammation are very common following cardiac surgery, although not necessarily prognostic. By contrast, the presence of 3 or more criteria was more discriminatory of death & prolonged ICU stay. We propose that 3 or more SIRS criteria is a more appropriate threshold that defines those patients with clinically significant inflammation post cardiac surgery.

Quality Of Cardiopulmonary Resuscitation Before And During Transport In Out-of-Hospital Cardiac Arrest

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Aim of the study: To evaluate quality of cardiopulmonary resuscitation (CPR) performed during transport after out-of-hospital cardiac arrests. Materials and methods: Retrospective, observational study of all non-traumatic cardiac arrest patients older than 18 years who received CPR both before and during transport between May 2003 and December 2006 from the community run EMS system in Oslo. Chest compressions and ventilations were detected from impedance changes in routinely collected ECG signals, and hands-off ratio calculated as time without chest compressions divided by total CPR time. Results: Seventy-five of 787 consecutive out-of-hospital arrests met the inclusion criteria. Quality data were available from 36 of 88 patients receiving manual CPR and seven of nine receiving mechanical CPR. CPR was performed for mean 21±11 min before and 12±8 min during transport. Quality of manual CPR deteriorated during transport compared to on-scene CPR with hands-off intervals increasing from 0.19±0.10 to 0.27±0.15 (p=0.002) and compressions per minute decreasing from 94±14 min to 82±19 min (p<0.001). Compression and ventilation rates were unchanged. Quality was significantly better with mechanical than manual CPR. Four patients (5%) survived to hospital discharge; two with manual CPR (Cerebral performance categories 2 & 1), and two with mechanical CPR (CPC scores 3 and 4). No discharged patients had any spontaneous circulation during transport. Conclusions: Quality of CPR deteriorated during transport of out-of-hospital cardiac arrest patients. Every effort therefore should be made to stabilise patients on-scene before transporting the patient to hospital, but all transport with ongoing CPR should be attempted.

Effect of Thrombolytics on the Immediate Prognosis for Out-of-Hospital Cardiac Arrest

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Immediate care of out-of-hospital cardiac arrest (CA) is standardized by the established ILCOR ACLS Guidelines. Studies concerning the impact of thrombolysis, generally for CA of cardiac etiology have not shown a benefit. We sought to evaluate the rate of hospital admission for all CA patients treated with pre-hospital thrombolytics. Methods: Non-randomized retrospective study was conducted from 09/1/2005 to 02/15/2007 of non-traumatic CA patients treated with T+ or without (T-) thrombolysis. The protocol for administration of thrombolytics was at the discretion of the field physician, aiming for within 20 minutes of collapse in almost all cases, and prior to return of spontaneous circulation. The primary endpoint was admission alive to the hospital. We performed multivariate analysis by logistic regression to identify risk factors independently associated with outcome: age, gender, response time, defibrillation, witnessed arrest, bystander CPR. Results: We reviewed 1331 consecutive patient records, of which 116 (8.7%) received thrombolytics. Both T+ and T- groups had comparable response times, witnessed arrest, and bystander CPR. Patients in T+ were significantly younger (59±14 vs 67±19 years old), predominantly males (81% vs 61%), and received more defibrillation shocks (61% vs 26%). Significantly more patients T+ arrived alive to hospital for admission (45% vs 24%). Risk factors independently associated with hospital admissions were thrombolysis, age, response time, witnessed arrest, and bystander CPR. The impact of thrombolysis was different whether or not the patient was defibrillated (odds ratios & 1.1; 95%CI: 0.5–2.5) vs without shocks 3.6; 95%CI: 1.9–6.9), despite a greater overall rate of hospital admission for shocked patients. Conclusion: Thrombolysis appears to improve the rate of admission alive to the hospital that were not defibrillated with adjustment for age, gender, response time, witnessed arrest, and bystander CPR. These results should be confirmed by a prospective randomized study. This analysis can help determine appropriate inclusion criteria for a future study.

Predictor of Neurologic Outcome in Mild Hypothermia After Cardiac Arrest: Age<70 and Ventricular fibrillation in initial rhythm were the positive predictive value and shock was the negative predictive value of neurologic outcome.

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Background) To evaluate the efficacy of mild hypothermia therapy (MHT) and investigate the predictor of neurologic outcome. Methods) Inclusion criteria of this study were as follows. 1) Decompensated cardiac-pulmonary arrest patients. 2) Success demonstrated in CPR results) in the history of the CPR. These patients were included if core temperature was successfully performed if needed.8) Intra-aortic balloon pumping (IABP) with or without Percutaneous Cardio-Pulmonary Bypass System (PCPS) was performed in patients (pts) with shock in spite of conservative therapy Mild hypothermia(MH) was performed with cooling temperature of 34°C for 60 min. Results) In the 8 sub groups, from May 1998 to May 2001, 53 pts in CPA and ROSC were met the above criteria and treated with normothermia therapy (NT). The mean time until ROSC 33±18 min. Survival at hospital discharge was 22% (42 pts), and favorable neurologic outcome (GR: Good recovery and MD: Moderate disability) was achieved.
In 2001 to April 2007, eligible 65 pts were cooled after ROSC. The mean time of CA-CPR was 5 ± 4 min (n=NS), and mean time until ROSC 34 ± 23 min (n=6801, compared with 44 ± 38 min for 65 pts; favorable outcome after MHI were seen in 33 pts (50.8%, p<.0001). In the multivariable analysis, the significant predictors of favorable outcome after MH were Age <70 (Relative Risk [RR] 7.75) and Ventricular fibrillation (VF) in the initial rhythm (RR 5.59). On the other hand, hemodynamic compromise state (RR 0.16) after ROSC, and the need for intervention and death. Conclusion: compared with NT, MH was considered to be effective for the patients with CPA-survivor patients. Age <70 and VF were the positive and shock was the negative predictive value of neurologic outcome.

Pathological Findings Of Ventricular Fibrillation In Pts Without Coronary Heart Disease

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To clarify histological characteristics in pts (pts) with out-of-hospital cardiac arrest , autopsies were immediately performed in 224 pts. We studied the cause of their sudden death investigating the incidence and the role of following pathological findings in 125 pts with sudden cardiac death (SCD). There were 95 men and 30 women aged from 16 to 93 years old (mean age : 60.3 ± 14.8 years old). Evaluated pathological findings were 1) myocardial break-up (MBF), 2) contraction band necrosis (CB), 3) contraction band (CB), 4) hyperosinophilic myofiber (HEM), MBF and CBN are known to indicate hypercontracted myofibers due to ventricular fibrillation (VF) associated with acute myocardial infarction (AMI). The latter two findings were not considered to indicate severe myocardial damage as defined by MBF and CBN. Postmortem autopsies revealed AMI in 24 pts. Myocardial infarction (OMI) in 24 pts but coronary heart disease (CHD) was not observed in 77 pts including 2 pts with hypertrophic cardiomyopathy. Cardiac rupture was observed in 16 out of 24 pts with AMI. MBF was not observed in 16 out of 24 pts with AMI but it was observed in 2 pts with OMI and 28 pts without CHD. CBN was observed only in 4 pts with AMI, 13 pts with OMI and 27 pts with CHD. CB and HEM were observed diffusely in both ventricles except subendocardium in all 77 pts without CHD and 24 pts with OMI but in only 7 pts with AMI in whom cardiac rupture was not observed. Ischemic event to induce VF could not be confirmed in pts without CHD and in pts with OMI in this study. Therefore, CB and HEM were considered to be the pathological evidence of VF not related to CHD. Conclusions: Cardiac rupture was the major reason of sudden death in pts with AMI rather than VF. In pts without CHD, the mechanism of SCD was considered to be VF. Nonspecific SCD was more frequently than SCD related to AMI in Japan.

A Prospective and Randomized Trial to Compare a Left Ventricular Assist Device (Impella LP2.5) With IABP in Patients With Cardiogenic Shock by Acute Myocardial Infarction: The ISAR-SHOCK Trial

Melchior Seyfarth, Iris Bauer, Dirk Sibbing, Lorenz Bott-Fügeln, Adnan Kastrati, Albert Schömig; Technische Universität München, Munich, Germany

Cardiogenic shock due to left ventricular failure after myocardial infarction is associated with a high mortality and morbidity rate despite immediate PCI, positive inotropic drugs, and the use of standard mechanical chest compressions. Therefore, CB and HEM were considered to be the pathological evidence of VF not related to CHD. Conclusions: Cardiac rupture was the major reason of sudden death in pts with AMI rather than VF. In pts without CHD, the mechanism of SCD was considered to be VF. Nonspecific SCD was more frequently than SCD related to AMI in Japan.

Heart Rate and Systolic Arterial Pressure Variability During Controlled Hemorrhagic Shock in Rats

Masaru Suzuki, Shingo Hori, Naski Akawa; Keio Univ, Tokyo, Japan

OBJECTIVES: The autonomic response to hemorrhagic shock is complex and has been under-investigated. Spectral analyses of RR interval (RRH) and systolic arterial pressure (SAP) have been proposed as an indirect index of autonomic modulation. The objective of this study was to investigate the relationship among hemodynamic variables and autonomic nervous activity presented by the spectral analyses of RRH and SAP during controlled hemorrhagic shock in rats. Methodology: Twelve Wistar male rats weighing 215 ± 9 g were anesthetized with sodium pentobarbital (1.5 mg/kg), LRI and SAP were recorded continuously and analyzed by wavelet transform using PC software (Heuclic®). Daiano, Sumitomo Pharma Co., Ltd., Osaka, Japan. Their power spectra were quantified into low frequency (LF), 0.27–0.74 Hz and high-frequency (HF): 0.74–2.00 Hz components. Baroreceptor sensitivity (BRS) was defined as RR-LF/SAP-LF. The left carotid artery was cannulated to draw blood (0.1 ml/min) continuously to induce hemorrhagic shock. Spontaneous respiration was kept during this study. Cerebral blood flow (CBF) was measured by Laser flow meter (Advance Co., Ltd., Tokyo, Japan). Statistical analyses were performed by a factor analysis using SPSS15.0J. RESULTS: During controlled hemorrhagic shock, SAP gradually decreased (0 min: 104 ± 18 mmHg, 20 min: 69 ± 9, 40 min: 60 ± 16, 60 min: 47 ± 7). Factor analysis extracted three major factors: vagal activity, sympathetic status, and sympathetic activity. In the factors, EDV and ASV, variables which had greater than 0.3 of partial correlation coefficient, were RR-HF (0.88), RR-LF (0.97), and BRS (0.96). Volume status was indicated by SAP (0.92), shed volume (-0.90), CBF (0.62), and SAP-HF (0.61). Sympathetic activity was indicated by SAP-LF (0.69), respiratory rate (0.85), and CBF (0.32). CONCLUSIONS: Factor analysis extracted autonomic activity and volume status. During hemorrhagic shock, sympathetic activity including arterial sympathetic activity indicated as SAP-LF, which was correlated with respiratory rate, could contribute to maintain CBF, although vagal activity did not affect hemodynamic variables. SAP-HF, as represented as respiration related fluctuation of SAP, was indicative of volume status.

Comparison between Mechanical Active Chest Compression/Decompression and Standard Mechanical Chest Compression

Giuseppe Ristagno, Weill Institute of Critical Care Medicine, Rancho Mirage, CA; Wanchun Tang, Hao Wang, Shijie Sun, Max H Well; Weill Institute of Critical, Rancho Mirage, CA

Introduction. After cardiac arrest, uninterrupted chest compressions with restoration of myocardial blood flow facilitate defibrillation. Accordingly, decreases in intrathoracic pressure (ITP), following complete chest recoil, increase the venous return to the heart prior to the next compression. Several new devices have recently been introduced to facilitate chest compressions and some of them are able to perform active chest decompression. We compared the hemodynamic effectiveness of “LUCAS®” (Jolife, Medtronic, Sweden) with that of the conventional “Thumper®” (Model 1000, Michigan Instruments, Grand Rapids, MI) Hypothesis. LUCAStm, able to produce active chest compression/decompression, might be more effective than the standard “Thumper®” for restoring circulation during CPR. Methods, In 10 domestic pigs weighing 29 ± 2 kg, ventricular fibrillation (VF) was electrically induced and untreated for 5 min. Animals were then randomized to receive chest compressions with either LUCAS® or Thumper®. After 5 min of mechanical chest compressions, defibrillation was attempted with a 360 J shock. Coronary artery perfusion pressure (CPP) and end tidal CO2 (ETCO2) were measured by conventional techniques. Carotid artery blood flow (CBF) was assessed utilizing an ultrasonic flowprobe, together with ITP, measured with the aid of a balloon tipped catheter advanced into the esophagus. Results. Each animal treated with LUCAS® and 4 of 5 animals treated with Thumper® were successfully resuscitated. LUCAS® continually produced negative ITP during the decompression phase (p < 0.05 vs Thumper®) and this was accompanied by greater CPP, ETCO2, and CBF compared to animals treated with Thumper®. Animals compressed with LUCAS® also had lesser broken ribs (p < 0.05). Table Conclusions.

Table

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<thead>
<tr>
<th>Lean</th>
<th>Aff</th>
<th>RAD</th>
<th>CPP</th>
<th>MBF</th>
<th>CI</th>
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<tr>
<td>No 20%</td>
<td>51 ± 3</td>
<td>16 ± 2</td>
<td>65 ± 4</td>
<td>0.80 ± 0.16</td>
<td>2.03 ± 0.29</td>
</tr>
<tr>
<td>Lean</td>
<td>87 ± 4</td>
<td>31 ± 1</td>
<td>22 ± 4</td>
<td>0.40 ± 0.34</td>
<td>1.85 ± 0.77</td>
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Incomplete Chest Recoil During Piglet CPR Worsens Hemodynamics

Mathias Zuechner, Ronald W Hilew, Sarver Heart Cntr, Tucson, AZ; Jon Nysaether, Laerdal Med Corp, Stavanger, Norway; Vinay M Nadkarni, Children’s Hosp, Philadelphia, PA; Marc D Berg, Univ of Arizona College of Medicine, Tucson, AZ; Gordon A Ewy, Karl B Kern, Sarver Heart Cntr, Tucson, AZ; Robert A Berg; Univ of Arizona College of Medicine, Tucson, AZ

Background. Incomplete chest recoil during cardiopulmonary resuscitation (CPR) (ie, leaning on the chest during the decompression phase) is purported to decrease venous return, and thereby decrease forward blood flow. Aim To determine the effect of 10% and 20% lean on hemodynamics during piglet CPR. Methods: 10 piglets (10.7 ± 1.2 kg) were anesthetized with isoflurane and instrumented with micromanometer-tipped catheters in the right atrium (RA) and aorta (Ao). After induction of ventricular fibrillation, CPR was provided in three-minute epochs with no lean, 10% lean, or 20% lean while aortic systolic pressure (AoS) was targeted at 80–90 mmHg. Because the mean force to attain 80–90 mm Hg AoS was 18 kg in preliminary studies, 10% and 20% lean were provided as 1.8 and 3.6 kg weights on the chest, respectively. Left ventricular myocardial blood flow (MBF) and cardiac index (CI) were determined by fluoroscent, color-microsphere technique. Statistics: paired t-test and repeated measurement ANOVA for parametric, Wilcoxon Rank Sum Test and Friedman’s ANOVA for non-parametric data. Results: 10% and 20% lean resulted in higher right atrial diastolic pressure (RADP) and lower coronary perfusion pressure (CPP) than no lean. Hemodynamics were not different with 10% lean vs. 20% lean. Mean 10%–20% lean resulted in substantially lower MBF and CI than no lean (Table). Conclusions: 10–20% leaning during CPR increases RAD, decreases CPP, and substantially decreases MBF and CI.

Compliance: 10-20% leaning during CPR increases RAD, decreases CPP, and substantially decreases MBF and CI.
The mechanical chest compressor LUCAS® is able to produce greater negative ITP during the active decompression phase and therefore produces greater blood flow during CPR.

### Results

**LUCAS®** | **Thumper®**
--- | ---
No. of broken ribs | 0.8 ± 0.8 | 4.4 ± 2.6
[TTP (min)]
PC 1 min PC 2 min PC 4 min | -9 ± 9.4 | -9.5 ± 9.5 | 1.7 ± 3.4
CPR (min) | 27.9 ± 28.5 | 7.3 ± 19 | 13.8 ± 3.19
EtCO2 (mmHg) | 35 ± 31.6 | 26.8 ± 8.6 | 20.5 ± 2.2
CPP (mmHg) | 2.3 ± 3.22 | 5 | 5
CBF (mL/min) | 93.2 ± 288 | 16.843 ± 27 | 72.5 ± 15.610 ± 13.700 ± 20

### Mechanical Chest Compressions With The LUCAS Device Does Not Increase The Incidence Of Injuries In Cardiac Arrest Victims

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**Introduction:** The eventual harm done by mechanical chest compressions using the LUCAS device during cardiopulmonary resuscitation (CPR) is under debate. However, a prospective study comparing injuries after mechanical or manual chest compressions has not been performed. **Hypothesis:** We hypothesized that there is no difference in the incidence of injuries after manual versus mechanical chest compressions using the LUCAS device. **Methods:** In a prospective study, from February 1, 2005, to April 1, 2007, patients not surviving cardiac arrest in two Swedish cities underwent autopsy based upon decision by the admitting physician. The pathologist recorded data from the autopsy in a standardized study protocol regarding external and internal injuries. During CPR, the patients had been treated with either manual or mechanical chest compressions with the LUCAS device. **Results:** Eighty-five patients underwent autopsy out of which 47 patients had received manual chest compressions and 38 patients had mechanical chest compressions. No injuries (skin wounds and skin marks not included) were found in 23/47 patients in the manual group versus 18/38 patients in the LUCAS group (p = 1.0). Sternum fracture and multiple costal fractures (≥3 fractures) were present in 10/47 versus 11/38 (p = 0.46) and in 13/47 versus 16/38 (p = 0.18) in the manual and LUCAS group respectively. Bleeding in the ventral mediastinum, 2/47 versus 3/38 (p = 0.65), retrosternal bleeding, 1/47 versus 3/38 (p = 0.32), epidermal, 1/47 versus 4/38 (p = 0.17) and hemopericardial bleeding, 4/47 versus 3/38 (p = 1.0) was found in the manual and LUCAS group respectively. There was one ruptured abdominal aortic aneurysm in the LUCAS group and one thoracic aortic dissection in each group, all considered by the pathologist as primary cause of the cardiac arrest and not secondary injuries from either treatment. One patient in the LUCAS group had a 4 cm rift in the liver with no bleeding and one patient in the manual group had a rift in the spleen with bleeding. Neither of these injuries was considered to be the cause of death. **Conclusion:** Mechanical chest compressions with the LUCAS device seem to have the same pattern of injuries as manual compressions and do not increase the incidence of injuries after CPR.

### Impact of Delayed Time to Defibrillation on Neurological and Functional Status Among Survivors of In-Hospital Cardiac Arrest

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**Background:** Expert guidelines advocate defibrillation within 2 minutes of an in-hospital cardiac arrest due to ventricular arrhythmias. However, the impact of delayed defibrillation on neurological and functional status at discharge among survivors is unknown. **Methods:** We identified 6,744 patients with cardiac arrests due to ventricular fibrillation or pulseless ventricular tachycardia at 369 hospitals within the National Registry of Cardiopulmonary Resuscitation. Using multivariable logistic regression that adjusted for demographics, clinical variables, hospital site, hospital-level variables (hospital size, monitored bed or intensive care), and hospital site, hospital-level variables (hospital size, monitored bed or intensive care), we hypothesized that time used for two ventilations with a bag-valve-mask device before defibrillation is longer than recommended, and that the extended time contributes to the high no flow time. **Results:** The Thermosuit® System was safe and highly effective in inducing therapeutic hypothermia in patients after cardiac arrest. The vast majority of the survivors had excellent neurological performance scores at hospital discharge.

### Efficacy and Safety of a Novel Rapid Non-invasive Surface Cooling Device for Induction of Therapeutic Hypothermia in Patients after Cardiac Arrest

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**Background:** Therapeutic hypothermia after cardiac arrest improves neurologic recovery and mortality. Rapid induction of therapeutic hypothermia might further improve neurologic outcome after cardiac arrest. The safety and effectiveness of the Thermosuit® System was assessed in survivors of cardiac arrest. **Methods:** Eight patients who have been successfully resuscitated from cardiac arrest were included in a prospective observational case series at an emergency department of a tertiary care university hospital. Patients were surface cooled with ice cold water circulating in the device (Thermosuit® System, Life Recovery Systems, Kinnelon, USA) until a target esophageal temperature of 34.5°C was achieved. Further they were kept at a temperature between 32 and 34°C for 12 hours by external cooling or warming. The patients were then passively rewarmed. Results are presented with median and interquartile range. **Results:** The age of the patients was 63 (48–69), there were 7 male patients, the body mass index was 26.1 (24.7–27.7) kg/m2, the time from cardiac arrest to ROSC was 16.5 (15.5–34.5) min. The esophageal temperature immediately before start of cooling was 36.2 (35.1–36.9) °C. The patients were cooled with the device for 37 (24–51) min and a temperature of 34°C was reached after 44 (30–60) min. This led to a cooling rate of 3.0 (1.9–3.5) °C/h. In 4 patients additional warming and in 3 patients additional cooling was needed during the maintenance phase. Seven patients (88%) were successfully discharged from the hospital. The NIH stroke scale at discharge was 0 (0–4.3) and the Mini Mental score was 29.5 (23–30). A total of 5 serious adverse events (ventricular fibrillation, pneumonia, sepsis) and 7 adverse events occurred in the 8 patients. No adverse event was related to the cooling device. **Conclusions:** The Thermosuit® System was safe and highly effective in inducing therapeutic hypothermia in patients after cardiac arrest. The vast majority of the survivors had excellent neurological performance scores at hospital discharge.

### 35 Integrin alpha-5 beta-1 and Fibronectin Receptor-Ligand Pair Determines Reparative and Neovascularization Potential of Endothelial Progenitor Cells

Kushore K Wary, Choun Mock, Sean Garan, Yidan D Zhao, Asrar B Malik; Univ Illinois Chicago, Chicago, IL

**Endothelial Progenitor Cell (EPC)-based therapy may be useful for the treatment of microvascular disorders associated with ischemic diseases and for therapeutic neovascularization. Here, we addressed whether mouse bone marrow derived EPCs (mEPCs) express integrins, syndeny, and deposit fibronectin matrix in injured microvessels. We used anti-CD34, anti-F1k, and anti-VE-cadherin antibodies as mEPC markers. Ex vivo expanded mEPCs were analyzed by fluorescent microscopy and Western blotting for expression of integrins, fibronectin, and von Willebrand Factor (ligands for integrins alpha-5 beta-1 and alpha-v beta-3). Fibronectin and VWF expression of mEPCs was compared with adult mouse lung endothelial cells (mECs). Fluorescent microscopy showed markedly increased fibronectin and VWF staining and Western blotting showed >20-fold increase in fibronectin and VWF expression in mEPCs compared with mECs. The appearance of polymerized fibronectin matrix suggested that mEPCs synthesized, deposited, and assembled fibronectin. Next, ex vivo expanded mEPCs were subjected to shRNA-mediated silencing of alpha-5 integrin, fibronectin and VWF genes. Silencing of alpha-5 integrin and fibronectin genes reduced the proliferative potential of mEPCs whereas VWF silencing had no effect. To evaluate the effectiveness of mEPCs treatment, we irradiated C57BL/6J mice (5.0 Gy) and challenged the mice i.p. with bacterial lipopolysaccharide (LPS) to induce endothelial barrier injury and pulmonary edema. Infusion of mEPCs induced greater survival (~30% at 7.5 mg of LPS/kg BW, n = 6) and prevented the primary edema resulting from microvascular injury. In contrast, mECs infusion had no protective effect. Thus, EPC expression of alpha-5 beta-1 integrin and secretion of fibronectin matrix may be crucial determinants of engraftment of EPCs at sites of vascular injury, and their ability to promote repair of injured microvessels and neovascularization.

### 36 Professional Rescuers provide two Bag-Valve-Mask Ventilations within the Time recommended by Guidelines during Out-Of-Hospital Cardiac Arrest

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**Aims:** The quality of CPR performed by professional rescuers during out-of-hospital cardiac arrest has been found substandard in several studies. In particular, the time without chest compressions (no flow time) has been too long and it has been higher before the time of intubation. In manikin-studies lay rescuers need approximately 15 seconds to deliver two ventilations. It is not known how long time professional rescuers use for two ventilations and we hypothesized that time used for two ventilations with a bag-valve-mask device before endotracheal intubation is longer than recommended, and that the extended time contributes to the high no flow time. **Methods:** Quality of CPR was available for analysis in 626 cases of out-of-hospital cardiac arrest in the ambulance service in Oslo, Akerhus, London, and Stockholm from 2002–2005. The 2000 Guidelines was used as reference. Ventilations were registered via changes in transthoracic impedance as measured via the standard defibrillation pads. We only included episodes with CPR with a 15:2 pattern for at least one minute and registered all pauses between chest compressions before intubation. **Results:** In 172 (27%) episodes we identified 2097 chest compression pauses. In 1587 (51%) of the pauses we
identified two ventilations and a mean pause length for each episode was calculated. The median of these means was 5.5 s (IQR: 4.5–7). These pauses comprised a median 14% (IQR: 10–20%) of the total time before intervention in these episodes. In 882 (29%) of the pauses we identified a different number of ventilations, or other interventions in addition to ventilation. In the remaining 618 pauses (20%) no ventilations were registered. **Conclusions:** It is achievable to deliver two bag-valve-mask ventilations close to the recommended 5 seconds during out-of-hospital cardiac arrest for professional rescuers. However, only half of the pauses were used for two ventilations in accordance with Guidelines. Excessive time for ventilation can not explain the high no flow time during CPR by professional rescuers before intubation.

**Background:** Studies have shown an association between obesity and total mortality in patients with and without coronary artery disease. Less is known regarding the impact of obesity after cardiac arrest. Obese survivors of ventricular fibrillation (VF) out-of-hospital cardiac arrest (OHCA) may have worse outcomes than nonobese patients due to resuscitation challenges, long-term risks of cardiovascular disease, and other comorbidities. **Methods:** All patients who presented with a VF OHCA in Rochester Minnesota from November 1990-September 2006 were included. Patients were classified by weight (BMI < 25, 25–30, >30). ICD shocks for VF/VT were determined by review of subsequent device interrogations. **Data to calculate BMI were available in 213 (95%). There was no difference between the relative difference in ICD implantation rates between weight groups (p = 0.02). Malignancy was the most common cause of death in the underweight group. The 5-year survival free of ICD shocks was 61±7% with no weight-based difference in shocks. Conclusion: There was no apparent weight-based influence on resuscitation survival after VF OHCA. Patients who are under to normal weight had a lower long-term survival and represent a high-risk population primarily due to noncardiac diseases. **Results**

**Objective:** Determine the incidence and outcomes of PSB during WCD use. **Methods:** ECG recordings from consecutive pts who had ICD/VT/VF while using WCD between March 2005 and March 2007 were retrospectively analyzed. All VT/VF occurring within 24 hours from the initial shock for VT/VF were defined as a single sudden death event (SDE) while those beyond 24 hours as a SDE recurrence. ECGs contained 30 seconds prior to the initial shock and > 15 seconds following VT/VF termination. **Conclusions:** WCD is an efficacious therapy for pts with sustained ventricular arrhythmias. However, it is not without complications. The incidence of PSB was less than expected and had a better prognosis than that observed in EMS studies. This may be attributed to faster WCD shock therapy (median 44 seconds) compared with EMS (>10 minutes).

**Background:** AHA guidelines for cardiopulmonary resuscitation (CPR) have recommended that administration of atropine can be considered for asystole or pulseless electrical activity (PEA), because atropine has improved survival to hospital admission in a retrospective review (Ann Emerg Med, 1984), and is inexpensive, easy to administer, and has few side effects. However, there are no prospective data in human beings. **Methods:** We assessed the effects of atropine in 7,443 adults patients with asystole or PEA arrest from the SOS-KANTO study: a prospective, multicenter, observational trial. The medications for asystole or PEA arrest were managed according to the advanced cardiovascular life support algorithm of the CPR guidelines (i.e. a 15 s period of refractory pulseless electrical activity (PEA) after transthoracic shock and subsequent administration of atropine. Baseline, the epinephrine and atropine group had significantly higher proportions of cardiac cause, witnessed arrest, and bystander CPR attempt than the epinephrine group. However, the two groups had a similar frequency of the favorable nonshockable rhythm (0.3% in each group, p = 0.403). Multiple logistic regression analysis showed that the adjusted odds ratio for the favorable neurological outcome was 0.6 (95% CI 0.2–1.7, p = 0.37) after epinephrine and atropine (compared with epinephrine). On the other hand, the epinephrine and atropine group had significantly higher rate of return of spontaneous circulation (ROSC) than the epinephrine group (95% vs. 93%, p < 0.001), and the adjusted odds ratio for ROSC was 1.6 (95% CI 1.4–1.7, p < 0.0001) after epinephrine and atropine (compared with epinephrine). **Conclusions:** We demonstrated that administration of atropine during management of asystole or PEA arrest did not increase the frequency of favorable neurological outcome, although the atropine favored initial ROSC. **Is Severe Post-shock Bradycardia In Patients Using Wearable Defibrillators Common or Serious?**

**Background:** A previous study has shown a 40% to 60% incidence of asystole immediately after transthoracic defibrillation of pulseless ventricular tachycardia/ventricular fibrillation (VT/VF). Such post-shock asystole has very poor outcomes. Wearable cardioverter defibrillators (WCD, LifeVest, ZOLL Lifecor) automatically record and treat VT/VF during transthoracic defibrillation without the need for a bystander. Post-shock bradycardia (PSB) is of clinical concern in patients (pts) using WCD. **Objective:** Determine the incidence and outcomes of PSB during WCD use. **Methods:** ECG recordings from consecutive pts who had ICD/VT/VF while using WCD between March 2005 and March 2007 were retrospectively analyzed. All VT/VF occurring within 24 hours from the initial shock for VT/VF were defined as a single sudden death event (SDE) while those beyond 24 hours as a SDE recurrence. ECGs contained 30 seconds prior to the initial shock and > 15 seconds following VT/VF termination. **Conclusions:** The incidence of PSB was less than expected and had a better prognosis than that observed in EMS studies. This may be attributed to faster WCD shock therapy (median 44 seconds) compared with EMS (>10 minutes).

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Controls: This study showed the continuous improvement of the chain of survival and outcomes of patients with witnessed OHCA in a large population. Further evaluation to increase bystander-initiated cardiac-only resuscitation would improve the outcomes more.

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Cardiac Catheterization After In-Hospital Cardiac Arrest: Guidelines Needed

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Background: The benefit of immediate cardiac catheterization after in-hospital cardiac arrest is uncertain as electrocardiographic and clinical criteria may be unreliable in this population. We sought to evaluate rates of cardiac catheterization after in-hospital ventilator fibrillation (VF) cardiac arrest and the potential association of cardiac catheterization with survival. Methods: Using a single hospital billing database we retrospectively identified cases with an ICD-9 code of cardiac arrest (427.5) or ventilator fibrillation (427.41). Discharge summaries were then reviewed to identify arrests that occurred in-hospital with an initial rhythm of VF. Rates of catheterization were determined by identifying cardiac catheterization charges on the day of or day after arrest. All cardiac catheterization reports were reviewed. Unadjusted analysis was performed to look for factors that may have contributed to survival to hospital discharge. A logistic regression was performed to further evaluate possible interactions. Results: There were 110 patients with return of circulation after VF in-hospital arrest included in the analysis. Cardiac catheterization was performed immediately or within one day of arrest in 27% (30/110) of patients and 57% (17/30) received angioplasty. Of those who received cardiac catheterization having a 3.8 increased odds of survival (OR 3.8, 95% CI 1.35–10.90, p< .01). Controlling for cardiac catheterization, age, gender, and race using logistic regression, this relationship persisted with patients undergoing cardiac catheterization having a 3.8 increased odds of survival (OR 3.8, 95% CI 1.35–10.90, p< .01). Conclusion: In patients receiving cardiac catheterization, more than half received this procedure in its ability to draw inference or causality. Future recommendations need to be established to guide clinicians on which in-hospital cardiac arrest patients might benefit from immediate cardiac catheterization.

A Mathematical Model of Ventilation, Perfusion, and Oxygenation in Low-Flow States

Daniel P Davis, Paul W Davis: UC San Diego, San Diego, CA

Background: Recent investigations underscore the critical importance of ventilation strategies on resuscitation outcomes. In low perfusion states, such as cardiac arrest and traumatic shock, the interaction of pulmonary pressure (PPV) and perfusion causes positive-pressure ventilation (PPV) (b) can significantly impede venous return and lead to a decrease in cardiac output. The optimal ventilation strategy in these “low-flow” states remains unclear. Objectives: To create a mathematical model of perfusion and oxygenation to predict the effects of PPV with both normotensive and hypotensive. Methods: The lung pressure-volume relationship was modeled using a novel formula allowing manipulation of various lung characteristics, including vital capacity, compliance, and the upper and lower inflection points. A separate model was then derived to predict mean intrathoracic pressure for a given minute ventilation using the pressure-volume relationship. The addition of positive end-expiratory pressure was also modeled. Finally, a model was derived to model oxygen absorbance as a function of alveolar surface area and flow based on ventilation rate and mean intrathoracic pressure. Results: Mathematical models of the lung pressure-volume relationship, mean intrathoracic pressure, and absorbance were then developed. The optimization of vital capacity, compliance, upper and lower inflection points, positive end-expiratory pressure, and minute ventilation allowed prediction of optimal ventilation rate and tidal volume for a normal and an ARDS lung. For a normal lung, optimal values for both mean intrathoracic pressure and absorption were achieved with a
ventilation rate of 4 breaths/min. A decrease in the upper inflection point or increase in minute ventilation resulted in faster optimal ventilation rates, although none exceeded 14 breaths/min. Conclusions: A mathematical model of ventilation was successfully created allowing manipulation of multiple variables related to lung compliance and ventilation strategy. This model suggests the use of lower ventilation rates with larger tidal volumes to minimize the hemodynamic effects of PEEP and maximize oxygen absorbance.

Outcome And Quality Of Life After Central Penumbral Embolism: Surgical Embolectomy Versus Medical Treatment

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Background: Therapy of massive pulmonary embolism is still a matter of debate. In tertiary centres embolic material is available. Aim of the present study was to assess outcome and mid-term quality of life (QoL) of patients with massive central pulmonary embolism treated either by surgical embolectomy (SE) or thrombolytic agents (TA).

Methods: 69 patients with central pulmonary embolism and severely haemodynamic compromised have been identified. 18 patients (27.5%) were treated by SE and the remaining patients by TA. All the in-hospital data have been assessed and a follow-up, focussing on outcome and quality of life, was made. Results: The surgical collective was younger (57.9 ± 14.9 y vs. 63.1 ± 16.9; p < 0.05) and more symptomatic at the time of diagnosis, with a Schock-Index: of 0.9 ± 0.4 vs. 1.3 ± 0.5 (p < 0.05) and a pCO2 of 50.3 ± 19.5mmHg vs. 36.7 ± 12.2mmHg (p < 0.05) in patients treated with TA. Early mortality was similar in both collectives (SE: 5.3% vs. TA: 7.1%; p=ns) as well as follow-up survival after an average follow-up 33.2 ± 12.3 months (SE: 68.4% vs. TA: 66.1%). 82 patients treated with TA were hospitalized due to a massive pulmonary embolism in the follow-up. 89.7% in the SE-group are under oral anticoagulation, compared to 81.8% in the TA-group (p=ns). No anticoagulation-related complications have been reported in the follow-up. Average age- and gender-matched quality of life was similar in both groups (SE: 83.9 ± 16.1 vs. TA: 85.0 ± 15.5; p=ns). Patients treated with TA reported a significant higher level of fear, than patients treated with SE. Conclusions: SE is an excellent therapy of central pulmonary embolism in haemodynamic compromised patients. Despite being more symptomatic early and mid-term follow-up were similar in both groups. Follow-up revealed that age and gender matched QoL is preserved in both groups. However, patients treated with TA are much more scared than patients who underwent surgery.

Comparison of Intraosseous Proximal Humerus and Sternal Routes for Drug Delivery during CPR

Stephen L Hoskins, Brian S Zachariah, Nick Copper, George C Kramer; Univ of Texas Med Branch, Galveston, TX

Intraosseous access can be delayed during medical emergencies such as shock and cardiac arrest. The intraosseous (IO) route delivers drugs into the non-collapsible vessels of the bone and can be established in marginal situations. IO therapy could be an effective alternative to intravenous drug delivery during CPR, as there have been a number of intraossesous devices developed for the adult market. A previous study from our group has shown the sternal IO to be 90% as effective as central IV in drug delivered during CPR and delivers drugs 2.5 times as fast as the tibial IO route. However, the safety of sternal puncture continues to be debated. Drug delivery via the proximal humerus may be an effective alternative for IV drug delivery during CPR. METHODS: Seven isoflurane anesthetized swine (30–45 kg) were subjected to cardiac arrest by KCl injection. Eight min post cardiac arrest CPR was initiated via Thumper (Michigan Instruments Inc.) at 100 compressions per minute. Delivery of epinephrine was evaluated by 2 routes after IO and sternal IO. Group 1 EZ-IO® (Vidacare Corporation, San Antonio, TX) was placed in the proximal humerus (PH). Group 2 EZ-IO® placed in the sternum (S). After 2 min of CPR post VF Evans blue 5mg/kg and indocyanine green 2.5mg/kg tracers were co-administered with epinephrine (2mg/kg) as a bolus to the S and PH, respectively. Post drug delivery arterial sampling was performed at 10s intervals for 8 min and analyzed by spectrophotometric assay to determine the arterial dose and time of drug delivery. Plasma was collected for HPLC analysis to determine arterial dose and time of delivery. RESULTS: Peak appearance times of tracers were S 32.5 ± 4.1 and PH 35 ± 4.6, respectively. The total dose delivered to arterial blood averaged over 8 min was same for both the S and PH routes. CONCLUSIONS: This study suggests that IO proximal humerus is comparable to IO sternal for prompt drug delivery during CPR. Previous work from our laboratory determined that IO sternal was 90% as effective in the dose delivered as compared to the S. Results from our study suggest that the proximal humerus is an effective and efficacious alternative to IO sternal delivery.

Risk of Cardiopulmonary Arrest after Acute Respiratory Compromise

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INTRODUCTION: Many hospitalized patients experience acute respiratory compromise (ARC), with a portion developing cardiopulmonary arrest (CPA) despite emergent care. We sought to characterize the clinical course of ARC patients and their risk of developing CPA. We hypothesized that a substantial portion of ARC patients develop CPA and that CPA occurs rapidly after ARC onset. METHODS: We used ARC data from the National Registry of Cardiopulmonary Resuscitation (NRCPR), a multicenter registry describing inhospital adult respiration compromise assisted ventilation (ARC-AV). Secondary outcomes were time to CPA and survival to discharge. We also identified factors associated with developing CPA. We used descriptive statistics and multivariable logistic regression. RESULTS: Of 4,358 ARC events, CPA occurred in 726 (16.7%; 95% CI: 15.6–17.8%). Median time from ARC onset to CPA was 7 minutes (IQR: 3–14 min); CPA occurred within 2 minutes in 48% of cases. Survival to CPA was 10% in 10 minutes in 6% of cases. Survival to CPA was lower for CPA patients than non-CPA patients; 14.3% vs. 58.4% (OR death 8.3, 95% CI: 6.7–10.4). Multivariable associations associated with CPA included failed invasive airway (OR 10.5; 95% CI: 6.9–16.1), tracheostomy or corticosteroid (7.1; 2.4–21.6), pulmonary embolism (3.4; 1.9–6.0), hypotension (1.7; 1.4–2.1), ECMO of tracheal injury (2.4; 1.8–3.0), paced (2.7; 1.7–4.4) or idioventricular (2.7; 1.3–5.9), and use of magnesium sulfate (2.7; 1.2–6.0). CPA was less likely when patients were conscious (0.8, 0.6–1.0) or breathing (0.4, 0.3–0.6) or if sedative induction agents were used (0.4, 0.3–0.5). CONCLUSIONS: CPA occurs frequently and rapidly.
after ARC and is associated with airway management complications, hypotension, bradycardias and pulmonary embolism. Survival to discharge after ARC-related CPA is low. Medical teams responding to ARC should prepare not only for airway management but also the possibility of CPA.

Potential Gradient Fields and Earliest Post Shock Activity Following External Defibrillation of Long Duration Ventricular Fibrillation in Swine

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Background: Though many studies have evaluated internal defibrillation during short duration VF (SDVF), the shock potential gradient (V) field and activation immediately following external defibrillation of long duration VF (LDVF) has not been well studied. We tested the hypothesis that the timing of post-shock activation following LDVF is different than following SDVF and is due to shock gradient differences between shocks delivered following short and long duration VF. Methods: In 6 pigs, 115–120 plunge needles each with 3–6 electrodes were inserted throughout the ventricles. After the chest was closed, external defibrillation pads were placed in a left lateral to right lateral configuration. Defibrillation threshold (VFT) strength biphasic shock potentials were recorded during SDVF (20 s of VF) and LDVF (7 min of VF). A VF 3-D map was generated. Earliest activation following each shock was determined. Results: The shock size required for defibrillation of LDVF (1660±446 stored V) was significantly different from the SDVF (DFT strength shocks (1632±429 stored V). Comparison of recorded potential distribution generated by different shocks within the same animal was similar between SDVF and LDVF shocks (R² = 0.81–0.98) also. The time from the shock until first recorded cardiac activation was significantly longer for LDVF (3845±451 ms) than SDVF (641±179 ms) p<0.05. Conclusions: Recorded potential distribution required for defibrillation is very similar between shocks delivered to animals in SDVF and LDVF. 2. The external defibrillation energy for LDVF is not greater than for SDVF; however, the time from the shock until first recorded activation is significantly longer. This difference is not due to a difference in shock field and likely represents changes in the tissue physiology secondary to the ischemia of long duration VF.

An Evidence Based Animal Model Of Prolonged Ventricular Fibrillation Cardiac Arrest

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Background: Promising basic science findings in cardiac resuscitation often do not translate into improved outcomes when studied in humans. One explanation is that the current animal models do not adequately reflect the out-of-hospital cardiac arrest (OHCA) clinical trial environment. The author sought to review the literature and devise a new model of prolonged VF with time intervals that more accurately simulate OHCA conditions. Methods: A systematic review of the literature (01/01–12/08) was conducted using PUBMED and a comprehensive list of appropriate MESH headings. All OHCA human clinical trials were included. The most relevant studies underwent explicit and detailed review. Mean values with 95%CI were calculated for each specified interval. Suitable conditions and establishment of appropriate times were then devised. Results: Twenty-two papers with adequate detail for evaluation were examined. Studies underwent explicit and detailed review. Mean values with 95%CI were calculated for each specified interval. Suitable conditions and establishment of appropriate times were then devised. Mean values with 95%CI were calculated for each specified interval. Suitable conditions and establishment of appropriate times were then devised. Conclusion: Recorded potential distribution required for defibrillation is very similar between shocks delivered to animals in SDVF and LDVF. 2. The external defibrillation energy for LDVF is not greater than for SDVF; however, the time from the shock until first recorded activation is significantly longer. This difference is not due to a difference in shock field and likely represents changes in the tissue physiology secondary to the ischemia of long duration VF.

Evidence for Circadian Variability in the Frequency of Out-of-Hospital Cardiac Arrest

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Introduction: Several sudden cardiac phenomena demonstrate circadian variability. It is not clear if there is also circadian variability in the frequency and outcome for out-of-hospital cardiac arrest (OHCA). The Resuscitation Outcomes Consortium (ROC) Epistry is a large prospective cohort of OHCA. Hypothesis: The maximum frequency of OHCA occurs in the morning hours. Methods: We included adult patients from all 11 North American emergency medical services (EMS) systems participating in the ROC with OHCA of presumed cardiac cause between 12/1/2005 and 11/30/2006. We excluded cases of untreated, untested OHCA. T he relation between time block (4 arbitrary 6-hour blocks) and survival to hospital discharge was analyzed using multivariate logistic regression adjusting for age, sex, witness status, bystander CPR, time from 911 call to EMS arrival and initial rhythm. Results: Of 15363 OHCA occurring during the study period, 8297 were included. The figure shows circadian variation of OHCA frequency with witness status. The highest frequency was observed between 0600–1200 hrs and the lowest during 0001–0600 hrs (p<0.001). This pattern was observed regardless of initial rhythm, witness status, gender or location of arrest. The adjusted odds ratio with 95% CI for survival to hospital discharge (patients in the 0001–0600 time block as reference) was 1.00 (0.88, 1.15) for 0600–1200 hrs, 0.99 (0.91, 1.07) for 1201–1800 hrs, and 1.00 (0.91, 1.09) for 1801–2400 hrs. Conclusions: OHCA shows circadian variability in frequency but not in survival to hospital discharge. OHCA occurs more frequently in the daytime as compared to night.

Preliminary Results With The Use of St. Jude Padz Pacing Electrode For Treatment Of Symptomatic Bradycardia In Emergency Department.

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Background: Since the mid-1980’s transthoracic pacing has been a common temporary treatment for arrhythmias. Present external pacing technology requires the application of both multifunction defibrillation electrodes and separate leads for electrocardiogram (EKG) monitoring. Separate ECG leads are required as the current from the pacing pulse creates artifact in the signal that prevents one from distinguishing between pace-captured and non-captured rhythms. Since the mid-1980’s transthoracic pacing has been a common temporary treatment for arrhythmias. Present external pacing technology requires the application of both multifunction defibrillation electrodes and separate leads for electrocardiogram (EKG) monitoring. Separate ECG leads are required as the current from the pacing pulse creates artifact in the signal that prevents one from distinguishing between pace-captured and non-captured rhythms. A typical clinical setting of the symptomatic bradycardia. Methods: We conducted a prospective study at Emergency Department of a University Hospital. During October 2006 to April 2007, 26 patients with symptomatic bradycardia were included in the study. Comparison between monitoring by conventional electrode and St. Jude Padz MWP electrode was performed. After that was selected Lead II, and adjusted pacing rate and milliammps for the stimulation. Records and comparison of electrical capture was performed with the three lead conventional electrodes and St. Jude Padz MWP electrodes. Results: The mean electrocardiographic diagnoses was third degree atrio-ventricular block in 50% of patients, and the principal symptoms were presyncope in 82 %, symptoms of reduced cardiac output in 79% and syncope in 43%. Previous diagnoses were Hypertension in 57%, Chagas’ heart disease in 21%, Valvar heart disease in 14% and Dilated Cardiomyopathy in 18 %. Monitoring of cardiac rhythm, electrical and mechanical capture were obtained in 100 % of patients. The mean energy for capture was 69±18 milliamps. When compared the records of electrocardiographic capture with St. Jude Padz MWP electrode, it was equal than conventional electrodes in 46 % and better in 54 %. Conclusion: The St. Jude Padz MWP electrode has the feasibility of recognise capture and non-capture rhythms and to perform pacing function effectively. It presents the possibility of providing rapid treatment in patients with symptomatic bradycardia avoiding monitoring by conventional electrodes.

Ventricular Fibrillation remains the Primary Presenting Rhythm: Results from the Wearable Cardioverter Defibrillator Human Study

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Background: Clinical studies during the last 2 decades have demonstrated a progressive decrease in the incidence of ventricular fibrillation (VF) as the presenting rhythm in settings of out-of-hospital sudden cardiac arrest (SCA). In the present study, we investigated the initial rhythm of SCA from data recorded in a wearable cardioverter defibrillator (WCD) which collected these events in real time. Hypothesis: In settings of out-of-hospital SCA, VF remains the leading cause. Methods and Results. The incidence and the type of arrhythmias were determined by reviewing stored electrocardiograms in the WCDs. Seventy-four consecutive WCD recipients and 108 events were analyzed. Patients with a previously implanted ICD that exhibited VF as the presenting rhythm were included. The maximum frequency of OHCA occurs in the daytime as compared to night.
required change due to infection were the most prevalent recipients of WCDs. Fifty-one percent were VF/VT patients and 43.6% were pulseless electrical activity (PEA) patients. VF/VT was the initial rhythm of SCA in 79.7% of patients and 86.1% of events while the PEA occurred in 20.3% of patients and 13.9% of events. 84.5% of patients survived VF/VT and 18.8% of patients survived PEA. There was no difference in the characteristics of patients with different initial rhythms. **Conclusions.** In out-of-hospital settings, VF remains the predominant initial rhythm when recorded immediately following SCA.

### 56 Ventilation Is Necessary During Cardiopulmonary Resuscitation in A Rat Model Of Cardiac Arrest Induced By Airway Obstruction

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Recent studies have showed that hyperventilation during cardiopulmonary resuscitation (CPR) improved the rates of return of spontaneous circulation (ROSC) and prognosis. However, there are few studies about the ventilation strategies during CPR in cardiac arrest caused by airway obstruction. To compare the effects of the three ventilation strategies during CPR in an animal model of cardiac arrest induced by airway obstruction, we investigated the rates of ROSC, survival rates, plasma cytokine levels, and lactate levels. Thirty-six male Sprague Dawley rats were anesthetized with intraperitoneal injection of pentobarbital. Cardiac arrest was induced by airway obstruction. After 3 minutes of cardiac arrest, animals were randomized to receive one of the three ventilation strategies during CPR (n = 12 per group): normoventilation (28 breaths/min), hyperventilation (14 breaths/min), or no ventilation. The rates of chest compression (CC) was 240–260 compressions/min and the depth of CC adjusted to maintain mean arterial pressure more than 25 mmHg in all groups. After 5 minutes of CPR, epinephrine (0.02 mg/kg) was administered, and all rats were ventilated at the rates of 28 breaths/min in FIO2 1.0. The rates of ROSC were 83%, 58%, 0% for the normoventilation, hyperventilation, and no-ventilation groups, respectively. The PaCO2 levels immediately after ROSC were 74 mmHg and 88 mmHg for the normoventilation, and hyperventilation groups, respectively. The increases of plasma cytokine (TNF-α, and IL-6) levels and lactate levels after ROSC in the normoventilation group were significantly less than those in the hypoventilation group. The present study showed that normoventilation during CPR improved the rates of ROSC and the survival rates after ROSC in the animal cardiac arrest model induced by airway obstruction. Moreover, normoventilation attenuated the elevation of cytokine and lactate responses. These findings suggest that ventilation may be necessary during CPR in cardiac arrest caused by airway obstruction.

### 57 Alterations In Left Ventricular Function After High-voltage Electrical Injury Assessed By Two-dimensional Speckle Tracking Echocardiography

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Myocardial damage after exposure to high-voltage electrical current has been reported to result in a serious and often life-threatening situation. However, because the diagnosis of myocardial injury based on ECG findings, creatinine kinase MB (CK-MB), and myocardial pyrophosphate scan is not reliable, the changes in myocardial function after high-voltage electrical injury are not identified yet. We investigated the alterations in the left ventricular function using two-dimensional speckle tracking imaging after high-voltage electrical injury. A total of 11 male patients (mean age 37 ± 7 years) with non-flash high-voltage (>22,900 volts) electrical injuries were prospectively evaluated. Serial echocardiogram was obtained on days 1, 3, and 7 after admission. In addition, serum CK-MB and troponin I levels were drawn on admission and every 6 hours for the first 24 hours. All parameters of study patients were compared to age- and sex- and body mass index-matched healthy control (n = 11). At admission and during follow up, there were no significant differences in left ventricular (LV) dimension, stroke volume index, cardiac output index, fractional shortening, ejection fraction, and peak strain (S) when compared to controls. In contrast to peak strain, peak systolic mitral annular velocity (Sa) and peak systolic strain rate (SR) were significantly increased and maintained throughout follow up in patient group (Table). No significant correlations were found between the increase of troponin I or CK-MB levels and all parameters of LV systolic function. In conclusion, these results demonstrate that LV myocardial damage after high-electrical injury is related to an increase of regional and global LV function through increased myocardial contractility rather than myocardial depression, and indicate changes of troponin I or CK-MB levels are not associated with myocardial damage.

### 58 Spontaneous Body Temperature Is Associated With Survival Following In-hospital Cardiac Arrest And Return Of Spontaneous Circulation: A Report From The National Registry Of Cardiopulmonary Resuscitation

Brian Soffiotta, Clifton Callaway, Univ of Pittsburgh, Pittsburgh, PA; Mary Ann Peberdy, Virginia Commonwealth Univ Health System, Richmond, VA; Terry Vanden Hoek; Univ of Chicago Hosps, Chicago, IL

Objective—Spontaneous changes in body temperature after cardiac arrest are common, but their association with survival is not known. This study tested the hypothesis that temperature is associated with survival to hospital discharge. **Methods—**Included were adults with in-hospital cardiac arrest, enrolled in the National Registry of CPR who achieved return of spontaneous circulation (ROSC) between January 1, 2005 and November 7, 2006. Excluded were those who required induced hypothermia. The lowest (Tmin) and highest (Tmax) body temperature during the first 24 hours after ROSC were included in a multivariable logistic regression predicting survival to hospital discharge, adjusting for variables that were independently associated with outcome. Tdelta was defined as Tmax - Tmin, examined in a separate regression. Goodness of fit was measured using Hosmer-Lemeshow (HL) statistic. **Results—**4,143 subjects were included. Of these, 5,319 (36.9%) survived to hospital discharge. Tmin and Tmax were available for 8,005 (55.5%) and 7,872 (54.6%) of all patients. Tables exhibit the odds ratio (95% CI) of survival to discharge by Tmin and Tmax and Tdelta groups. **Conclusions—**Spontaneous hyperthermia and hypothermia following in-hospital cardiac arrest is associated with lower odds of survival to discharge. Lability of temperature > 1°C is also associated with lower odds of survival to discharge.

### 59 The Incidence Of Pulmonary Aspiration With Laryngeal Mask Airway Use During Cardiopulmonary Resuscitation And Positive Pressure Ventilation In Swine.

Brian Soffiotta, James Menegazzi, Eric Logue, David Salcido; Univ of Pittsburgh, Pittsburgh, PA

Objective: Pulmonary aspiration of gastric contents occurs 20–30% of the time during cardiopulmonary resuscitation (CPR) of cardiac arrest. This is due to loss of protective airway reflexes, pressure changes generated during CPR, and positive pressure ventilation (PPV). Even though the American Heart Association (AHA) has recommended the laryngeal mask airway (LMA) as an acceptable alternative airway for use by EMS personnel, concerns over the capacity of the device to protect from pulmonary aspiration remain. We sought to determine the incidence of aspiration after LMA placement, CPR and PPV. Methods: We conducted a prospective study on 16 consecutive post-experimental mixed-breed domestic swine of either sex (mean mass 25.7 ± 1.4 kg). A standard size 4-LMA was modified so that a vacuum catheter could be advanced into and past the LMA diaphragm. The LMA was placed into the hypopharynx and its position confirmed using End-lidial CO2 and direct visualization of lung expansion. Fifteen milliliters of heparinized blood were instilled into the pharynx. After 5 PPVs with a mechanical ventilator, chest compressions were performed for 60s with asynchronous ventilations continuing at a rate of 12 per minute. After chest compressions, a suction catheter was inserted into the cuff and suction applied for approximately 1 minute. The catheter was removed and inspected for signs of blood. The LMA cuff was deflated and the LMA removed. The intima of the LMA diaphragm was inspected for signs of blood. In a validation cohort of 4 animals, the LMA was reinserted, a cricotrorypharyngeal performed and 5 mL of blood instilled directly into the trachea. Results: There were 0/16 (95% CI 0–17%) with a positive test for the presence of blood in both the vacuum catheter and the intima of the LMA diaphragm. In the validation cohort, all four were positive for blood in both the vacuum catheter and the intima of the LMA diaphragm. Conclusions: In this simple model of resuscitation after LMA placement, there was no sign of pulmonary aspiration, and no evidence that blood had passed beyond the seal created by the LMA cuff. Concerns over aspiration with LMA use may be unfounded. Future studies should determine the frequency of pulmonary aspiration after LMA placement in the clinical setting.
Hospital induced hypothermia after out-of-hospital cardiac arrest: Emergency Medical Services State of the Practice in the US in 2007

Brian Suffoletto, James Menegazzi, David Salcido; Univ of Pittsburgh, Pittsburgh, PA

Objective-Post-resuscitation care of comatose survivors of cardiac arrest using induced hypothermia (IH) is recommended by the American Heart Association (AHA) and the International Liaison Committee on Resuscitation (ILCOR). However, the current rate of its use by Emergency Medical Services (EMS) in the US is not known. We sought to determine the prevalence of EMS agencies that initiate IH in the prehospital setting, and to identify perceived barriers to initiating IH. Methods- We conducted a prospective,anonymous, IRB-approved survey using a convenience sample of physician members of the National Association of EMS Physicians. We conducted the survey during the national conference, from January 11–13, 2007. Results-One-hundred forty-five of the 244 (59%) physician members in attendance completed the survey, representing 109 EMS Medical Directors and 36 non-Medical Director EMS Physicians from 92 regions of 34 US states. A total of 9/145 (6.2%) physicians stated that the EMS agency they are affiliated with have protocols for IH. The median (QR) duration of having a protocol was 12 months (6–12) and all used either ice bags or cold IV fluid, or a combination of the two. Among those that reported prehospital use of IH, only 1/6 (12.5%) reported having cooled greater than 10% of eligible patients. Common perceived barriers to IH include: providers being overburdened with other tasks (62.1%), short transport times (60.7%), lack of refrigeration equipment (60.0%), and receiving hospitals’ failure to continue therapeutic hypothermia (56.6%). Twenty-two percent incorrectly indicated that IH was not in the AHA guidelines and only 62% correctly identified 32–34 degrees C as the recommended target temperature range. Conclusions- Despite advisory statements from the AHA/ILCOR recommending the early implementation of post-resuscitation cooling of comatose survivors of cardiac arrest, prehospital initiation of IH in the US is rare. Infrquent use of prehospital IH seen in our sample may be due to the perceived barriers that were identified and/or incomplete understanding of guidelines by medical providers. Future studies should examine methods for overcoming barriers and improving guideline dissemination to EMS physicians.

Resuscitation Science Symposium: Best of the Best (Oral Abstract Presentations Part II)
Sunday Morning Room 230ab Abstracts 61–65

Acute Cardiac Catheterization in Survivors of Sudden Cardiac Arrest due to Ventricular Fibrillation is Associated with Improved Survival
Justin A Strote, Charles Maynard, Carol Fahrenbruch, Univ Of Washington, Seattle, WA; Michael Copass, Michele Olsufka, Leonard Cobb, Harborview Med Cntr, Seattle, WA; Francis Kim; Univ Of Washington, Seattle, WA

Background: Acute coronary lesions are present in patients with sudden cardiac arrest (SCA) between 10 and 90% in autopsy series, and chronic stenotic lesions are also present. Despite advisory statements from the AHA/ILCOR recommending the early implementation of post-resuscitation cooling of comatose survivors of cardiac arrest, prehospital initiation of IH in the US is rare. Infrquent use of prehospital IH seen in our sample may be due to the perceived barriers that were identified and/or incomplete understanding of guidelines by medical providers. Future studies should examine methods for overcoming barriers and improving guideline dissemination to EMS physicians.

Resuscitation with Actual Performance Integrated Debriefing (RAPID) Improves CPR Quality and Initial Patient Survival
Dana P Edelson, Barbara Litzinger, Vinnet Arora, Deborah Walsh, Univ of Chicago, Chicago, IL; Salem Kim, Univ of Pennsylvania, Philadelphia, PA; Diane S Lauderdale, Terry L Vanden Hoek, Univ of Chicago, Chicago, IL; Lance B Becker, Benjamin S Abella; Univ of Pennsylvania, Philadelphia, PA

Introduction Recent investigations have documented poor cardiopulmonary resuscitation (CPR) performance in the clinical practice. We hypothesized that a debriefing intervention using CPR quality data from actual cardiac arrests (Resuscitation with Actual Performance Integrated Debriefing, or RAPID) would improve CPR performance and initial patient survival. Methods Rescuers at a university teaching hospital underwent weekly RAPID sessions between March, 2006 and February, 2007. During the intervention period, facilitators led debriefing discussions using actual performance data, obtained from a CPR-sensing defibrillator with audiovisual feedback capability, and highlighted deficiencies in CPR quality and defibrillation. These data were compared to an historical control in which a similar debriefing session was used. The main outcomes were objective metrics of CPR performance and initial return of spontaneous circulation (ROSC). Results CPR quality and outcome data from 123 patients resuscitated during the intervention period were compared to 101 patients in the baseline cohort. Compared to the control period, CPR quality parameters and defibrillation accuracy were improved (table). These were associated with a significant improvement in the unadjusted rate of ROSC (table). After adjusting for shockable vs. non-shockable rhythm, time and location of arrest, and patient demographics, the RAPID intervention was associated with a significant increase in the adjusted odds of ROSC (OR 1.84 [1.30–2.60]; p=0.003). Conclusions The combination of RAPID and real-time audiovisual feedback improved CPR quality over the use of feedback alone, and was associated with an increased rate of ROSC; CPR sensing and recording devices allow for methods of debriefing that were previously available only for simulation based education; such methods have the potential to fundamentally alter resuscitation training and improve patient outcomes.

Resuscitation Performance and Patient Outcomes by Cohort

<table>
<thead>
<tr>
<th>Baseline</th>
<th>RAPID</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compression depth (mm)</strong></td>
<td>44 (11)</td>
<td>50 (10)</td>
</tr>
<tr>
<td><strong>Compression rate (bpm)</strong></td>
<td>100 (15)</td>
<td>105 (15)</td>
</tr>
<tr>
<td><strong>Ventilation rate (/min)</strong></td>
<td>18 (9)</td>
<td>13 (6)</td>
</tr>
<tr>
<td><strong>No-flow fraction</strong></td>
<td>0.20 (0.13)</td>
<td>0.13 (0.10)</td>
</tr>
<tr>
<td><strong>Pre-shock pause (sec)</strong></td>
<td>16.2 (8.2–21.1)</td>
<td>7.2 (13.3–14.2)</td>
</tr>
<tr>
<td><strong>Post-shock pause (sec)</strong></td>
<td>7.1 (7.2–14.8)</td>
<td>2.4 (13.3–15.2)</td>
</tr>
<tr>
<td><strong>Appropriate shocks</strong></td>
<td>0.01</td>
<td>0.001</td>
</tr>
<tr>
<td><strong>ROSC</strong></td>
<td>45/101 (44.6%)</td>
<td>73/125 (59.4%)</td>
</tr>
</tbody>
</table>

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Hands-On Defibrillation: An Analysis of Current Flow Through Rescuers in Contact With Patients During Biphasic External Defibrillation
Michael S Lloyd, Eric L Kvitvitsky, Paul F Walter, Jonathan J Langberg; Emory Univ, Atlanta, GA

Background: During cardiopulmonary resuscitation, the need for rescuers to stand clear before a shock is delivered invariably interrupts chest compressions. Brief interruptions like these reduce the efficacy of defibrillation in animal models. Current flow through a rescuer in contact with a patient is low when a biphasic waveform and electrodes with breakthrough methods has not been investigated. We hypothesized that leakage current is low through a rescuer performing chest compressions at the time of shock delivery. Methods: During 18 elective coronary lesions using truncated exponential biphasic waveforms (American energy 200 joules, range 100–360 joules), an investigator serving as the rescuer placed a gloved hand on the patient’s anterior chest immediately adjacent to the defibrillating patch with approximately 20lbs of pressure to simulate chest compressions. Skin electrodes were used to connect the rescuer’s thigh to the patient’s torso via a simulated pathway. During shock delivery, voltage and current through the rescuer (hand to thigh) were recorded using a digital storage oscilloscope during the shock delivery. Results: In no cases were shocks perceptible to the rescuer. Mean patient transthoracic impedance was 57 +/- 14 ohms (range 36–79 ohms). Potential differences in volts (V) between the rescuer’s wrist and thigh ranged from 1.7 to 14 V (mean 6.7 +/- 2.7 V). Calculated impedances through rescuers ranged from 8,190 to 100,400 ohms (mean 30,100 +/- 20,400 ohms). The average leakage current flowing through the rescuer’s body for each phase of the shock waveform was 273 +/- 191 microamperes (range 1 to 910 microamperes). All measured values in our series were below 2,500 microamperes, an accepted safety standard for earth-leakage current in medical devices. Conclusions: Even in a simulated worst-case scenario, a rescuer performing chest compressions during biphasic external defibrillation is exposed to low levels of leakage current. Our findings demonstrate the safety and feasibility of uninterrupted chest compressions during shock delivery, which may enhance the efficacy of defibrillation and cardiocerebral perfusion.

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A Tale of Seven EMS Systems: An Impedance Threshold Device and Improved CPR Techniques Double Survival Rates After Out-of-Hospital Cardiac Arrest
Tom P Aufderheide, Med College of Wisconsin, Milwaukee, WI; Marvin Birnbaum, Madison Fire Dept, Madison, WI; Charles Lick, Allina Med Transportation, Anoka County, MN; Brent Myers, Wake County EMS, Raleigh, NC; Laurie Romig, Pinellas County EMS, Largo, FL; Joseph Stothert, Omaha Fire Dept, Omaha, NE; Leon Vartanian; Cypress Creek and Harris County EMS, Cypress Creek, FL

Introduction: Maximizing outcomes after cardiac arrest depends on optimizing a sequence of interventions from collapse to hospital discharge. The 2005 American Heart Association (AHA)
Guidelines recommended many new interventions during CPR [New CPR] including use of an Impedance Threshold Device (ITD). Hypothesis: The combination of the ITD and New CPR will increase the return of spontaneous circulation (ROSC) and hospital discharge (HD) rates in patients with an out-of-hospital cardiac arrest. Methods: Quality assurance data were pooled from 7 emergency medical services (EMS) systems (Anoka Co., MN; Harris Co., TX; Madison, WI; Milwaukee, WI; Omaha, NE; Plymouth, Co., FL; and Wake Co., NC) where the ITD (ResQPOD®, Advanced Circulatory Systems; Minneapolis, MN) was deployed for ~3 months. Historical or concurrent control data were used for comparison. The EMS systems simultaneously implemented New CPR including compression/ventilation strategies to provide more compressions/min and continuous compressions during Advanced Life Support. All sites stressed the importance of full chest wall recoil. The sites have a combined population of ~3.2 M. ROSC data were available from all sites; HD data were available as of June 2007 from 5 sites (MN, TX, Milwaukee, NE, NC). Results: A total of 893 patients treated with New CPR + ITD were compared with 1424 control patients. The average age of both study populations was 77 years; 65% were male. Comparison of the ITD vs controls (all patients) for ROSC and HD (Odds ratios (OR), (95% confidence intervals), and Fisher’s Exact Test) were: 37.9% vs 33.8% [1.2, (1.02, 1.40), p = 0.022] and 15.7% vs 7.9% [2.2, (1.53, 3.07), p < 0.001], respectively. Patients with ventricular fibrillation had the best outcomes in both groups. Neurological outcome data are pending. Therapeutic hypothermia was used in some patients (MN, NC) after ROSC.

Conclusion: Adoption of the ITD are pending. Therapeutic hypothermia was used in some patients (MN, NC) after ROSC. Several meta-analyses have evaluated the evidence for prophylactic cooling in patients who have suffered cardiac arrest. However, the role of therapeutic hypothermia in cardiac arrest patients remains uncertain. 

Table: CPR Skills of Pre- and Post-training

<table>
<thead>
<tr>
<th></th>
<th>Pre-training</th>
<th>Post-training</th>
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<tbody>
<tr>
<td></td>
<td>V (n=95)</td>
<td>C (n=87)</td>
</tr>
<tr>
<td>Correct chest compressions, n (%)</td>
<td>92 (96.8)</td>
<td>94 (96.6)</td>
</tr>
<tr>
<td>Achieve correct chest compressions, %</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Achieve correct chest compressions, %</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Achieve correct chest compressions, %</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Correct position of the defibrillator pad, n (%)</td>
<td>87 (100)</td>
<td>87 (100)</td>
</tr>
</tbody>
</table>

Vasopressin impairs Brain, Heart and Kidney Perfusion in Acute Heart Failure

Stig Müller, Ole-Jakob How, Stig E Hermansen, Truls Myrmel, Uni Hosp North Norway, Tromsoe, Norway

Arginvin Vasopressin (APV) is increasingly used to restore mean arterial pressure (MAP) in various circulatory shock states including cardiogenic shock. This is potentially deleterious since APV is also known to reduce cardiac output by increasing vascular resistance. Aim: We hypothesized that restoring MAP by APV improves vital organ blood flow in experimental acute cardiac failure. Methods: Cardiac output (CO) and arterial blood flow to the brain, heart, kidney and liver were measured in nine pigs by transit-time flow probes. Heart function and contractility were measured using left ventricular Pressure-Volume catheters. Catheters in central arteries and veins were used for pressure recordings and blood sampling. Left ventricular dysfunction was induced by intermittent coronary occlusions, inducning an 18% reduction in cardiac output and a MAP from 67 ± 3 to 47 ± 2 mm Hg. A low-dose therapeutic infusion of APV (0.005 μg/kg/min) restored MAP but further impaired systemic perfusion (CO and blood flow to the brain, heart and kidney reduced by 28, 23 and 34 %, respectively). The reduced blood flow was due to a 2.0, 2.2, 1.9 and 2.1 fold increase in systemic, brain, heart and kidney specific vascular resistances, respectively. Contractility remained unaffected by APV. The hypoperfusion induced by APV was most likely responsible for observed elevated plasma lactate levels and an increased systemic oxygen extraction. Oxygen saturation in blood drawn from the great cardiac vein fell from 31 ± 1 to 22 ± 3 % dropping as low as 10 % in one pig. Finally, these effects were reversed forty minutes after weaning the pigs from the drug. Conclusion: The pronounced reduction in coronary blood flow point to a potentially deleterious effect in postoperative cardiac surgical patients and in patients with coronary heart disease. Also, this is the first study to report a reduced cerebral perfusion by APV.

Translational Application of Medium Voltage Therapy for Treatment of Cardiac Arrest

Hao Wang, Wanchun Tang, Min-shan Tsai, Shijie Sun, Yongqin Li, Carlos Castillo, Jun Guang, Max H Weil; Weil Institute of Critical Care Med, Rancho mirage, CA

Background. Previous studies suggest that translational stimulation voltage in the range of 200 Vdc produces non-invasive blood pressure waveforms. This electrical therapy might represent a new approach to generate and maintain forward blood flow prior to defibrillation in victims of cardiac arrest. The present study investigated efficacy of the medium voltage therapy (MVT) waveform on coronary and cerebral perfusion during ventricular fibrillation (VF) in a porcine model of cardiac arrest. Hypothesis. After a short interval of untreated cardiac arrest, MVT may be effective in producing threshold levels of coronary perfusion pressure (CPP), carotid artery blood flow (CBF) and end-tidal CO2 (EtCO2), at least equal to that produced by manual chest compressions (MCC). Methods and Results. In 5 domestic male pigs

Resuscitation Science Symposium: Best Original Resuscitation Science (Moderated Poster Session II and Reception)

Sunday Afternoon
Room W224
Abstracts 66–115

Effectiveness Of Cardiac-only CPR Training by Self-learning Video, a 1-hour program, or Both

Chika Nishiyama, Takui Iwami, Takashi Kawamura, Masakiko Ando, Kyoto Univ Sch of public health, Kyoto, Japan; Robert A Berg, The Univ of Arizona College of Medicine, Arzona, AZ; Nacicio Yonemoto, Kyoto Univ Sch of public health, Kyoto, Japan; Risa Fukuda, Osaka Univ Graduate Sch of medicine, Osaka, Japan; Haruyuki Yusa, KinKi Univ Sch of Medicine, Osaka, Japan; Aoko Kada, Hirokuri Yokoyama, Hiroshi Nonogu, J-PULSE Investigators; National Cardiovascular Ctr, Osaka, Japan

[Introduction]Despite present efforts to train the general public in CPR, the proportion of bystander CPR is still low. Length of CPR training program and complexity of CPR skills may be barriers to bystander CPR performance. Recently, simple video self-learning has been shown to be an effective CPR training technique. [Objective]To evaluate the effectiveness of cardiac-only CPR training program by a self-learning video, a 1-hour practical course, or both.

[Method]Designs: A randomized controlled trial. Participants: General public aged 18 years or older. Intervention: In the video (V) group, participants received the self-learning video before CPR training and then attended a 1-hour cardiac-only CPR training program; in the control (C) group participants attended the training program without a self-learning video. Data collection: Before and immediately after the training, a 2 minute scenario-based test was conducted and CPR skills were recorded. Outcomes: The primary outcome measure was the number of correct chest compressions immediately after the training. We also calculated the achievement of correct chest compressions, which meant the proportion of correct chest compressions in relation to the ideal number of chest compressions based on 2005 CPR guideline. [Result]214 participants were randomly assigned to V (108) and C (106) groups. Before the training, the proportion of attempting chest compression, attempting AED operation, and calling for an AED, and the total number of chest compressions were significantly greater in the V group. After the training, all measured CPR skills of both groups improved substantially compared with pre-training skills, but there were no differences between groups (Table). [Conclusion]A self-learning video improved CPR skills. However, a 1-hour practical training course was substantially more effective and the addition of a self-learning video did not improve its effectiveness.
Improving the Prehospital Trauma Triage Guidelines for Physiologic Evaluation Of Abdominal Blood Flow During Chest Compression In Cardiac arrest Patients Using Enhanced Computed Tomography (CT)

Yasumasa Oode, Kentarou Shimizu, Asako Matsushima, Kentarou Kajino, Yuukou Nakagawa, Osamu Tasaki, Tadahiko Shiozaki, Hiroshi Ogura, Yasuyuki Kusawagata, Hiroshi Tanaka, Takeshi Shimazu, Hisahisa Sugimoto; Osaka Univ Hosp, Osaka, Japan

Background: The mechanism of blood flow during chest compression in cardiac arrest patients remains under investigation. We often experience that cardiac arrest patients suffer severe diaphragm after successful cardiopulmonary resuscitation (CPR), which would be attributable to intestinal ischemia during cardiac arrest and resuscitation. However, few studies have been made to evaluate abdominal blood flow during chest compression in cardiac arrest patients. Patients and Methods: The study was made in four patients immediately after termination of cardiopulmonary resuscitation. A 100ml bolus of 300 mg I/ml contrast medium was injected from a short femoral vein catheter, followed by continuous chest compression at a rate 200/min. In order to evaluate the distribution of contrast medium, CT images of the chest and abdomen were taken after 100 and/or 200 chest compressions, respectively. Results: CT scans showed similar enhance patterns in the patients. After 100 chest compressions, enhancement values were higher at inferior vena cava (IVC) regions compared to ascending aorta and main arteries. After 200 compressions, enhancement values of the arteries were increased by two to four times. However, significant enhancement of hepatic veins and limited enhancement of portal veins suggest impaired perfusion of the liver and the bowel. Conclusion: One hundred or 200 chest compressive motions are not sufficient to enhance abdominal organs including the liver and bowel. Figures: Typical MP-RIR/flip angle planes images after 100 compressions at two different conal planes; hepatic vein and IVC(left), portal veins(right). portal veins(right) are depicted.

Evaluation Of Abdominal Blood Flow During Chest Compression In Cardiac Arrest Patients Using Enhanced Computed Tomography (CT)

Improving the Prehospital Trauma Triage Guidelines for Physiologic Derangement: Can We Do Better?

Craig D Newgard, Oregon Health & Science Univ, Portland, OR; Kyle Rustler, Univ of Washington, WA, Jennie R Hedges, Oregon Health & Science Univ, Portland, OR; Eileen Bulger, Univ of Washington, Seattle, WA; Ian G Stell, Univ of Ottawa, Ottawa, Canada; Daniel Davis, Univ of California at San Diego, San Diego, CA; Laurie J Morrison, Univ of Toronto, Toronto, Canada; Jeffrey Kerby, Univ of Alabama, Birmingham, AL; Thomas E Temel, Penn State Milton S. Hershey Med Cntr, Hershey, PA; Joseph P Minie, Univ of Texas Southwestern Med Cntr, Dallas, TX; Scott Emerson, Univ of Washington, Seattle, WA; Resuscitation Outcomes Consortium

Introduction: The American College of Surgeons (ACS) recommends immediate transport to a trauma center for all injured persons with field physiologic derangement (ACS Step 1 trauma triage criteria). However, it remains unclear whether these criteria could be refined to identify high-risk trauma patients with improved predictive value. Hypothesis: We assessed the hypothesis that an easily applied, prehospital, clinical decision rule could be developed to better identify high-risk injured persons meeting ACS Step 1 criteria. Methods: We conducted a prehospital prospective cohort study of injured adults >15 years where field resuscitation was attempted and ACS physiologic criteria were present. SBP <90 mmHg or RR <10 or <29 breaths/minute, GCS <8, or field intubation. Population-based data were collected from December 1, 2005 through November 30, 2006 by 268 EMS agencies transporting to 287 acute care hospitals (trauma and non-trauma centers) in 11 sites across the U.S. and Canada. Ten prehospital variables were assessed: SBP, RR, GCS, pulse, pulse oximetry, shock index (pulse/SPB), mechanism of injury, penetrating injury, age, and gender. High-risk injured persons included: death (before or after admission) or hospital LOS >2 days. 60% of the sample was randomly selected for rule derivation and analyzed using classification and regression tree analysis. The remaining 40% were used for rule validation. The final rule was based on a targeted sensitivity of >90%. Results: Of 4,983 eligible patients, 4,326 injured persons had complete outcome information and were included in the analysis. The sample included 2,495 (58%) persons with death or LOS >2 days, as well as 1,061 (25%) patients that did not require admission. The final rule included the following variables (in order): field intubation, GCS < 8, shock index < 1.4, mechanism of injury, and age. >70 years. Rule validation demonstrated the following accuracy measures: sensitivity 94.9% (95% CI 93.5–96.3%), specificity 14.1% (95% CI 11.6–16.6%). Conclusions: While we were able to generate a highly sensitive decision rule, the rule appears too complex for field application and is non-specific. Further refining ACS physiologic triage criteria to increase predictive value remains an ongoing challenge.

Is the new Basic Life Support protocol (2005) easier to learn?

Jozsef Bethlen, Gabor Nagy, Jozsef Marton, Univ of Pecs, Pecs, Hungary; Zsigmond Gondocs; National Ambulance Service, Budapest, Hungary

Objectives: The effective learning of basic life support (BLS) skills in the process of training is always an important expectation during the course. Each assessment of BLS training is a complex, continuous action where the evaluation should not be subjective by using the examiner’s experiences only. In order to reach the reliable standard of pedagogical assessment, our department developed a score to ensure more objectively on BLS examination. Methods: The developed scoring tool which is consistent with the steps of 2000 and 2005 ERC BLS protocols was introduced at the faculty. After a trial period we assessed in a cross sectional study design 156 students in 2005/2006 first semester based on 2000 ERC BLS, and 207 students in 2006/2007 first semester based on 2005 ERC BLS protocol. The volunteers are between the age 18 and 25 years, and all students studied the same BLS protocol in 28 hours/semester. The data were analyzed by Chi Square test and cross tabulation with SPSS 11.00. Results: The positive results in all steps of 2005 BLS protocol were correlating with successful of BLS exams significantly. Comparing the five steps of 2005 BLS protocol to 2000 BLS protocol, the checking for responsiveness (p = 0.001), shouting for help (p = 0.013), checking for breathing (p = 0.000; Phi 0.688 vs 0.459), chest compression (p = 0.000; Phi 0.443 vs 0.472), breathing (p = 0.000; Phi 0.360 vs 0.764), seemed to be influencing the successful exams in the 2005 ERC BLS protocol significantly, which made it easier to learn the new protocol, too. There was not significant correlation between the genders in case of 2000 or 2005 BLS protocol. Conclusions: Our earlier developed score is useful in evaluating the 2005 BLS protocol and the new protocol can be learned more successfully.

Muscle Metabolomic Changes in a Porcine Model of Hemorrhagic Shock and Resuscitation

Nancy Witowski, Greg Beilman; Univ of Minnesota, Minneapolis, MN

Introduction: Treatment of hemorrhage shock remains a clinical challenge despite decades of study. Investigation of metabolism during hemorrhagic shock and resuscitation may yield novel approaches for intervention strategies. Methods: Pigs underwent a standardized hemorrhagic shock protocol after general anesthesia and instrumentation. Animals were hemorrhaged via IVC canula, then resuscitated to a goal of 80 mm Hg systolic blood pressure after 45 minutes. Animals were fully resuscitated after 8 hours and weaned and extubated at 24 hours after beginning experiment. Survivors were sacrificed at 48 hours post-hemorrhage. Muscle samples were obtained at baseline (prior to hemorrhage), shock45 (after 45 min of shock), and 8, 23, and 48 h post resuscitation (PR). Muscle samples were processed using a dual-phase extraction process and the water-soluble metabolites examined by 1H and 31P NMR. Results: The phosphocreatine:inorganic phosphate ratio decreases with shock and remains below baseline values at 48 h PR (A). Phosphoesterers (glycolytic intermediates) increase during shock and return to levels below baseline at 48PR in successfully resuscitated pigs (B). Non-survivors exhibited higher levels of 1H NMR-visible lipids and of 31P NMR-visible ADP at baseline when compared to survivors (C). Conclusions: Hemorrhage shock induces metabolic changes observable with NMR spectroscopy. Survivors exhibited persistent metabolic changes not resolved at 46 hours. Response to hemorrhage and risk of mortality may be dependent on initial metabolic state.

Table

<table>
<thead>
<tr>
<th>GROUP</th>
<th>NO</th>
<th>CP(mmHg)</th>
<th>CBF (ml/min)</th>
<th>ETCO2 (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVT</td>
<td>10</td>
<td>20.9 ± 8.1</td>
<td>70.4 ± 26.2</td>
<td>32.1 ± 21.1</td>
</tr>
<tr>
<td>MCC</td>
<td>10</td>
<td>25.6 ± 8.7</td>
<td>61.6 ± 24.9</td>
<td>42.4 ± 10.6</td>
</tr>
<tr>
<td>P-value</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
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</table>
Rapid Whole Body Cooling in Large Swine: Effects on Heart Rate and Arterial Blood Pressure

William Ohley, Univ of Rhode Island, Kingston, RI; Robert B Schock, Life Recovery Systems, Kinelton, NJ; Cathy Klock, Univ of Rhode Island, Kingston, RI; Lorraine Schoffeld, Rhode Island Hosp, Providence, RI; Marc Cote, Robert Freedman; Life Recovery Systems, Kinelton, NJ

There have been recent reports of a variety of cooling methods for reducing the body temperature of victims of post resuscitative syndrome. In the work reported here we cooled a series of large (> 60 kg) domestic swine (n = 6) using a whole body approach. The animals were anesthetized using propofol and buprinophine and instrumented with arterial pressure monitoring and ECG, and thermocouple sensors in the pulmonary artery (PA), carotid artery, tympanic membrane and esophagus. With an initial average PA temperature at 37 ± 0.3 °C, the swine underwent a rapid cooling sequence. This was performed with a flexible surround suit system that provided for a thin 0.5 cm layer of circulating ice water in direct skin contact held between 0.5 ± 1.5 °C. A pumping system was used to circulate the water volume of 20 liters at a rate of 15 liters per minute. The average PA temperature at the start was 37 ± 0.3 °C. Cooling was targeted at 34 °C with an average value of 34.1 ± 0.3 °C. Time to fall 3°C was 13.0 ± 3.0 min. At the same time, heart rate dropped (although not significantly) from 71 ± 7.9 BPM to 59.5 ± 11.4 BPM while mean carotid pressure dropped from 100.3 ± 16 mmHg to 77.3 ± 14.8 mmHg (p < 0.05). We interpreted these changes as beneficial reductions in cardiac work while the subject is kept cool. It is hypothesized that this is due to a reduction in total body metabolic demands. Thus it is possible, in addition to positive neurological effects, that the process of rapid whole body cooling also may be effective in reducing total workload seen by the heart, and thus may aid in salvaging myocardium in such patients.

Prognostic markers in Myocardial Infarction complicated by Cardiogenic Shock

Roland Prondzinsky, Henning Lemm, Michael Swyter, Nicholas Wegener, Susanne Unverzagt, Justin M Carter, Axel Schlitt, Ute Buereke, Martin Russ, Karl Wedman, Michael Buerke; Dept of Medicine III, Halle/Saale, Germany

Objectives. Despite aggressive therapy (including PCI and IABP use), survival following acute myocardial infarction complicated by cardiogenic shock (MI-CS) is poor. Early identification of survivors from non-survivors enables better, patient tailored therapy. We hypothesised that APACHE II scoring and other common markers may provide prognostic information in patients receiving coronary, PCI based therapy for MI-CS. Methods: We conducted the IABP-shock trial (a monocentric, prospective, randomized, controlled, IABP intervention trial) and analysed potential prognostic markers amongst the whole study population. Forty consecutive patients with acute MI complicated by cardiogenic shock were enrolled and APACHE II scores, Cardiac index (CI), BNP and IL-6 levels were measured at enrolment and daily for 4 days before correlation with subsequent 28 day mortality. Results: The mean age was 64 ± 1.9 years, 52% were mechanically ventilated, the mean ejection fraction was 27 ± 2.1% and overall 28 day survival was 67%. The initial (on admission to hospital) and serial (over the 4 days) APACHE II scores successfully discriminated between survivors and non-survivors (initial APACHE II scores, 18.1 ± 1.66 and 29.9 ± 2.88, respectively, p < 0.05). Following receiver operating curve (ROC) analysis, APACHE II scores were most predictive of survival followed in order of predictive value by CI, IL-6 and BNP (Table 1). Values for APACHE II scores and cardiac index were significantly predictive of survival. Conclusions. We conclude that both initial and serial APACHE II scores provide reliable prognostic information for MI-CS patients treated with coronary, PCI centred therapy. Cardiac index was also of some predictive value. However, in contrast to previous data (applicable mainly to chronic heart failure patients), serial BNP values were not predictive of mortality in this cohort of patients.

Table 1: ROC analysis

<table>
<thead>
<tr>
<th>Variable (initial timepoint)</th>
<th>Area under curve</th>
<th>Standard error</th>
<th>Asymptotic significance</th>
<th>Lower limit*</th>
<th>Upper limit*</th>
</tr>
</thead>
<tbody>
<tr>
<td>APACHE II score</td>
<td>0.850</td>
<td>0.074</td>
<td>&lt;0.001</td>
<td>0.705</td>
<td>0.965</td>
</tr>
<tr>
<td>Cardiac index</td>
<td>0.771</td>
<td>0.086</td>
<td>0.008</td>
<td>0.598</td>
<td>0.944</td>
</tr>
<tr>
<td>IL-6</td>
<td>0.769</td>
<td>0.092</td>
<td>0.011</td>
<td>0.589</td>
<td>0.950</td>
</tr>
<tr>
<td>BNP</td>
<td>0.602</td>
<td>0.111</td>
<td>0.987</td>
<td>0.284</td>
<td>0.719</td>
</tr>
</tbody>
</table>

Electronic Integrated Monitoring of Medical Emergency Team Calls to a Step Down Unit

Marilyn Hravnak, Univ Pittsburgh Acute T Care, Pittsburgh, PA; Leslie Edwards, Molly Foster-Healey, Amy Clontz, Cynthia Valencia, Univ of Pittsburgh Med Ctr, Pittsburgh, PA; Michael DeVita, Michael Pinskey; Univ Pittsburgh, Pittsburgh, PA

Purpose: Early discharge from intensive care units (ICU) to lower acuity monitoring units (step-down units < SDU) is increasing to improve care throughout. However, the ability of minimally invasive monitoring via electronic integrated monitoring systems (IMS) in SDUs to identify cardiopulmonary deterioration in order to activate Medical Emergency Team (MET) response is unknown. We evaluated the ability of an IMS index value to detect clinically significant events which might trigger activation of the MET earlier than called. Results: Patients were monitored on a 24 bed trauma SDU according to prevailing policy and bedside decision making. An IMS (BioSign) was inserted into the monitoring system and IMS data were collected in a blinded fashion for 6 weeks from all patients. The IMS uses 4 parameters (heart rate [HR], respiratory rate [RR], blood pressure [BP], peripheral oxygen saturation [SpO2]) to develop a single neural networked signal known as the BioSign Index (BSI). Data were analyzed for patient deterioration according to both BSI trigger value and local MET criteria (DeVita, Qual Safety Health Care 2004). Results: Data from 333 patient admissions were evaluated reflecting 18,692 hours of continuous monitoring. SpO2 monitoring data were absent in 38.5% of monitored hours, despite being mandatory. Most patients were stable throughout their SDU stay. MET activation occurred on 10 occasions (4 respiratory cause [2 SpO2], 2 SpO2 + RR, 2 cardiac, 1 mixed respiratory + cardiac, and 3 other (1 chest pain, 2 acute mental status change). All 7 MET events of respiratory and/or cardiac cause were detected by BSI in advance (mean advanced detection time prior to MET activation was 6.33 hours). Cardiopulmonary deterioration was generally characterized by progressive increases in BSI over time, not step increases. Conclusion: In this population, cardiopulmonary deterioration requiring MET activation was uncommon but always preceded by IMS index elevations which would have alerted the nursing staff in advance. Continuous monitoring of physiological variables may be augmented by integrating information from multiple parameters to create a new variable. The new index parameter may detect patient deterioration earlier than current parameter monitoring.

Are There Gender Differences on Admission Time, Disease Severity and Treatment at Emergency Room for Acute Coronary Syndrome?

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Controversies exist in relation to admission hours at emergency room (ER) and treatment used in women and men with acute coronary syndromes (ACS). Women supposed to be treated inadequately or later to explain higher mortality after acute myocardial infarction (AMI). Methods: From January 2003, we prospectively analyzed admission time, clinical characteristics, laboratory, angiographic findings and hospital mortality in 579 patients with ACS in a tertiary hospital ER setting. Admission hours were categorized in four daily periods each one of 6 hours. Traditional risk factors were analyzed; severity of atherosclerosis was based in the number of coronary involved with greater than 50% reduction in lumen size at angiography; and treatment used was classified in clinical, angioplasty plus stent placement and surgical myocardial revascularization. Results: Age (59.8 ± 7.9 to 63.2 ± 11.9 years; p < 0.01), smoking (16% vs 6%; p = 0.028), hypertension (47% vs 31%; p = 0.032), diabetes (16% vs 13%; p = 0.013) and dyslipidemia (24% vs 19%; p = 0.030) were greater in men. Admission times were similar in women and men for all daily periods [0:01h-6:00h: 16% vs 13%; 6:01h-12:00h: 30% vs 30%; 12:01h-18:00h: 32% vs 28%; 18:01-24:00h: 25% vs 26% (p = NS)]. Severity of coronary disease was greater in men and underwent to more angioplasty with stent placement (39% vs 17%; p < 0.01). Clinical (20% vs 18%; p = NS) and CABG (4% vs 2%; p = NS) treatments showed no gender differences. Multivariate analysis disclosed body mass index [OR = 0.91 (IC95%:0.85–0.98); p = 0.01], monosity [OR = 0.83 (IC95%:0.75–0.92); p < 0.01] and CK mass peak [OR = 0.99 (IC95%: 0.98 – 1.00); p = 0.02] as independent variables associated with ACS in men. Nevertheless, hospital mortality (3% vs 2%) was similar for all admission times in both women and men. In conclusion, there were no gender differences in arrival time at ER and severity of coronary disease was greater in men justifying more percutaneous intervention in them.

Effects Of Short-term Fasting On Mortality, Inflammatory And Coagulation Responses To Endotoxin-induced Shock In Rats

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Obesity is a common problem in sepsis. We evaluated the effects of short-term fasting on the mortality rate, inflammatory and coagulation response in rats with endotoxin-induced shock. Male Wistar rats (n = 30) were used. Animals were randomly assigned to one of two groups: control group (n = 15), receiving intravenous Escherichia coli endotoxin (15 mg/kg over 2 min); fasted group (n = 15), short-term fasting for 3 days before endotoxin injection. The mortality rates, hemodynamics, arterial blood gases, plasma cytokine concentrations and coagulation parameters were measured. The mortality rates at 96h after endotoxin injection were 75% and 5% for control and fasted groups, respectively. Hypotension and the increases of TNF-alpha and interleukin-6 concentrations were less for the fasted group than the control group. Moreover, the increase of the prothrombin-time and thrombin-antithrombin III complex were less for the fasted group than the control group. The present study showed that short-term fasting inhibited hypotension and elevations in cytokine concentrations, reducing the mortality rate of rats with endotoxin-induced shock. Moreover, short-term fasting inhibited the elevation of coagulation parameters. These findings suggest that short-term fasting may exert favorable effects during sepsis and septic shock.
Cardiopulmonary and Automatic External Defibrillator handling skills evaluation in lay persons

Thiago I. Silva, Luana D. Olival, Ana P. Quilici, Maria Margarita Gonzalez, Sergio Timerman; Heart Institute (InCor), Univ of Sao Paulo Med Sch, Sao Paulo, Brazil

Background: Since the public access of defibrillation law was approved in Sao Paulo city in 2005, it has been increasing the number of lay people who demand for cardiopulmonary resuscitation (CPR) and Automatic External Defibrillator (AED) training courses. According to the law, subway stations should have an AED and 30% of the Agents should be trained in HeartSaver AED. The American Heart Association advises a Basic Life Support (BLS) refresh every two years. However, recent published papers demonstrated a significant increase in CPR skills only 6 months following a BLS course. Hypothesis: we hypothesized that retention of skills in CPR and AED use considerably diminish after 8 months of training in HeartSaver AED course.

Methods: This is an observational prospective study on the retention of CPR and AED handling skills. Twenty Subway Agents who were previously trained in these maneuvers were evaluated. The evaluation of the skills retention was performed 8 months after the success completion of the first HeartSaver AED course, consisting in a cardiopulmonary arrest simulation in a training mannequin. Experienced HeartSaver AED instructor evaluated the following performed skills: 1) Check for response; 2) Activate Emergency Response System and Get an AED; 3) Open airway; 4) Check breathing; 5) Give two breaths; 6) Perform compressions hard and fast in a correct hands position; 7) AED operation Results: it was observed that the totality of the participants didn’t perform, at least, one of the evaluation: 85% of the participants checked response, 55% asked for help after check response, 45% asked for help at another moment, 45% opened correctly the airway, 30% checked breathing, 50% gave two breaths, 65% performed 30 compressions, 35% performed compressions in a correct frequency and 65% had performed correct chest place CPR. Concerning the AED use, 30% powered the AED in an appropriated manner and 15% correctly attached the pads but 15% removed the pads after the shock. Conclusion: The results suggest a possible necessity of a continuous CPR and AED training in view of a significant decreasing in the performance of these skills 8 months following the first training course.

Emergency Medical Services Utilization in ST-Elevation Myocardial Infarction: Significant Urban Versus Rural Differences

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Background: National practice guidelines and strategies for reperfusion recommend pre-hospital ambulance triage of STEMI patients en route to PCI hospitals. Unfortunately, Emergency Medical Services (EMS) have been underutilized which could limit this strategy and cause treatment delays. Objective: To assess the prevalence of EMS use by ST-segment myocardial infarction (STEMI) patients and its impact on door to balloon times in a regional STEMI network. Methods: Data were obtained from a prospective registry of 1,464 consecutive STEMI patients admitted or transferred to a regional PCI center. Results: EMS use by STEMI patients was stratified by gender, age and rural vs urban (table). Only 40% of rural STEMI patients utilize EMS versus 65% of urban patients. In the urban setting there were no significant age group (p = 0.35) or gender (p = 0.64) differences. In contrast, in the rural setting, males (p < 0.001) and age < 65 (p < 0.001) are less likely to use EMS. Median door to balloon times were shorter for those using EMS in both urban (60 vs 77 minutes: p < 0.0001) and rural settings (103 vs 107 minutes, p = 0.006). Conclusion: In contrast to patients in the urban setting, significant gender and age differences are present in rural EMS utilization. Door to balloon times are faster when STEMI patients use EMS in both settings, but less is saved in rural patients. These findings may impact current reperfusion strategies and should direct public educational efforts towards those subgroups who are least likely to use EMS in the event of an acute myocardial infarction.

Role Of Vascular Beta 2-adrenoceptors In Endotoxemic Shock

Bertrand Rozec, Thuy Tran Quan, Emmanuelle Lavrazis-Blancou, Leslie Audigane, Institut du Thorax-INSERM U533, Nantes, France; Chantal Gauthier-Erfanian; Institut du Thorax-INSERM U533, Nantes, France

Although it is known that during endotoxemic shock the use of β-adrenergic agonists can improve organs blood flow independently of cardiac output increase, there is no study in the literature concerning the remodelling of the vascular β-adrenoceptors (β-AR, β1, β2 and β3) in male Sprague-Dawley rats received either 5 mg/kg of lipopolysaccharide (LPS) or the same volume of the vehicle (C). At the end of the experiment, three hours later, the aorta rings were harvested to perform functional and mRNA expression studies. To take into account the failure of the vascular constriction in sepsis, aortic rings were precontracted with an appropriated concentration of phenylephrine (10⁻⁶ M agonist) in order to obtain 80% of the maximal contraction in both groups. Concentration-relaxation curves were then constructed with several β-AR agonists: isoproterenol (ISO), a non selective agonist; dobutamine (DOB), salbutamol (SAL) and SR 59611A (SR) respectively. The β₁-AR and β₂-AR concentration-relaxation curves were significantly reduced in both groups. The ISO-induced relaxation was not modified (Table). In LPS treated rats, β₁- and β₂-AR mRNA abundance was significantly reduced by 40% and 64% (p < 0.05) respectively, without modification of β₃-AR mRNA expression. Our work suggests, for the first time, a differential regulation of the 3 vascular β-AR at the early stage of endotoxemic shock. Moreover, as vascular β₂-AR function and mRNA expression are preserved during endotoxemia, it strengthens the putative effect of β₂-AR agonists to maintain blood flow in septic shock.

How Rapidly Can People find an AED?

Hisashi Kaneko, Nagoya City Fire Dept, Nagoya, Japan; Tetsuo Hatanaka, Emergency Life-Saving Technique Academy, Kitakyushu, Japan; Aki Nagase, Niigata College of Nursing, Niigata, Japan; Hiroko Noguchi, Musashino Univ, Tokyo, Japan; Atsuko Nagatani, Nagasaki Univ Hosp of Medicine and Dentistry, Nagasaki, Japan; Seishiro Marukawa, Hyogo Med Sch, Kobe, Japan

Success of public defibrillation program (PAD) depends in part on the rapidity for lay people to find an AED. The aim of the present study was to investigate how rapidly lay people can find an AED in transportation airports, and to identify the factors that facilitate rapid detection of an AED. Methods: In 20 randomly selected locations in each of the airports (8 AEDs / 38000 m² and 6 AEDs / 14760 m²), 2 people (total of 80) were asked to find an AED as rapidly as possible, and the time (Ta) needed to find an AED and the routes they followed were recorded. The theoretical time (Tt) needed to find an AED was calculated on the diagram assuming that people would reach the nearest AEDs. Results: When combined over the 2 airports, Ta was 168 (140 – 450) seconds (median, IQR) and was significantly longer than Tt of 36.4 (17.1 – 51.8) seconds. Conclusion: The results suggest a possibility of a continuous CPR and AED training in view of a significant decreasing in the performance of these skills 8 months following the first training course.

Awareness of Guidelines of Automated External Defibrillator Use in Children within Emergency Medical Services

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BACKGROUND. Ventricular fibrillation occurs in 10–20% of pediatric cardiac arrests. Survival rates in children with ventricular fibrillation can be as high as 30% when the rhythm is identified and treated promptly. In the last five years, recommendations have been made for the use of automated external defibrillations (AED) in children 1–8 years of age.

OBJECTIVE. The goal of this study was to determine the awareness of American Heart Association (AHA) guidelines and statewide protocols concerning AED use in children ages 1–8 among emergency medical providers after new guideline release. Availability of pediatric capable AED equipment was also assessed.

METHODS. Surveys were distributed to EMS providers in Iowa and Montana within one year of the AHA advisory statement in 2003 recommending use of AEDs in children ages 1–8, and again approximately one year after the 2005 AHA guidelines on cardiopulmonary resuscitation were published. In Iowa, there were concentrated efforts to disseminate information about AED use in children, while there were minimal efforts in Montana. RESULTS. Awareness of AHA guidelines for use of AEDs in children was low in both states in 2003 (29% in Iowa vs 9% in Montana, p < 0.001). After release of the 2005 guidelines, awareness improved significantly in both states but was still significantly greater in Iowa (83% vs. 60%, p < 0.002). In 2003, less than 20% of respondents in both states reported AED use by EMS in children. Availability of pediatric signs and calls for non-nearest AEDs. Whether or not people had advance knowledge about an AED did not affect Ta: 160 (94 – 387) vs 177 (94 – 387) seconds, respectively with vs without advance knowledge. It was similar for 2 airports: 38.8 (17.1 – 44.2) vs 28.9 (14.9 – 63.5) seconds. Despite the considerable inter-airport difference in the configuration of the on-site AED signs (protruding with AED pictogram vs non-protruding without pictogram), Ta was not significantly different between the airports: 163.3 (104.5 – 342.0) vs 194.5 (91.5 – 424.5) seconds. Neither of the airports had off-site signs that showed directions to the nearest AEDs. CONCLUSIONS. The theoretical prediction of the time based on the diagram of the facilities significantly underestimated the actual time required to find an AED, partly because it ignores the fact that people fail to reach the nearest AED in about 40% of the cases. This suggests that presence of off-site signs showing the direction to the nearest AED is an important factor for rapid detection of an AED. Configurations of the on-site AED signs and the advance knowledge on an AED appeared to be minor factors.
protocols are implemented. An effective and efficient method to disseminate new pediatric out-of-hospital protocols emergency care to become standard of care in a timely matter should be developed.

Preconditioning With Periodic Acceleration (pGz) Prior To Whole Body Ischemia Reperfusion Injury Ameliorates Myocardial Stunnung And Arrhythmias

Jose A Adams, Jorge Basusuk, Heng Wu, Jaqueline Arias, Dongmei Wu, Vinod Jorapur, Gervasio Lamas, Mt Sinai Med Cntr, Miami Beach, FL; Paul Kurlansky; Florida Heart Rsch, Miami, FL

Periodic acceleration (pGz) consists of sinusoidal, head to foot motion of the supine body achieved with a motion platform. pGz produces pulsatile shear stress on the vascular endothelium by vasoconstriction in vivo and in vitro thereby inducing release of endothelial derived NO (eNO) and prostaglandins. Additionally, pGz when applied as a sole means for CPR decreases myocardial stunning and improves outcome from ventricular fibrillation (VF). VF followed by resuscitation (CPR) is a model of whole body ischemia reperfusion injury (RI). Pharmacological and ischemic preconditioning prior to I/R have been shown to ameliorate global and focal cardiac ischemia, reduce arrhythmias, and improve myocardial function after reperfusion. This study tests whether pGz applied prior to CPR, also ameliorates reperfusion injury. Twenty male swine (40–50lbs) were anesthetized, intubated and instrumented to measure blood gases and hemodynamics. They were placed on a motion platform and randomized to 1 hr of active pGz (3 Hz and Gz ± 0.4) (PRE) or no activation for the same time period, control(C). VF was electrically induced and unsupported for 8 min, followed by continuous manual chest compression and defibrillation until return of spontaneous circulation (ROSC) or 10 min. Echocardiograms to measure ejection fraction (EF%), fractional shortening (FS%) and wall motion score index (WMSI) were performed at baseline (BL), after pGz or control (BL2) and 30, 120 mins after ROSC (ROSC30, ROSC120). All animals had ROSC after a median of 4 defibrillation attempts. There were no differences between groups in defibrillation attempts, time to ROSC, arterial blood gases or hemodynamics over time. PRE animals had less hemodynamically significant arrhythmias in the first 30 mins ROSC; C (35) vs PRE (7) (p < 0.05) and less myocardial stunning. Data mean ± SD * p < 0.05 C vs PRE † p < 0.05 time vs BL pGz applied prior to I/R is cardioprotective and a novel means to precondition the myocardium.

Coronary Perfusion Pressure Augmentation by Sustained Abdominal Compression: Comparison with Vasopressor Drugs

Aaron E Lottes, Ann E Rundell, Leslie A Geddes, Andre E Kemeny, Michael P Otlewski, Charles F Babic; Purdue Univ, West Lafayette, IN

Objectives: This study investigated sustained abdominal compression as a means to improve coronary perfusion pressure (CPP) during cardiopulmonary resuscitation (CPR) and compared the resulting CPP augmentation with that achieved using vasopressor drugs. Method: During electrically induced ventricular fibrillation in anesthetized, 30 kg juvenile pigs, Thumper® CPR was supplemented at intervals either by constant abdominal compression at 100 to 500 mmHg using an inflatable contoured cuff or by the administration of vasopressor drugs (epinephrine, vasopressin, or glibenclamide). CPP before and after cuff inflation or drug administration was the end point. Results: Sustained abdominal compression at >200 mmHg increases CPP during VF and otherwise standard CPR by 8 to 18 mmHg. The effect persists over practical ranges of chest compression force and duty cycle and is similar to that achieved with vasopressor drugs. Constant abdominal compression also augments CPP after prior administration of epinephrine or vasopressin. Conclusions: During CPR noninvasive abdominal compression with the inflatable contoured cuff rapidly elevates the CPP, sustains the elevated CPP as long as the device is inflated, and is immediately and controllably reversible upon device deflation. Physical control of peripheral vascular resistance during CPR by abdominal compression has some advantages over pharmacologic managenent and deserves serious reconsideration, now that the limitations of pressor drugs during CPR have become better understood, including post-resuscitation myocardial depression and the need for intravenous access.

Cyclosporin A does not Prevent Myocardial Dysfunction after Resuscitation from Cardiac Arrest in Rats

Iyad M Ayoub, Jeejabai Radhakrishnan, Raúl J Gazmuri; Rosalind Franklin Univ of Medicine and Science, North Chicago, IL

Objective: We have previously reported in a rat model of VF and closed-chest resuscitation that cycloporine C is released into the bloodstream after resuscitation from cardiac arrest attaining plasma levels inversely proportional to survival. Recent evidence indicates that release of cycloporine C during ischemia and reperfusion may be a manifestation of prolonged opening of the mitochondrial permeability transition pore (mPTP). In this study, we investigated whether cycloporine A (CsA, an inhibitor of mPTP opening) can prevent post-resuscitation (PR) myocardial dysfunction and improve survival. Methods: VF was electrically induced and left untreated for 10 mins. Resuscitation was attempted by 8 mins of chest compression followed by biphasic waveform defibrillation. Rats were randomized to received a bolus CsA (10 mg/kg) five minutes before inducing VF (n=6), immediately before starting chest compression (n=6), or to receive vehicle control before inducing VF (n=3) or before starting chest compression (n=3). CsA-treated (n=12) and vehicle-treated (n=6) rats were pooled for this analysis. Results: CsA did not improve PR myocardial function (Table). Survival time was comparable between CsA-treated (321 ± 67 mins) and vehicle-treated (331 ± 67 mins) rats. Conclusions: In our rat model of VF and
resuscitation, Csa failed to prevent PR myocardial dysfunction and improve survival. These data contrast with numerous studies demonstrating a protective effect in isolated heart models of ischemia and reperfusion. Two possible explanations are 1) the mfTP does not open in this unique setting of cardiac arrest and resuscitation, and 2) the optimal in vivo dose of Csa needs to be determined as the protective effects of Csa are dose dependent.

### Hemodynamic and Left Ventricular Function

<table>
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<th>Variable</th>
<th>Baseline</th>
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<th>PR360 mins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Aortic Pressure, mmHg</td>
<td>141 ± 14</td>
<td>110 ± 31 [10]</td>
<td>75 ± 30 [9]</td>
</tr>
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<td>Vehicle n=0</td>
<td>138 ± 15</td>
<td>112 ± 14 [5]</td>
<td>97 ± 35</td>
</tr>
<tr>
<td>Cardiac Index, ml/min/m²</td>
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<td>56 ± 9 [10]</td>
<td>46 ± 10 [8]</td>
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<tr>
<td>Vehicle n=0</td>
<td>62 ± 20</td>
<td>58 ± 13 [5]</td>
<td>52 ± 10</td>
</tr>
</tbody>
</table>

### Alterations in Pulmonary Vasoreactivity Following Lung Contusion in Rats

Satyan Lakshminrusinha, Bruce A Davidson, Rita M Ryan, Jadwiga D Helinski, Krishnan Raghavendran; SUNY, Buffalo, NY

Lung contusion, a common complication of blunt chest trauma is an independent risk factor for ALI/ARDS. Using a recently described rat model for isolated bilateral lung contusion from blunt chest trauma (Anesesth Analg 2005;101:1482), studies suggested an inconsistent correlation between the extent of inflammation and hypoxia. We set out to investigate the alteration in pulmonary arterial (PA) reactivity in lung contusion. Methods: Lung contusion was induced in anesthetized spontaneously breathing adult male rats by dropping a hollow aluminum cylindrical weight (300 g) onto the chest with a protective shield placed on the precordium. Rats were allowed to recover and sacrificed at 4h and 24h (n=6–9) and compared to uninjured controls. Third generation PA rings were dissected and placed in a bath with modified Krebs solution, connected to a transducer and bubbled with 21% O₂ : 6% CO₂. Some rings were pretreated with a non-specific NO synthase (NOS) inhibitor, L-nitro arginine (LNA 10⁻³ M). Rings were constricted with norepinephrine (NE) and relaxed with either a NOS agonist (A 23187) or NO donor (SNAP) at 10⁻⁴ M. Results: Rats were hypoxic at 4h post-contusion (A-a gradient 337 ± 49 mmHg, mean ± SE) compared to controls (196 ± 29), but recovered 24h after contusion (217 ± 22). Pretreatment with LNA increased baseline tension significantly more in control PA compared to 4h or 24h post-contusion PA (130 ± 14, 112 ± 22 and 66 ± 16 g, respectively). Constriction response to NE in the presence of LNA was significantly higher 4h after contusion compared to controls (671 ± 114 vs 392 ± 77 g). Relaxation to A23187 (73 ± 5 vs 33 ± 7%) and SNAP (88 ± 7 vs 45 ± 12%) were significantly impaired 24h after contusion compared to controls. Pretreatment with LNA improved relaxation to SNAP in PA isolated from contraled lungs. Conclusions: Hypoxemia and increased PA contractility are observed 4h after lung contusion in rats with recovery by 24h. Production of response to NO are significantly diminished in PA following lung contusion. Speculation: Uncoupling of NOS with reduced production of NO and increased production of superoxide may be observed in PA following lung contusion. Therapy with inhaled NO and antioxidants such as superoxide dismutase may alleviate hypoxemia following lung contusion.

### The Prognostic Factor of Patients with Asystole on Arrival

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Background: Patients with asystole on arrival (AOA) at hospital have a poor prognosis. However, little is known about the prognostic factor of patients with AOA. Objective: The purpose of this study was to determine predictors for 24 hours survival in patients with AOA. Methods and results: Consecutive patients with AOA admitted to the Hiroshima University Hospital (Hiroshima, Japan) from April 2002 to January 2007 were retrospectively analyzed. Patients were divided into two groups according to the outcomes, i.e. non-survivors vs. survivors at 24 hours after admission. Data including blood gas analysis, lactate levels, and levels of minerals on admission were obtained and analyzed. Of 102 (male; 60) patients with AOA, fourteen patients survived for 24 hours. Univariate analysis found that pH, PaO₂, PaCO₂, base excess, lactate, and serum potassium concentration were associated with survival (p< 0.05) (Table). Multivariate analysis determined that serum potassium concentration independently affected 24 hours survival. Conclusions: These results suggested that the serum potassium level on admission is a strong, independent predictor of survival of patients with AOA.

### Inhospital Outcome of 458 Patients with Acute Myocardial Infarction Requiring Mechanical Ventilation. Results of the BEAT Registry of the ALKK

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Background: There is only limited information about characteristics and clinical outcome of patients with acute myocardial infarction (AMI) requiring endotraqueal intubation and mechanical ventilation. Therefore we sought to evaluate the clinical course of a large cohort of patients with AMI and mechanical ventilation. Methods: The BEAT Registry of the ALKK prospectively enrolled all consecutive patients requiring mechanical ventilation, who were admitted to an internal intensive care unit (ICU) of 45 participating German centers. Patient characteristics, treatment and complications until discharge were collected. For this analysis we created a subpopulation of patients admitted with AMI and investigated the outcome of these patients. Results: During the 9-month study period 458 consecutive patients with AMI were included. The mean age was 68±8 years and 71% were men. While 40% of the patients were intubated in the prehospital phase, 60% were intubated in the hospital. The initial cause for intubation was in 48% of the cases ventilator fibrillation/ tachycardia or sudden cardiac death, in 39% congestive heart failure and in 13% of the cases non-cardiac. Of the 458 patients 256 (56%) developed cardiogenic shock, 86 (19%) acute renal failure, 76 (17%) coma or brain damage, 64 (14%) severe infection, 46 (10%) sepsis, 28 (6%) MODS and 17 (4%) gastrointestinal bleeding. 204 (45%) patients underwent coronary angiography, 38% were treated with PCI and 5% with coronary artery bypass grafting. The inhospital mortality in the total group was 48% and in the subgroup of patients with cardiogenic shock 69%. Conclusion: Patients requiring mechanical ventilation as complication during the early phase of an AMI constitute a high risk subgroup with a mortality of 50%. Further research is necessary to improve the outcome of these patients.

### Written Evaluation in Advanced Cardiovascular Life Support is not a Predictor for Cardiac Arrest Performance

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Objectives: Successful completion of American Heart Association (AHA) Advanced Cardiovascular Life Support (ACLS) requires both a written knowledge assessment and a practical evaluation that tests psychomotor skills, cognitive knowledge, and affective behaviors such as leadership and team skills. Previous evidence has indicated little to no correlation between written and practical skills in Basic Life Support courses. There is limited data on the correlation between written and practical evaluations in advanced level courses or on the ability of the written test to predict performance following an ACLS course. Methods: 34 senior nursing students from four nursing programs participated in ACLS. Each participant completed the written and practical evaluations. Immediately after completing the course, all participants served as team leaders for a simulated cardiac arrest event that was video recorded. A panel of expert ACLS instructors who did not participate as instructors in the ACLS course reviewed each video and independently scored team leaders’ performances. Results: There was no significant correlation between written evaluation scores and practical skills performance as rated by the expert instructor panel. Paired samples correlation was .219 (p = .213). Conclusions: The ACLS written evaluation was not a reliable predictor of participant success in managing a simulated cardiac arrest event immediately following an ACLS course. The ACLS performance evaluation tests a much broader spectrum of course content or in-work in concert define myocardial infarction.
Majors results were compared based on job title. Results Sixty-one questionnaires were filled out (25 paramedics, 13 nurses, and 23 physicians). Personnel was mostly aged under 40 (70,5%, n=43), with over 2 years experience in prehospital emergency care (75,4%, n=46); 47,5% (n=29) had no training in pediatrics; 68,9% (n=42) had BLS certification and 31,1% (n=19) reported regular participation in first aid training programs. A minority of subjects declared knowing the 2005 Guidelines (11,5%, n=7), even among physician (17,4%, n=4).

Table 1 contains major results about CPR parameters according to job title. Conclusion This study emphasizes the lack of knowledge and the repeated changes which require more frequent and more extensive training for entire personnel on the team, focusing on basic CPR for physicians and advanced CPR for paramedics and nurses.

### Table 1: Answers according to job title

<table>
<thead>
<tr>
<th>AED</th>
<th>Basic CPR</th>
<th>Advanced CPR</th>
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<tr>
<td></td>
<td>Incident</td>
<td>Prioritization</td>
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<td></td>
<td>Age</td>
<td>Mode</td>
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<td></td>
<td>infant</td>
<td>Childhood</td>
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### The Potential Mechanisms of Reduced Incidence of VF as the Presenting Rhythm

Hao Wang, Wanchung Tan, Shijie Sun, Min-shan Tsai, Yongqin Li, Tong Wang, Max H Weil; Weill Institute of Critical Care Med, Rancho mirage, CA

Background. In our previous studies, we have demonstrated that the administration of both beta-adrenergic receptor blocker (β1

**Methods:** Baseline normal sinus rhythm (NSR) CI was 3.1 L/min/m² and MBF was 0.55 L/g. Hemodynamics during CPR were not worse with device use, as reported in Table 1. In both groups, CI was ~40% of NSR, and LVfs was ~40%–75% of NSR. Conclusions: Use of a 260g sternal accelerometer/or force-measurement device with manual chest compressions did not have adverse effects on CPR hemodynamics.

### Dual Pathway Defibrillator Shocks Produce Less Hemodynamic Compromise than Standard, Single Pathway Shocks

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Emergency ventricular defibrillation is conventionally performed using a single pair of external electrodes. We have shown that the use of two defibrillators, discharged simultaneously, or sequentially (dual pathway, DP), during ventricular defibrillation can convert the heart to sinus rhythm with significantly lower total energy using similar waveforms compared to single pathway (SP) shocks. Studies have also shown that high energy SP biphasic waveform shocks can produce immediate, post-shock hypotension, although less than monophasic shocks. This study was designed to determine if high energy DP shocks produce a similar hemodynamic effect as SP biphasic shocks at the same energy. **Methods:** Defibrillator testing was performed using eight pigs of either sex (range 32–41 kg). Animals were anesthetized with isoflurane and instrumented with surface ECG to monitor rhythm and arterial cannula to monitor systemic blood pressure. Self adhesive defibrillation electrodes (Zoll Medical) were placed on the shaved torso in an anterior-posterior orientation in both SP and DP configurations. High energy defibrillator shocks (total energy 200J for RLB and BTE waveforms) were delivered in sinus rhythm to compare a DP rectangular biphasic waveform (DP-RLB: Zoll Medical) to a SP-RLB waveform and an SP biphasic truncated exponential (BTE: Physio-Control) waveform. The immediate post shock reduction in mean arterial blood pressure (as percent of pre-shock value) were recorded and compared. The 200J shock strength was chosen due to it’s high shock efficacy in this population (approximately 3 times defibrillation threshold). Results: The DP-RLB waveform configuration produced a post-shock reduction of 5.4 ± 6.9% in mean arterial pressure, while the SP-RLB waveform reduction was 14.1 ± 8.4% and the SP-BTE waveform reduction was 13.0 ± 6.0% at the same 200J total energy (p = 0.03). Conclusions: The DP shock configuration using the SP-RLB waveform produces less reduction in mean arterial pressure following high energy shocks than both the RLB and the BTE waveforms using a single pathway configuration. Further studies would need to be performed to determine if this hemodynamic benefit would be greater following a period of ventricular fibrillation, as would be clinically.
Spontaneous Refibrillation Following External Defibrillation of Long Duration Ventricular Fibrillation in Swine

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Background: Following successful defibrillation of the long duration ventricular fibrillation (LDFV) associated with sudden cardiac arrest (SCA), defibrillation occurs in over half of resuscitation attempts. In experimental animals with normal hearts, refibrillation almost never occurs following short duration VF lasting < 1 min (SDVF). It is not known if the collection following LDFV is due to the cardiac disease that caused the initial LDFV of SCA or if the LDFV itself causes abnormalities that can initiate VF. Further, the mechanism of refibrillation initiation is unknown. We tested the hypothesis that refibrillation occurs frequently following LDFV in previously normal hearts and propagates from a common area within the heart selecte area in 8 pigs, 115–120 plunge needles containing 3–6 electrodes each were inserted throughout the heart. With the chest closed, external defibrillation pads were placed in a left lateral to right lateral configuration. Following successful defibrillation of 20 s of SDVF, the animal was observed for spontaneous VF for at least 4 min. After termination of 7 min of SDVF, the animal was placed on cardiopulmonary bypass and observed for 15 min for spontaneous VF. Results: Following LDFV, 1.33 ±0.8 episodes of spontaneous VF occurred in each animal. The mean time to VF was 71 s (range 5 – 139 s) following defibrillation of LDFV. Three animals had a second episode of VF within 3 min of termination of LDFVF. Earliest sites of origin of spontaneous VF occurred equally in the LV (3), RV (3), and septum (2) and arose equally from the endocardium (3), epicardium (2), and myocardium (3). Refibrillation originated in the posterior half of the ventricles 75% of the time. The first refibrillation cycle appeared focal in 75% of cases and atrioventricular in 25%. Premature ventricular beats arising out of the posterior RV base immediately preceded 75% of VF episodes. Conclusions: 1. Spontaneous VF is common after defibrillation of LDFV but not SDVF in previously healthy swine, indicating that refibrillation does not require preexisting cardiac disease but can be caused by the detrimental effects of LDFV. 2. Most episodes of refibrillation begin as focal activity within the posterior half of the ventricles.
Predictors of Transfusion in Acute Myocardial Infarction: Insights from APEX-AMI (Assessment of Pexelizumab in Acute Myocardial Infarction) Trial

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Introduction: We previously demonstrated that blood product transfusion strongly and independently predicts death in a population of STEMI patients treated with primary percutaneous coronary intervention (PCI). Using multivariable regression analyses, we explored which baseline and in-hospital factors predict transfusion. Methods: Stepwise variable selection was performed from the database of the APEX-AMI trial, a phase 3 trial that compared pexelizumab to placebo in 5,736 patients with STEMI treated with primary PCI in 17 countries between 2004 and 2006. In-hospital CABG patients were excluded from the analysis (n = 141). Results: Of the 4,429 non-CABG pts with complete baseline and in-hospital covaraiates, 211 (4.6%) were transfused. Most transfused pts (81%) experienced moderate or severe bleeding. Baseline independent predictors of transfusion are presented in the table. After 24 hours, intra-aortic balloon pump use (OR: 6.05 [95% CI 3.62–10.09], p = .47) and nadir hemoglobin (OR: 2.57 [95% CI 1.62–4.08], p < .001, 16.0, per 10 mg/dL) were identified independent predictor of transfusion. Landmark analyses for the first 5 days maintained all predictors. Interestingly, transfusion rates were not increased in patients treated with Gp IIb/IIIa inhibitors or recatherization. Conclusions: In this contemporary acute MI population treated with PCI, baseline independent predictors of transfusion (ΔHb ≥ 2 g/dL and nadir hemoglobin < 10.0 mg/dL) were identified. Differences in the hospital course effectively discriminate the risk of receiving blood transfusion. These data will be useful in developing strategies to reduce the need for blood transfusions so as to avoid their long term adverse effects.

Baseline Predictors of Transfusion

<table>
<thead>
<tr>
<th>Baseline Variables</th>
<th>OR</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin (per 10 mg/dL)</td>
<td>0.67</td>
<td>[0.62–0.72]</td>
<td>0.105</td>
</tr>
<tr>
<td>North America (enrollment site)</td>
<td>2.40</td>
<td>[1.73–2.24]</td>
<td>0.012</td>
</tr>
<tr>
<td>Heart rate &gt; 65 (per 10 BPM)</td>
<td>1.19</td>
<td>[1.11–1.28]</td>
<td>21.0</td>
</tr>
<tr>
<td>Diastolic blood pressure &gt; 90 (per mmHg)</td>
<td>0.77</td>
<td>[0.64–0.97]</td>
<td>16.3</td>
</tr>
<tr>
<td>Age (per 10 y)</td>
<td>1.38</td>
<td>[1.31–1.45]</td>
<td>15.8</td>
</tr>
<tr>
<td>Female Gender</td>
<td>1.85</td>
<td>[1.35–2.53]</td>
<td>14.9</td>
</tr>
<tr>
<td>Creatinine &gt; 85 (per 10 μmol/L)</td>
<td>1.03</td>
<td>[1.02–1.05]</td>
<td>14.8</td>
</tr>
</tbody>
</table>

Transferring Images via the Wireless Messaging Network using Camera Phones Shortens Time Required to Diagnose Acute Coronary Syndrome

Masashi Ohtsuka, Eiji Uchida, Toru Nakajima, HIroyuki Yamaguchi, Sei-Ei Yokohama General Hosp, Yokohama, Japan; HIroyuki Takano, Iseki Komuro; Chiba Univ Graduate Sch of Medicine, Chiba, Japan

The speed at which repercussion treatment can begin is critical in cases of acute coronary syndrome. Electrocardiograms (ECG) are used to make the diagnosis. In the absence of a cardiologist in the emergency room (ER), the ECG image data must be sent to a cardiologist on site. We compared the time taken to transmit images from the ER to a cardiologist, the time taken to analyze the image and the total time elapsed from image transmission to diagnosis by the cardiologist. All data presented are mean ±SD. Group comparisons were based on the Student’s t-test. The amount of time taken in transmitting the images from the ER to the cardiologist was longer in the F group (163.8 ± 76.8 sec) than that of the CP group (124.9 ± 48.6 sec). However, the amount of time taken by the cardiologist to analyze those images was shorter in the F group (12.9 ± 8.1 sec) than that of the CP group (24.1 ± 4.3 sec). Total time elapsed from image transmission to diagnosis was shorter in the CP group (95.6 ± 8.4 sec) than that of the F group (176.7 ± 49.9 sec). In conclusion, using camera phones to transmit ECG images to the cardiologist shortens the time taken to diagnose acute coronary syndrome. Furthermore, camera phones are more advantageous in regards to availability and cost in comparison to fax machines because of the advantage in regards to availability and cost in comparison to fax machines because of the

Surface Cooling Induced Therapeutic Hypothermia Following Pediatric Cardiac Arrest

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Introduction: Induced therapeutic hypothermia protocols following clinical pediatric cardiac arrest have not reported efficacy or compared core temperature (T) monitoring sites. An effective cooling protocol is necessary before outcome trials can be performed. Hypothesis: Therapeutic hypothermia to goal range 32–36°C for 24 hours will be maintained with overshoot hypothermia, using a core temperature in the intervention arm were more likely to perform compressions to ventilations at a ratio of 30:2 than controls, [15/16 (94%) vs. 4/15 (27%), p = .001], even with stratification by rescue background: laypeople [8/9 (89%) vs. 0/4 (0%), p = .020], medical or nursing student [7/7...
The Comparison The Artifact By The Usual Electrocardiogram Versus The Dynamic Monitorizer (Radarcirc®) During Chest Compressions Of Cardiac Arrest Patients

GENJI SHIMPUKU, Teikyo Univ Sch of Medic, Tokyo, Japan

[Background] The 2005 American Heart Association (AHA) guidelines for cardiopulmonary resuscitation (CPR) and emergency cardiovascular care (ECC), increased emphasis on importance of the chest compressions. These guidelines developed that rhythm checks should be very brief. The dynamic monitorizer (RADARCIRC®) was developed to reduce the artifact, but there is no study for the artifact during chest compressions of cardiac arrest patients. Our purpose was to compare the effect of the artifact by the usual electrocardiogram versus RADARCIRC®. [Materials and methods] We observed rhythms during chest compressions of 20 cardiac arrest patients by the usual electrocardiogram and the RADARCIRC®. [Results] Almost all rhythm by the RADARCIRC® reduced artifact. Image-1 is a typical rhythm (asystole) by the usual electrocardiogram. Image-2 is a typical one by the RADARCIRC®. RADARCIRC® will be able to shorten the time checking rhythm, because of the artifact during CPR. Image-1: A typical rhythm (asystole) by the usual electrocardiogram Image-2: A typical rhythm (asystole) by the RADARCIRC®.

Asymmetric Dimethylarginine Predicts Outcome and Time of Stay in Hospital in Patients Attending an Internal Medicine Emergency Room

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Introduction For patients attending the emergency room (ER) valid diagnostic criteria which give information about further progress are needed. We investigated the predictive value of asymmetric dimethylarginine (ADMA), an independent cardiovascular risk factor, in unselected patients attending the internal medicine ER of a university medical center regarding outcome of the patients and duration of stay in the hospital. Patients and Methods Patients (n = 417) attending the ER were classified according their primary diagnosis in six groups: cardiovascular (n = 156), pulmonary (n = 31), CNS/neurological (n = 42), gastrointestinal (n = 84), cancer related (n = 26), other diagnosis (n = 78). Routine laboratory tests were performed and ADMA was determined by LC-MS from plasma. A primary endpoint of in hospital death and complicated outcome (need for continuous hospital based support) was defined. Results ADMA levels were highest in patients with cancer related diagnosis (0.84 ± 0.36 μmol/L) and in patients with cardiovascular diagnosis (0.71 ± 0.19 μmol/L) (ANOVA; p = 0.001). In patients with cardiovascular diagnosis those reaching the primary endpoint had significantly higher ADMA levels than those without complications (0.88 ± 0.22 μmol/L vs. 0.69 ± 0.18; p = 0.001). We found increasing proportions of patients experiencing the primary endpoint over the quarters of ADMA (4.6%, 8.2%, 9.6%, and 15.8%; p = 0.007). ADMA was an independent predictor of the primary endpoint in a multivariate linear regression model (odds ratio 16.8; p = 0.038) after correction for age, gender, laboratory parameters, and chronic cardiovascular diseases. In a Cox proportional hazard model correcting for gender, BMI, diabetes, hypertension, CHD, and heart failure, ADMA was an independent predictor of the length of hospitalization (hazard ratio (HR) 0.49 (95% CI: 0.30–0.81); p = 0.005) beside age (HR 0.99 (0.98–0.99); p = 0.031), creatinine HR 0.87 (0.77–0.99); p = 0.035), and CRP (HR 0.94 (0.91–0.96); p = 0.001) in patients with cardiovascular diagnosis, respectively. Conclusion We conclude that ADMA independently predicts future complications and hospitalization in patients attending an ER.
Ventilation is not Necessary During Cardiopulmonary Resuscitation in a Rat Model of Hemorrhagic Cardiac Arrest

Takumi Taniguchi, Hideo Inaba; Kanazawa Univ, Kanazawa, Japan

Recent studies showed that arterial blood pressure during hemorrhagic shock is made worse with hyperventilation and improved with hyperventilation. However, there are few studies about the ventilation during cardiopulmonary resuscitation (CPR) in hemorrhagic cardiac arrest. To compare the effect of three ventilation strategies during CPR in an animal model of hemorrhagic cardiac arrest. Thirty-six male Sprague Dawley rats were anesthetized with pentobarbital ip. Hemorrhagic cardiac arrest was induced with removing of blood. After 3 minutes of cardiac arrest, animals were randomized to receive one of three ventilation strategies during CPR (in = 12 per group): normoventilation (20 breaths/min, FiO2 1.0), hyperventilation (10 breaths/min, FiO2 1.0), or no-ventilation. The rate of chest compressions (CC) was 240–260/min and depth of CC was titrated to maintain diastolic arterial pressure between 25–30 mmHg in all groups. After 5 minutes of CPR, the all removing blood and epinephrine (0.02 mg/kg) were administered. There were no other therapies before, during or after CPR. The rates of return of spontaneous circulation (ROSC) were 92%, 83%, and 92% for normoventilation, hyperventilation, and no-ventilation groups, respectively. The survival rates at 2hrs after ROSC were 67%, 58%, and 67% for normoventilation, hyperventilation, and no-ventilation groups, respectively. The PCO2 levels immediately after ROSC were 70 mmHg, 74 mmHg, and 80 mmHg for normoventilation, hyperventilation, and no-ventilation groups, respectively. The increases of plasma cytokine (TNF-alpha and IL-6) and lactate concentrations were not significantly different between all groups. Moreover, the elevations of coagulation parameters after ROSC were not significantly differences between all groups. The present study showed that there were no significantly different on ROSC and the changes of cytokines and lactate and coagulation parameters between the three ventilation strategies during CPR in the hemorrhagic cardiac arrest model. These findings suggest that ventilation during CPR in hemorrhagic cardiac arrest may not be necessary.

Use Of Medical Hyperspectral Imaging in the Evaluation of Blunt Chest Trauma and Hemorrhagic Shock in a Porcine Model

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INTRODUCTION: Hyperspectral Technology cutaneous Oxygenation Monitoring (HTcOM) provides scans that quantify oxyhemoglobin (HT-Oxy) and deoxyhemoglobin (HT-Deoxy) on a pixel by pixel basis. In monitoring mode, a series of sequential scans show oxygen delivery to the tissue and oxygen extraction by the tissue of interest. In this study, we tested the feasibility of using HTcOM to monitor tissue oxygenation changes during blunt chest trauma and hemorrhage. METHODS: 16 female Yorkshire pigs (~35 kg, 10 bleed, 6 controls) are undergoing a combined blunt chest trauma & hemorrhage protocol implementing blunt right chest trauma with a modified captive-bolt humane stunner under anesthesia. Severity of pulmonary contusion is documented by arterial & venous blood gases & CT scans at 0, 15, 30, 60, & 120 min. Injury is followed 120 min later by constant-rate, fixed-volume hemorrhage of 40 ml/kg in 2 stages, with 20 min between stages. Hyperspectral imaging of the anterior lower extremities (near infrared system) and the lower abdomen (visible light system) is continuously performed. RESULTS: To date, 3 pigs have been studied. With chest trauma HT-Deoxy levels increased on average by 50% (range 14–112). Following 1st bleed, changes to HT-Oxy & HT-Deoxy were small while following 2nd bleed, HT-Oxy dropped 15% (range 11–20) & HT-Deoxy increased 4% (range 2–7). Using ANOVA, with HT-Oxy & HT-Deoxy as the outcomes & measurements made between 5 min before & 5 min after the event (injury, bleed 1, bleed 2, & death) as the predictive factors, changes in the 2 outcomes associated with the events (p<0.001). Changes in HT-Oxy correlated with systolic BP for event periods (r = 0.47 to 0.97). HT-Oxy & HT-Deoxy also correlated with blood lactate values (r = -0.64 to -0.89 for HT-Oxy, 0.36 to 0.65 for HT-Deoxy). CONCLUSIONS: Quantitative measures of HT-Oxy & HT-Deoxy were extracted from HTcOM data & used to determine skin microvascular changes as a local manifestation of systemic hemodynamics in injured swine. Consistent trends of HTcOM responses were noted and found to be different with injury vs hemorrhage. HTcOM provides information that may be useful in the clinic & in the field to aid in the assessment of trauma patients.