
To derive and validate a prediction rule in patients with acute chest pain (CP) without existing known coronary disease. Cohort study including 2233 patients with CP. Based on clinical judgment, 1435 were discharged as very low risk and the remaining 798 underwent exercise tolerance test (ETT). End point: 6-month composite of cardiovascular death, nonfatal myocardial infarction, and revascularization. The prediction rule was derived from a randomly selected test cohort (n = 1106) summing factors of variables selected by multivariate regression analysis: CP score higher than 6 (factor of 3), male gender, age older than 50 years, metabolic syndrome, and diabetes mellitus (factor of 1, for each). The prediction rule was validated in the remaining cohort (n = 1127). All patients with CP were categorized into 3 groups: group A (prediction rule 0-1), B (2-4), or C (5-6). Outcomes and prognostic yield of ETT were compared among each group. In the test cohort, 55 patients (5%) reached the composite end point. Event rate increased as the prediction rule increased: 1% for group A, 6% for B, and 25% for C (P < .001). This pattern was confirmed in the validation cohort (P < .001). A normal ETT did not significantly improve the high (99%) negative predictive value in group A and did not succeed in excluding the composite end point (17%) in group C. In patients with acute CP without existing coronary disease, a prediction rule based on clinical characteristics provided a useful method for prognostication with possible implication in decision making.


BACKGROUND: Unlike Resuscitation Guidelines (GL) 2000, GL2005 advise resuming cardiopulmonary resuscitation (CPR) immediately after defibrillation. We hypothesized that immediate CPR resumption promotes earlier recurrence of ventricular fibrillation (VF).

METHODS AND RESULTS: This study used data of a prospective per-patient randomized controlled trial. Automated external defibrillators used by first responders were randomized to either (1) perform postshock analysis and prompt rescuers to a pulse check (GL2000), or (2) resume CPR immediately after defibrillation (GL2005). Continuous recordings of ECG and impedance signals were collected from all patients with an out-of-hospital cardiac arrest to whom a randomized automated external defibrillator was applied. We included patients with VF as their initial rhythm in whom CPR onset could be determined from the ECG and impedance signals. Time intervals are presented as median (Q1-to-Q3). Of 361 patients, 136 met the inclusion criteria: 68 were randomly assigned to GL2000 and 68 to GL2005. Rescuers resumed CPR 30 (21-to-39) and 8 (7-to-9) seconds, respectively, after the first shock that successfully terminated VF (P<0.001); VF recurred after 40 (21-to-76) and 21 (10-to-80) seconds, respectively (P=0.001). The time interval between start of CPR and VF recurrence was 6 (0-to-67) and 8 (3-to-61) seconds, respectively (P=0.88). The hazard ratio for VF recurrence in the first 2
seconds of CPR was 15.5 (95% confidence interval, 5.63 to 57.7) compared with before CPR resumption. After more than 8 seconds of CPR, the hazard of VF recurrence was similar to before CPR resumption. CONCLUSIONS: Early CPR resumption after defibrillation causes early VF recurrence. Clinical Trial Registration- clinicaltrials.gov Identifier: ISRCTN72257677.

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Prediction rules for pulmonary embolism use variables explicitly shown to estimate the probability of pulmonary embolism. However, clinicians often use variables that have not been similarly validated, yet are implicitly believed to modify probability of pulmonary embolism. The objective of this study is to measure the predictive value of 13 implicit variables. Patients were enrolled in a prospective cohort study from 12 centers in the United States; all had an objective test for pulmonary embolism (D-dimer, computed tomographic angiography, or ventilation-perfusion scan). Clinical features including 12 predefined previously validated (explicit) variables and 13 variables not part of existing prediction rules (implicit) were prospectively recorded at presentation. The primary outcome was venous thromboembolism (pulmonary embolism or deep venous thrombosis), diagnosed by imaging up to 45 days after enrollment. Variables with adjusted odds ratios from logistic regression with 95% confidence intervals not crossing unity were considered significant. Seven thousand nine hundred forty patients (7.2% venous thromboembolism positive) were enrolled. Mean age was 49 years (SD 17 years) and 67% were female patients. Eight of 13 implicit variables were significantly associated with venous thromboembolism; those with an adjusted odds ratio (OR) greater than 1.5 included non-cancer-related thrombophilia (OR 1.99), pleuritic chest pain (OR 1.53), and family history of venous thromboembolism (OR 1.51). Implicit variables that predicted no venous thromboembolism outcome included substernal chest pain, female sex, and smoking. Nine of 12 explicit variables predicted a positive outcome of venous thromboembolism, including patient history of pulmonary embolism or deep venous thrombosis in the past, unilateral leg swelling, recent surgery, estrogen, hypoxemia, and active malignancy. In symptomatic outpatients being considered for possible pulmonary embolism, non-cancer-related thrombophilia, pleuritic chest pain, and family history of venous thromboembolism increase probability of pulmonary embolism or deep venous thrombosis. Other variables that are part of existing pretest probability systems were validated as important predictors in this diverse sample of US emergency department patients.

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Study objective: The first hour after the onset of out-of-hospital traumatic injury is referred to as the “golden hour,” yet the relationship between time and outcome remains unclear. We evaluate the association between emergency medical services (EMS) intervals and
mortality among trauma patients with field-based physiologic abnormality. **Methods:** This was a secondary analysis of an out-of-hospital, prospective cohort registry of adult (aged ≥15 years) trauma patients transported by 146 EMS agencies to 51 Level I and II trauma hospitals in 10 sites across North America from December 1, 2005, through March 31, 2007. Inclusion criteria were systolic blood pressure less than or equal to 90 mm Hg, respiratory rate less than 10 or greater than 29 breaths/min, Glasgow Coma Scale score less than or equal to 12, or advanced airway intervention. The outcome was inhospital mortality. We evaluated EMS intervals (activation, response, on-scene, transport, and total time) with logistic regression and 2-step instrumental variable models, adjusted for field-based confounders. **Results:** There were 3,656 trauma patients available for analysis, of whom 806 (22.0%) died. In multivariable analyses, there was no significant association between time and mortality for any EMS interval: activation (odds ratio [OR] 1.00; 95% confidence interval [CI] 0.95 to 1.05), response (OR 1.00; 95% CI 0.97 to 1.04), on-scene (OR 1.00; 95% CI 0.99 to 1.01), transport (OR 1.00; 95% CI 0.98 to 1.01), or total EMS time (OR 1.00; 95% CI 0.99 to 1.01). Subgroup and instrumental variable analyses did not qualitatively change these findings. **Conclusion:** In this North American sample, there was no association between EMS intervals and mortality among injured patients with physiologic abnormality in the field.

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Hyperventilation is both common and detrimental during cardiopulmonary resuscitation (CPR). Chest-wall impedance algorithms have been developed to detect ventilations during CPR. However, impedance signals are challenged by noise artifact from multiple sources, including chest compressions. Capnography has been proposed as an alternate method to measure ventilations. We sought to assess and compare the adequacy of these two approaches. Continuous chest-wall impedance and capnography were recorded during consecutive in-hospital cardiac arrests. Algorithms utilizing each of these data sources were compared to a manually determined ‘gold standard’ reference ventilation rate. In addition, a combination algorithm, which utilized the highest of the impedance or capnography values in any given minute, was similarly evaluated. Data were collected from 37 cardiac arrests, yielding 438min of data with continuous chest compressions and concurrent recording of impedance and capnography. The manually calculated mean ventilation rate was 13.3+/−4.3/min. In comparison, the defibrillator’s impedance-based algorithm yielded an average rate of 11.3+/−4.4/min (p=0.0001) while the capnography rate was 11.7+/−3.7/min (p=0.0009). There was no significant difference in sensitivity and positive predictive value between the two methods. The combination algorithm rate was 12.4+/−3.5/min (p=0.02), which yielded the highest fraction of minutes with respiratory rates within 2/min of the reference. The impedance signal was uninterpretable 19.5% of the time, compared with 9.7% for capnography. However, the signals were only simultaneously non-interpretable 0.8% of the time. Both the impedance and capnography-based algorithms underestimated the ventilation rate. Reliable ventilation rate determination may require a novel combination of multiple algorithms during resuscitation.
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OBJECTIVE: In acute respiratory distress syndrome, alveolar recruitment improves gas exchange only if perfusion of the recruited alveolar units is adequate. To evaluate functional recruitment induced by positive end-expiratory pressure, we assessed pulmonary conductance for gas exchange based on lung diffusion for carbon monoxide and its components, including pulmonary capillary blood volume. DESIGN: Prospective, randomized, crossover study. SETTING: Medical intensive care unit of a university hospital. PATIENTS: Sixteen patients with lung injury/acute respiratory distress syndrome as well as eight control patients under invasive ventilation and eight healthy volunteers. INTERVENTIONS: Mechanical ventilation with two levels of positive end-expiratory pressure (5 and 15 cm H2O). MEASUREMENTS AND MAIN RESULTS: Lung diffusion for carbon monoxide and lung volumes, arterial blood gas analysis, and pressure-volume curves. In patients with acute respiratory distress syndrome, high positive end-expiratory pressure induced a 23% mean lung diffusion for carbon monoxide increase (4.4 +/- 1.7 mm Hg . min vs. 3.6 +/- 1.4 mL . mm Hg . min). In control patients and in healthy volunteers, lung diffusion for carbon monoxide values were (median [interquartile range]) 5.5 [3.8-8.0] mm Hg . min and 19.6 [15.1-20.6] mL . mm Hg . min, respectively. Among patients with acute respiratory distress syndrome, eight showed a >20% lung diffusion for carbon monoxide increase (responders) when increasing positive end-expiratory pressure. In the other eight, lung diffusion for carbon monoxide decreased or showed a <5% increase (nonresponders) with high positive end-expiratory pressure. Compared with nonresponders, responders at low positive end-expiratory pressure had smaller lungs with higher capillary blood volume-to-lung-volume ratio, higher values of the lower inflection point, and significantly greater increases in pulmonary capillary blood volume with high positive end-expiratory pressure. High positive end-expiratory pressure increased PaO2/Fio2 only in the responders. CONCLUSIONS: The functional response to positive end-expiratory pressure in patients with acute lung injury/acute respiratory distress syndrome seems better when the lungs are smaller and with a higher capillary blood-volume-to-lung-volume ratio. Lung diffusion for carbon monoxide measurement supplies additional information about functional lung recruitment, which is not synonymous with mechanical recruitment.

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BACKGROUND: Acute coronary syndromes remain a leading cause of preventable early deaths. However, previous studies have indicated that paramedics' compliance with chest pain protocols is suboptimal and that many patients do not receive the benefits of appropriate prehospital treatment. AIMS: To evaluate paramedics' level of compliance with national clinical practice guidelines and to investigate why, in certain circumstances, they may deviate from the clinical guidelines. SETTING: The Health Service Executive Mid-Western Regional Ambulance Service which serves a mixed urban and rural population across three counties in the west of Ireland. METHOD: A retrospective review of completed ambulance Patient Care Report Forms was conducted for all adult patients with non-
traumatic chest pain treated between 1 December 2007 and 31 March 2008. During the same study period, paramedics were asked to complete a prospective questionnaire survey investigating the rationale behind their treatment decisions, their estimation of patient risk and their attitudes towards the clinical practice guidelines and training. RESULTS: 382 completed Patient Care Report Forms were identified for patients with chest pain, of whom 84.8% received ECG monitoring, 75.9% were given oxygen, 44.8% were treated with sublingual glyceryl trinitrate (GTN) and 50.8% were treated with aspirin. Only 20.4% of patients had a prehospital 12-lead ECG recorded. 58 completed questionnaires were returned (response rate 15%); 64% of respondents said they had received insufficient training to identify ECG abnormalities. CONCLUSIONS: Prehospital treatment with oxygen, aspirin, sublingual GTN and ECG monitoring remains underused by paramedics, even though only a small number of patients had documented contraindications to their use. The small number of patients who received a prehospital 12-lead ECG is a cause of particular concern and suggests that incomplete patient assessment may contribute to under-treatment. Further provision of training and equipment is necessary to enable paramedics to more accurately assess and treat patients with acute coronary syndromes.


Objective: To describe the use and feasibility of therapeutic hypothermia after pediatric cardiac arrest. Design: Retrospective cohort study. Setting: Pediatric tertiary care university hospital. Patients: Infants and children (age 1 wk to 21 yrs) without complex congenital heart disease with return of spontaneous circulation after in-hospital or out-of-hospital cardiac arrest from 2000 to 2006. Intervention: None. Measurements and Main Results: We studied 181 patients after cardiac arrest, of which 91% were asphyxial in etiology (vs. cardiac) and 52% occurred in-hospital. Overall survival to hospital discharge was 45%. Forty patients received therapeutic hypothermia; all were admitted during or after 2002. Sixty percent of patients in the therapeutic hypothermia group had an initial temperature <35°C. The median therapeutic hypothermia target temperature was 34.0° C (33.5-34.8 °C), was reached by 7 hrs (5-8 hrs) after admission in patients who were not hypothermic on admission, and was maintained for 24 hrs (16-48 hrs). Re-warming lasted 6 hrs (5-8 hrs). In the therapeutic hypothermia group, temperature <32 °C occurred in 15% of patients and was associated with higher hospital mortality (29% vs. 11%; p = .02). Patients treated with therapeutic hypothermia differed from those treated with standard therapy, with more unwitnessed cardiac arrest (p = .04), more doses of epinephrine to achieve return of spontaneous circulation (p = .03), and a trend toward more out-of-hospital cardiac arrests (p = .11). After arrest, therapeutic hypothermia patients received more frequent electrolyte supplementation (p < .05). Standard therapy patients were twice as likely as therapeutic hypothermia patients to have a fever (>38 °C after arrest (37% vs. 18%; p = .02) and trended toward a higher rate of re-arrest (26% vs. 13%; p = .09). Rates of red blood cell transfusions, infection, and arrhythmias were similar between groups. There was no difference in hospital mortality (55.0% therapeutic hypothermia vs. 55.3% standard therapy; p = 1.0), and 78% of the therapeutic hypothermia survivors were discharged home (vs. 68% of the standard therapy survivors; p = .46). In multivariate analysis, mortality was independently associated with initial hypoglycemia or hyperglycemia, number of doses of epinephrine during resuscitation, asphyxial etiology, and longer duration of cardiopulmonary
resuscitation, but not treatment group (odds ratio for mortality in the therapeutic hypothermia group, 0.47; p = .2). Conclusions: This is the largest study reported on the use of therapeutic mild hypothermia in pediatric cardiac arrest to date. We found that therapeutic hypothermia was feasible, with target temperature achieved in <3 hrs overall. Temperature below target range was associated with increased mortality. Prospective study is urgently needed to determine the efficacy of therapeutic hypothermia in pediatric patients after cardiac arrest.

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Background-- Outcomes of patients presenting with acute coronary syndromes are improved with an early invasive approach; however, approximately one third of these patients are treated medically after angiographic screening. We sought to assess the predictors of adverse cardiac events in patients with acute coronary syndrome assigned to medical management. Methods and Results-- This sub-study of the Acute Catheterization and Urgent Intervention Triage Strategy (ACUITY) trial included 4491 acute coronary syndrome patients treated medically after angiographic triage. Rates of bleeding and composite ischemia (death, myocardial infarction, revascularization) were compared among the 3 antithrombotic treatment arms. Composite ischemia occurred in 399 patients (9.5%) at 1 year. Treatment with bivalirudin glycoprotein IIb/IIIa inhibitors significantly reduced major bleeding at 30 days (2.5% bivalirudin monotherapy; P=0.005, 2.0% bivalirudin plus glycoprotein IIb/IIIa inhibitors; P=0.0002 versus 4.4% heparin with glycoprotein IIb/IIIa inhibitors). Composite ischemic events at 1 year were not significantly different in the 3 groups (bivalirudin monotherapy, 9.6%; bivalirudin plus glycoprotein IIb/IIIa inhibitors, 9.7%; heparin plus glycoprotein IIb/IIIa inhibitors, 9.1%). Independent predictors of composite ischemia were mostly angiographic factors at 30 days, including jeopardy score and coronary ectasia, and at 1 year, including previous percutaneous coronary intervention, jeopardy score, coronary ectasia, and increasing number of diseased vessels. Conclusions-- Among the ACUITY acute coronary syndrome patients treated medically after angiographic triage, bivalirudin therapy significantly reduced bleeding complications compared with heparin without any negative impact on ischemic outcomes at 1 year. The most powerful predictors of ischemic outcomes were angiographic rather than traditional clinical parameters, supporting the early use of angiographic screening in the moderate- and high-risk but medically treated acute coronary syndrome population. Clinical Trial Registration-- URL: http://www.clinicaltrials.gov. Unique identifier: NCT00093158.

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To evaluate key pre-arrest factors and their collective ability to predict post-cardiopulmonary arrest mortality. CPR is often initiated indiscriminately after in-hospital cardiopulmonary arrest. Improved understanding of pre-arrest factors associated with mortality may inform advance care planning. A cohort of 49,130 adults who experienced pulseless cardiopulmonary arrest from January 2000 to
September 2004 was obtained from 366 US hospitals participating in the National Registry for Cardiopulmonary Resuscitation (NRCPR). Logistic regression with bootstrapping was used to model in-hospital mortality, which included those discharged in unfavorable and severely worsened neurologic state (Cerebral Performance Category %3). Overall in-hospital mortality was 84.1%. Advanced age, black race, non-cardiac, non-surgical illness category, pre-existing malignancy, acute stroke, trauma, septicemia, hepatic insufficiency, general floor or Emergency Department location, and pre-arrest use of vasopressors or assisted/mechanical ventilation were independently predictive of in-hospital mortality. Retained peri-arrest factors including cardiac monitoring, and shockable initial pulseless rhythms, were strongly associated with survival. The validation model's AUROC curve (0.77) revealed fair performance. Predictive pre-resuscitation factors may supplement patient-specific information available at bedside to assist in revising resuscitation plans during the patient's hospitalization.


BACKGROUND: The multifunctional image-guided therapy suite (MIGTS), a combined diagnostic and operating theatre, is currently the subject of considerable interest. This study investigated the effect of instituting a MIGTS on the emergency treatment of multiply injured patients. METHODS: This prospective controlled intervention study (MIGTS versus conventional treatment) included consecutive multiply injured trauma patients (Injury Severity Score of 16 or more) admitted between February 2003 and April 2005 to a university hospital. Main outcome measures were time to computed tomography (CT) and number of in-hospital transfers. RESULTS: A total of 168 patients were enrolled, 87 in the MIGTS and 81 in the control group. On average, CT was started at least 13 min sooner in the MIGTS group (P < 0.001), and these patients underwent fewer within-hospital transfers before arrival in the intensive care unit (median 2 versus 4 for controls; odds ratio -2.92, P < 0.001). Team members indicated increased satisfaction with the quality of the MIGTS procedure over the course of the study (P = 0.009). Thirty-day mortality rate (17 per cent for MIGTS versus 22 per cent for controls; P = 0.420) and long-term outcome did not differ between the two groups. CONCLUSION: Implementation of a MIGTS in the emergency treatment of multiple trauma significantly accelerated the procedure and reduced the number of in-hospital transports. Registration number: NCT0072213 (http://www.clinicaltrials.gov


Return of spontaneous circulation (ROSC) is improved by greater vital organ blood flow during cardiopulmonary resuscitation (CPR). We tested the hypothesis that myocardial flow above the threshold needed for ROSC may be associated with greater vital organ injury and worse outcome. Aortic and right atrial pressures were measured with micromanometers in 27 swine. After 10 minutes of untreated ventricular fibrillation, chest compression was performed with an automatic, load-distributing band. Animals were randomly assigned to
receive flows just sufficient for ROSC (low flow: target coronary perfusion pressure = 12 mm Hg) or well above the minimally effective level (high flow: coronary perfusion pressure = 30 mm Hg). Myocardial flow was measured with microspheres, defibrillation was performed after 3.5 minutes of CPR, and ejection fraction was measured with echocardiography. Return of spontaneous circulation was achieved by 9 of 9 animals in the high-flow group and 15 of 18 in the low-flow group. All animals in the high-flow group defibrillated initially into a perfusing rhythm, whereas 12 of 15 animals achieving ROSC in the low-flow group defibrillated initially into pulseless electrical activity (P < .05, Fisher exact test). Compared with animals in the low-flow group, animals in the high-flow group had shorter resuscitation times, higher mean aortic pressures at ROSC, and higher ejection fractions at 2 hours post-ROSC (all P < .05). High-flow CPR significantly improved arrest hemodynamics, rates of ROSC, and post-ROSC indicators of myocardial status, all indicating less injury with higher flows. No evidence of organ injury from vital organ blood flow substantially above the threshold for ROSC was found.


The chosen age cutoff for considering patients with trauma to be ‘elderly’ has ranged from 55 to 80 years in trauma guidelines and studies. The goal of this study was to identify at what age mortality truly increases for older victims of trauma. We performed a cross-sectional study of the Ohio Trauma Registry, a statewide database of all injured patients who died or were admitted for more than 48 hours to both trauma and non-trauma centers. Patients 16 years or older entered into the registry between January 1, 2003, and December 31, 2006, were included. Inhospital mortality rates were obtained and stratified by 5-year age intervals and by injury severity score (ISS). Rates between age groups were compared using logistic regression to identify significant differences in mortality. Included were 75 658 patients. In logistic regression, patients 70 to 74 years of age had significantly greater mortality than all younger age groups when stratified by ISS (P .001-.004). When considering other 5-year age groups as referent (40-44, 45-49, 50-54, 55-59, 60-64, 65-69 years old), no other group was associated with significantly increased mortality, as compared to younger groups (P > .05 for all). Patients 70 to 74 years of age have significantly greater mortality than all younger age groups when stratified by ISS. Age cutoffs based on younger ages are not associated with significant increases in mortality. An age of 70 years should be considered as an appropriate cutoff for considering a patient to be elderly in future studies of trauma and development of geriatric trauma triage criteria.


The purpose of this study was to investigate whether the takeover by Advanced Life Support [ALS] trained ambulance paramedics from rescuers using an automated external defibrillator [AED] delays shocks and if this delay is associated with decreased survival after out-of-hospital cardiac arrest [OHCA]. We analyzed continuous ECG recordings of LIFEPAK AEDs and associated manual defibrillator recordings of OHCA of presumed cardiac cause, prospectively collected from July 2005 to July 2009. The primary outcome measure was survival to
discharge. Among 693 patients treated with AEDs, 110 had a shockable initial rhythm and a shockable rhythm during ALS takeover. We measured the time interval between the expected shock if the AED would remain attached to the patient and the first observed shock given by the manual defibrillator [shock timing]. Survival was 62% (13/21) if the shock was given early (<20s), 52% (11/21; odds ratio [OR]=0.68, ns) if given on time (20 to 20s), 29% (10/34; OR=0.26, 95% confidence interval [CI]=0.08 - 0.81; P=0.02) if the shock was 20 -150s delayed and 21% (7/34; OR=0.16, 95% CI=0.05 - 0.54; P=0.003) if the shock was delayed >150s. The OR for trend was 0.41, 95% CI=0.25 - 0.71; P=0.001. The association between shock timing and survival was significant for patients with more than 150s shock delay (OR=0.19; 95% CI=0.04 - 0.71; P=0.02) or for trend in shock timing (0.42, 95% CI=0.20 - 0.84; P=0.02) after multivariable adjustment for prognostic factors age and slope of ventricular fibrillation. ALS takeover delays the next shock delivery in almost two-third of cases. This delay is associated with decreased survival.

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Recommendations for optimal first-shock energies with biphasic waveforms are conflicting. We evaluated prospectively the relation between type and duration of atrial tachyarrhythmias and the probability of successful cardioversion with a specific biphasic shock waveform to develop recommendations for the initial energy setting aiming at the lowest total cumulative energy with 2 or less consecutive shocks. We analyzed 453 consecutive patients undergoing their first transthoracic electrical cardioversion, including 358 attempts for atrial fibrillation (AF) and 95 attempts for atrial flutter (AFL) or atrial tachycardia (AT). A step-up protocol with a truncated exponential biphasic waveform starting at 50 J was used. Total cumulative energies were estimated under the assumption of a 2-tiered escalating shock protocol with different initial energy settings and a ‘rescue shock’ of 250 J for AFL/AT or 360 J for AF. The initial energy setting leading to the lowest total cumulative energy was regarded as the optimal first-shock level. Cardioversion was successful in 448 patients (cumulative efficacy, 99 %). In patients with AFL/AT, the lowest total cumulative energy was attained with an initial energy setting of 50 J. In patients with AF, lowest values were achieved with an initial energy of 100 J for arrhythmia durations of 2 days or less and an initial energy of 150 J for arrhythmia durations of more than 2 days. We recommend an initial energy setting of 50 J in patients with AFL/AT, of 100 J in patients with AF 2 days or less, and of 150 J with AF more than 2 days.

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Background: Out-of-hospital cardiac arrest (OHCA) has a low probability of survival to hospital discharge. Four clinical decision rules (CDRs) have been validated to identify patients with no probability of survival. Three of these rules focus on exclusive prehospital basic life support care for OHCA, and two of these rules focus on prehospital advanced life support care for OHCA. Clinical Question: Can a CDR for the termination of resuscitation identify a patient with no probability of survival in the setting of OHCA? Evidence Review: Six
validation studies were selected from a PubMed search. A structured review of each of the studies is presented. Results: In OHCA receiving basic life support care, the BLS-TOR (basic life support termination of resuscitation) rule has a positive predictive value for death of 99.5% (95% confidence interval 98.9 - 99.8%), and decreases the transportation of all patients by 62.6%. This rule has been appropriately validated for widespread use. In OHCA receiving advanced life support care, no current rule has been appropriately validated for widespread use. Conclusions: The BLS-TOR rule is a simple rule that identifies patients who will not survive OHCA. Further research is required to identify similarly robust CDRs for patients receiving advanced life support care in the setting of OHCA.

17/
Context: Goal-directed resuscitation for severe sepsis and septic shock has been reported to reduce mortality when applied in the emergency department. Objective: To test the hypothesis of non-inferiority between lactate clearance and central venous oxygen saturation (ScvO2) as goals of early sepsis resuscitation. Design, Setting, and Patients Multicenter randomized, non-inferiority trial involving patients with severe sepsis and evidence of hypoperfusion or septic shock who were admitted to the emergency department from January 2007 to January 2009 at 1 of 3 participating US urban hospitals. Interventions: We randomly assigned patients to 1 of 2 resuscitation protocols. The ScvO2 group was resuscitated to normalize central venous pressure, mean arterial pressure, and ScvO2 of at least 70%; and the lactate clearance group was resuscitated to normalize central venous pressure, mean arterial pressure, and lactate clearance of at least 10%. The study protocol was continued until all goals were achieved or for up to 6 hours. Clinicians who subsequently assumed the care of the patients were blinded to the treatment assignment. Main Outcome Measure The primary outcome was absolute in-hospital mortality rate; the non-inferiority threshold was set at \( \Delta \) equal to -10%. Results: Of the 300 patients enrolled, 150 were assigned to each group and patients were well matched by demographic, comorbidities, and physiological features. There were no differences in treatments administered during the initial 72 hours of hospitalization. Thirty-four patients (23%) in the ScvO2 group died while in the hospital (95% confidence interval [CI], 17%-30%) compared with 25 (17%; 95% CI, 11%-24%) in the lactate clearance group. This observed difference between mortality rates did not reach the predefined -10% threshold (intent-to-treat analysis: 95% CI for the 6% difference, -3% to 15%). There were no differences in treatment-related adverse events between the groups. Conclusion: Among patients with septic shock who were treated to normalize central venous and mean arterial pressure, additional management to normalize lactate clearance compared with management to normalize ScvO2 did not result in significantly different in-hospital mortality. Trial Registration clinicaltrials.gov Identifier: NCT00372502

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Study objective: We determine whether the use of capnography is associated with a decreased incidence of hypoxic events than standard monitoring alone during emergency department (ED) sedation with propofol. Methods: Adults underwent ED propofol sedation with standard monitoring (pulse oximetry, cardiac and blood pressure) and capnography and were randomized into a group in which treating physicians had access to the capnography and a blinded group in which they did not. All patients received supplemental oxygen (3 L/minute) and opioids greater than 30 minutes before. Propofol was dosed at 1.0 mg/kg, followed by 0.5 mg/kg as needed. Capnographic and SpO2 data were recorded electronically every 5 seconds. Hypoxia was defined as SpO2 less than 93%; respiratory depression, as end tidal CO2 (ETCO2) greater than 50 mm Hg, ETCO2 change from baseline of 10%, or loss of the waveform. Results: One hundred thirty-two subjects were evaluated and included in the final analysis. We observed hypoxia in 17 of 68 (25%) subjects with capnography and 27 of 64 (42%) with blinded capnography (P=.035; difference 17%; 95% confidence interval 1.3% to 33%). Capnography identified all cases of hypoxia before onset (sensitivity 100%; specificity 64%), with the median time from capnographic evidence of respiratory depression to hypoxia 60 seconds (range 5 to 240 seconds). Conclusion: In adults receiving ED propofol sedation, the addition of capnography to standard monitoring reduced hypoxia and provided advance warning for all hypoxic events.


This study aims to know if the level of S100B protein at the initiation of cardiopulmonary resuscitation (CPR) and immediately after return of spontaneous circulation (ROSC) can predict clinical outcome. A prospective observational study from December 2004 to October 2006 was conducted in an urban tertiary hospital emergency department. Clinical demographics for out-of-hospital cardiac arrest patients were collected based on the Utstein style. Outcomes collected included ROSC for 20min, survival to admission, survival and Glasgow Outcome Scale (GOS) at 1 month. S100B protein was measured twice before starting CPR (first S100B) and immediately after ROSC (second S100B). We investigated the association between S100B protein levels and clinical outcomes using a multivariate logistic regression model. A total of 151 patients were included (age: 60.2±16.8 years, male: 64.2%). Of these, 60 (39.7%) had ROSC and 46 (30.5%) survived to admission. After 1 month, 12 (8.0%) survived and only three patients showed good GOS (>4 points). The S100B levels were not different for ROSC, survival to admission and 1-month survival between survivors and non-survivors (p>0.05, first and second S100 B level). For the witnessed out-of-hospital cardiac arrest (OHCA) group (N=87), only the first S100B (1.22±0.85μg/l vs. 3.91±4.25μg/l, p<0.001) showed significant difference for 1-month survival between survivors and non-survivors. The first S100B showed significant association with survival to emergency department (ED) but not 1-month survival (adjusted odds ratio (OR)=0.905, 95% confidence interval=0.821 - 0.998). Higher levels of S100B at start of CPR were significantly associated with lower survival to admission, and not for 1-month survival.

AIM OF THE STUDY: Hypothermia treatment with cold intravenous infusion and ice packs after cardiac arrest has been described and used in clinical practice. We hypothesised that with this method a target temperature of 32-34 degrees C could be achieved and maintained during treatment and that rewarming could be controlled. MATERIALS AND METHODS: Thirty-eight patients treated with hypothermia after cardiac arrest were included in this prospective observational study. The patients were cooled with 4 degrees C intravenous saline infusion combined with ice packs applied in the groins, axillae, and along the neck. Hypothermia treatment was maintained for 26 h after cardiac arrest. It was estimated that passive rewarming would occur over a period of 8h. Body temperature was monitored continuously and recorded every 15 min up to 44 h after cardiac arrest. RESULTS: All patients reached the target temperature interval of 32-34 degrees C within 279+/−185 min from cardiac arrest and 216+/−177 min from induction of cooling. In nine patients the temperature dropped to below 32 degrees C during a period of 15 min up to 2.5h, with the lowest (nadir) temperature of 31.3 degrees C in one of the patients. The target temperature was maintained by periodically applying ice packs on the patients. Passive rewarming started 26 h after cardiac arrest and continued for 8+/−3h. Rebound hyperthermia (>38 degrees C) occurred in eight patients 44 h after cardiac arrest. CONCLUSIONS: Intravenous cold saline infusion combined with ice packs is effective in inducing and maintaining therapeutic hypothermia, with good temperature control even during rewarming.


Repeated failed shocks for ventricular fibrillation (VF) in out-of-hospital cardiac arrest (OOHCA) can worsen the outcome. It is very important to rapidly distinguish between early and late VF. We hypothesised that VF waveform analysis based on detrended fluctuation analysis (DFA) can help predict successful defibrillation. Electrocardiogram (ECG) recordings of VF signals from automated external defibrillators (AEDs) were obtained for subjects with OOHCA in Taipei city. To examine the time effect on DFA, we also analysed VF signals in subjects who experienced sudden cardiac death during Holter study from PhysioNet, a publicly accessible database. Waveform parameters including root-mean-squared (RMS) amplitude, mean amplitude, amplitude spectrum analysis (AMSA), frequency analysis as well as fractal measurements including scaling exponent (SE) and DFA were calculated. A defibrillation was regarded as successful when VF was converted to an organised rhythm within 5s after each defibrillation. A total of 155 OOHCA subjects (37 successful and 118 unsuccessful defibrillations) with VF were included for analysis. Among the VF waveform parameters, only AMSA (7.61+/−3.30 vs. 6.30+/−3.13, P=0.028) and DFA+/−2 (0.38+/−0.24 vs. 0.49+/−0.24, P=0.013) showed significant difference between subjects with successful and unsuccessful defibrillation. The area under the curves (AUCs) for AMSA and DFA+/−2 was 0.63 (95% confidence interval (CI)=0.52 - 0.73) and 0.65 (95% CI=0.54 - 0.75), respectively. Among the waveform parameters, only DFA+/−2, SE and dominant frequency showed significant time effect. The VF waveform analysis based on DFA could help predict first-shock defibrillation success in patients with
OOHCA. The clinical utility of the approach deserves further investigation.


Background: Some neonatologists state that at the delivery of extremely premature infants they rely on "how the baby looks" when deciding whether to initiate resuscitation. Previous studies have reported poor correlation between early clinical signs and prognosis. Objective: To determine if neonatologists can accurately predict survival to discharge of extremely premature infants on the basis of observations in the first minutes after birth. Methods: We showed videos of the resuscitation of 10 extremely premature infants (<26 weeks' gestation) to attending neonatologists and fellows from the 3 major perinatal centers in Melbourne, Australia. Antenatal information was available to the observers. A monitor visible in each video displayed the heart rate and oxygen saturation of the infant. Observers were asked to estimate the likelihood of survival to discharge for each infant at 3 time points: 20 seconds, 2 minutes, and 5 minutes after birth. The predictive ability of observers was expressed as the area (95% confidence interval [CI]) under the receiver-operating-characteristic curve. Results: Seventeen attending neonatologists and 17 neonatal fellows completed the study. Receiver-operating-characteristic curves were generated for the combined and individual groups. Observers' ability to predict survival was poor (combined results): 0.61 (95% CI: 0.54-0.67) at 20 seconds, 0.59 (95% CI: 0.52-0.64) at 2 minutes, and 0.61 (95% CI: 0.55-0.67) at 5 minutes. Level of experience did not affect the observers' accuracy of predicting survival. Conclusion: Neonatologists' reliance on initial appearance and early response to resuscitation in predicting survival for extremely premature infants is misplaced.


Epinephrine is indicated for various medical emergencies, including cardiac arrest and anaphylaxis, but the dose and route of administration are different for each indication. For anaphylaxis, it is given intramuscularly at a low dose, whereas for cardiac arrest a higher dose is required intravenously. We encountered a patient with suspected anaphylaxis who developed transient systolic dysfunction because of inappropriately received cardiac arrest dose, ie, larger dose given as an intravenous push. Three additional patients who experienced potentially lethal cardiac complications after receiving inappropriately higher doses intravenously were also identified. These iatrogenic errors resulted from underlying confusion by physicians about proper dosing of epinephrine for anaphylaxis. The risk of error was amplified by the need for rapid decision making in critically ill anaphylactic patients. An e-mail survey of local hospitals in southeast Michigan revealed that 6 of 7 hospitals did not stock prefilled intramuscular dose syringes for emergency use in anaphylaxis. At our institution, we have introduced prefilled and appropriately labeled intramuscularly dosed epinephrine syringes in crash carts, which are easily distinguished from intravenously dosed epinephrine syringes. In this Concepts article, we describe the clinical problem of inadvertent epinephrine overdose and propose a potential solution. Epinephrine must be clearly packaged and
labeled to avoid inappropriate usage and unnecessary, potentially lethal complications in patients with anaphylaxis.

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Our primary aim is to measure no-flow time and no-flow ratio before and after an emergency department (ED) switched from manual to a load-distributing band mechanical cardiopulmonary resuscitation (CPR) device. This was a phased, before-after cohort evaluation at an urban tertiary hospital ED. We collected continuous video and chest compression data with the Physiocontrol Code Stat Suite 7.0 for resuscitations during the period just before and after adoption of load-distributing band CPR. All out-of-hospital, non-traumatic cardiac arrest, adult patients were eligible. From February 2007 to July 2008, there were 26 manual and 41 load-distributing band cases. Patients in both phases were comparable in terms of demographics, medical history, witnessed arrest, arrest location, bystander CPR rates, out-of-hospital defibrillation, initial rhythm, and ED defibrillation. The median no-flow time, defined as the sum of all pauses between compressions longer than 1.5 seconds, during the first 5 minutes of resuscitation, was manual CPR 85 seconds (interquartile range [IQR] 45 to 112 seconds) versus load-distributing band 104 seconds (IQR 69 to 151 seconds). The mean no-flow ratio, defined as no-flow time divided by segment length, was manual 0.28 versus load-distributing band 0.40 (difference +/− 0.12; 95% confidence interval 0.22 to 0.02). However, from 5 to 10 minutes into the resuscitation, median no-flow time was manual 85 seconds (IQR 59 to 151 seconds) versus load-distributing band 52 seconds (IQR 34 to 82 seconds) and mean no-flow ratio manual 0.34 versus load-distributing band 0.21 (difference=0.13; 95% confidence interval 0.02 to 0.24). The average time to apply load-distributing band CPR during this period was 152 seconds. Application of a load-distributing band in the ED is associated with a higher no-flow ratio than manual CPR in the first 5 minutes of resuscitation. We suggest that attention to team training, rapid application of the device to minimize interruption, and feedback from defibrillator and video recordings may be useful to improve resuscitation team performance.

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Acute pulmonary embolism can produce abnormalities on ECG that reflect severity of pulmonary hypertension. Early recognition of these findings may alter the estimated pretest probability of pulmonary embolism and prompt more aggressive treatment before hemodynamic instability ensues, but it is first important to test whether these findings are specific to patients with pulmonary embolism. We hypothesize that ECG findings consistent with pulmonary hypertension would be observed more frequently in patients with pulmonary embolism. Secondary analysis of a prospective, observational cohort of emergency department patients who were tested for pulmonary embolism. ECGs were ordered at clinician's discretion and interpreted at presentation. Six thousand forty-nine patients had an ECG, 354 (5.9%) of whom were diagnosed with pulmonary embolism. The frequency, positive likelihood ratio (LR+) and 95% confidence interval (CI) of each predictor were as follows: S1Q3T3 8.5% with pulmonary embolism versus 3.3% without pulmonary
embolism (LR+ 3.7; 95% CI 2.5 to 5.4); nonsinus rhythm, 23.5% versus 16.6% (LR+ 1.4; 95% CI 1.2 to 1.7); inverted T waves in V1 to V2, 14.4% versus 8.1% (LR+ 1.8; 95% CI 1.3 to 2.3); inversion in V1 to V3, 10.5% versus 4.0% (LR+ 2.6; 95% CI 1.9 to 3.6); inversion in V1 to V4, 7.3% versus 2.0% (LR+ 3.7; 95% CI 2.4 to 5.5); incomplete right bundle branch block, 4.8% versus 2.8% (LR+ 1.7; 95% CI 1.0 to 2.7); tachycardia (pulse rate >100 beats/min), 28.8% versus 15.7% (LR+ 1.8; 95% CI 1.5 to 2.2). Likelihood ratios and specificities were similar when patients with previous cardiopulmonary disease were excluded from analysis. Findings of acute pulmonary hypertension were infrequent overall but were observed more frequently in patients with the final diagnosis of pulmonary embolism compared with patients who do not have pulmonary embolism.


Critical incident reports can identify areas for improvement in resuscitation practice. The Danish Patient Safety Database is a mandatory reporting system and receives critical incident reports submitted by hospital personnel. The aim of this study is to identify, analyse and categorize critical incidents related to cardiac arrests reported to the Danish Patient Safety Database. The search terms ‘cardiac arrest’ and ‘resuscitation’ were used to identify reports in the Danish Patient Safety Database. Identified critical incidents were then classified into categories. One hundred and seven reports describing 122 separate incidents were identified and classified into incidents related to: alerting the resuscitation team (n=32; 26%), human performance (n=22; 18%), equipment failure (n=19; 16%), resuscitation equipment not available (n=13; 11%), physical environment (n=14; 11%), insufficient monitoring (n=14; 11%), and medication error (n=8; 7%). Critical incidents related to cardiac arrest occur due to logistical, technical, team-working and knowledge problems. These findings should be considered when planning education and implementing resuscitation practice.


Patient history and physical examination are widely accepted as cornerstones of diagnosis in modern medicine. We aimed to assess the value of individual historical and examination findings for diagnosing acute myocardial infarction (AMI) and predicting adverse cardiac events in undifferentiated Emergency Department (ED) patients with chest pain. We prospectively recruited patients presenting to the ED with suspected cardiac chest pain. Clinical features were recorded using a custom-designed report form. All patients were followed up for the diagnosis of AMI and the occurrence of adverse events (death, AMI or urgent revascularization) within 6 months. AMI was diagnosed in 148 (18.6%) of the 796 patients recruited. Following adjustment for age, sex and ECG changes, the following characteristics made AMI more likely (adjusted odds ratio, 95% confidence intervals): pain radiating to the right arm (2.23, 1.24 - 4.00), both arms (2.69, 1.36 - 5.36), vomiting (3.50, 1.81 - 6.77), central chest pain (3.29, 1.94 - 5.61) and sweating observed (5.18, 3.02 - 8.86). Pain in the left anterior chest made AMI significantly less likely (0.25, 0.14 - 0.46). The presence of rest pain (0.67, 0.41 - 1.10) or pain radiating to the
left arm (1.36, 0.89 - 2.09) did not significantly alter the probability of AMI. Our results challenge many widely held assertions about the value of individual symptoms and signs in ED patients with suspected acute coronary syndromes. Several ‘atypical’ symptoms actually render AMI more likely, whereas many ‘typical’ symptoms that are often considered to identify high-risk populations have no diagnostic value.

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Endotracheal intubation (ETI) is considered to be the gold standard of prehospital airway management. However, ETI requires substantial technical skills and ongoing experience. Because failed prehospital ETI is common and associated with a higher mortality, reliable airway devices are needed to be used by rescuers less experienced in ETI. We prospectively evaluated the feasibility of laryngeal tubes used by paramedics and emergency physicians for out-of-hospital airway management. During a 24-month period, all cases of prehospital use of the laryngeal tube disposable (LT-D) and laryngeal tube suction disposable (LTS-D) within five operational areas of emergency medical services were recorded by a standardised questionnaire. We determined indications for laryngeal tube use, placement success, number of placement attempts, placement time and personal level of experience. Of 157 prehospital intubation attempts with the LT-D/LTS-D, 152 (96.8%) were successfully performed by paramedics (n=70) or emergency physicians (n=87). The device was used as initial airway (n=87) or rescue device after failed ETI (n=70). The placement time was ≥45s (n=120), 46 - 90s (n=20) and >90s (n=7). In five cases the time needed was not specified. The number of placement attempts was one (n=123), two (n=25), three (n=2) and more than three (n=2). The majority of users (61.1%) were relative novices with no more than five previous laryngeal tube placements. The LT-D/LTS-D represents a reliable tool for prehospital airway management in the hands of both paramedics and emergency physicians. It can be used as an initial tool to secure the airway until ETI is prepared, as a definitive airway by rescuers less experienced with ETI or as a rescue device when ETI has failed.

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Background-- In 2000, the definition of myocardial infarction (MI) changed to rely on troponin rather than creatine kinase (CK) and its MB fraction (CK-MB). The implications of this change on trends in MI incidence and outcome are not defined. Methods and Results-- This was a community study of 2816 patients hospitalized with incident MI from 1987 to 2006 in Olmsted County, Minnesota, with prospective measurements of troponin and CK-MB from August 2000 forward. Outcomes were MI incidence, severity, and survival. After troponin was introduced, 278 (25%) of 1127 incident MIs met only troponin-based criteria. When cases meeting only troponin criteria were included, incidence did not change between 1987 and 2006. When restricted to cases defined by CK/CK-MB, the incidence of MI declined by 20%. The incidence of non-ST-segment elevation MI increased markedly by relying on troponin, whereas that of ST-segment
elevation MI declined regardless of troponin. The age- and sex-adjusted hazard ratio of death within 30 days for an infarction occurring in 2006 (compared with 1987) was 0.44 (95% confidence interval, 0.30 to 0.64). Among 30-day survivors, survival did not improve, but causes of death shifted from cardiovascular to non-cardiovascular (P=0.001). Trends in long-term survival among 30-day survivors were similar regardless of troponin. Conclusions-- Over the last 2 decades, a substantial change in the epidemiology of MI occurred that was only partially mediated by the introduction of troponin. Non-ST-segment elevation MIs now constitute the majority of MIs. Although the 30-day case fatality improved markedly, long-term survival did not change, and the cause of death shifted from cardiovascular to non-cardiovascular.

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Objectives: Prehospital triage of trauma patients is of paramount importance because adequate trauma center referral improves survival. We developed a simple score that is easy to calculate in the prehospital phase. Design: Multicenter prospective observational study. Setting: Prehospital physician-staffed emergency system in university and non university hospitals. Interventions: We evaluated 1360 trauma patients receiving care from a prehospital mobile intensive care unit in 22 centers in France during 2002. The association of prehospital variables with in-hospital death was tested using logistic regression, and a simple score (the Mechanism, Glasgow coma scale, Age, and Arterial Pressure [MGAP] score) was created and compared with the triage Revised Trauma Score, Revised Trauma Score, and Trauma Related Injury Severity Score. The model was validated in 1003 patients from 2003 through 2005. Measurements and Main Results: Four independent variables were identified, and each was assigned a number of points proportional to its regression coefficient to provide the MGAP score: Glasgow Coma Scale (from 3-15 points), blunt trauma (4 points), systolic arterial blood pressure (>120 mm Hg: 5 points, 60 to 120 mm Hg: 3 points), and age <60 yrs (5 points). The area under the receiver operating characteristic curve of MGAP was not significantly different from that of the triage Revised Trauma Score or Revised Trauma Score, but when sensitivity was fixed >0.95 (under triage of 0.05), the MGAP score was more specific and accurate than triage Revised Trauma Score and Revised Trauma Score, approaching those of Trauma Related Injury Severity Score. We defined three risk groups: low (23-29 points), intermediate (18-22 points), and high risk (<18 points). In the derivation cohort, the mortality was 2.8%, 15%, and 48%, respectively. Comparable characteristics of the MGAP score were observed in the validation cohort. Conclusion: The MGAP score can accurately predict in-hospital death in trauma patients.

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Background-- Despite the existence of national American Heart Association guidelines and 2 termination-of-resuscitation (TOR) rules for ceasing efforts in refractory out-of-hospital cardiac arrest, many emergency medical services agencies in the United States have adopted their own local protocols. Public policies and local perceptions may serve as barriers or facilitators to implementing national TOR.
guidelines at the local level. Methods and Results-- Three focus groups, lasting 90 to 120 minutes, were conducted at the National Association of Emergency Medical Services Physicians meeting in January 2008. Snowball sampling was used to recruit participants. Two reviewers analyzed the data in an iterative process to identify recurrent and unifying themes. We identified 3 distinct groups whose current policies or perceptions may impede efforts to adopt national TOR guidelines: payers who incentivize transport; legislators who create state mandates for transport and allow only narrow use of do-not-resuscitate orders; and communities where cultural norms are perceived to impede termination of resuscitation. Our participants suggested that national organizations, such as the American Heart Association and American College of Emergency Physicians, may serve as potential facilitators in addressing these barriers by taking the lead in asking payers to change reimbursement structures; encouraging legislators to revise laws to reflect the best available medical evidence; and educating the public that rapid transport to the hospital cannot substitute for optimal provision of prehospital care. Conclusion-- We have identified 3 influential groups who will need to work with national organizations to overcome current policies or prevailing perceptions that may impede implementing national TOR guidelines.


The increased use of organophosphorus (OP) pesticides and the ever increasing possibility of terror groups using nerve agents underscore a need to develop effective and safe antidotes against OP poisoning. The objectives of the present study were to develop a novel atropine sulfate (AS) sublingual injection formulation, to create its bioavailability data in humans and to evaluate its suitability for field use with a view to obtain early therapeutic drug concentration in comparison to the conventional intramuscular route that provides a therapeutic peak of 6 to 8 ng/mL in blood at 30 minutes. Two milligrams per 0.1 mL of AS was sublingually injected in 6 volunteers and bioavailability and atropinization signs (blood pressure, pupil diameter, and heart rate) were noted. Human bioavailability curve was created, which was equivalent to 2 mg IM injection in amplitude within 10 minutes and describing a better curve thereafter. Peak plasma concentration of AS occurred at 15 minutes and was 21 ng/mL. Increase in heart rate became extremely significant at 5 minutes (P < .0001) with maximum increase of 62% +/- 6% at 10 minutes after administration. Pupil diameter showed maximal increase of 58% +/- 21% at 15 minutes (P < .01). Sublingual AS appears to have several advantages over conventional IM route including better bioavailability, rapid onset of action, and early atropinization. It is a safe and efficacious procedure with the potential to become an alternative to conventional IM injection, particularly in case of chemical terrorism scenario where hundreds of victims may require immediate atropinization simultaneously.
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Objective: We hypothesized that childhood obesity would be associated with decreased likelihood of survival to hospital discharge after in-hospital, pediatric cardiopulmonary resuscitation (CPR). Methods: We reviewed 1477 consecutive, pediatric, CPR index events (defined as the first CPR event during a hospitalization in that facility for a patient <18 years of age) reported to the American Heart Association National Registry of Cardiopulmonary Resuscitation between January 2000 and July 2004. The primary outcome was survival to hospital discharge. A total of 1268 index subjects (86%) with complete registry data were included for analysis. Children were classified as obese ($\geq$95th weight-for-length percentile if <2 years of age or $\geq$95th BMI-for-age percentile if $\geq$2 years of age) or underweight ($<$5th weight-for-length percentile if <2 years of age or $<$5th BMI-for-age percentile if $\geq$2 years of age), with adjustment for gender. Results: Obesity was noted for 213 (17%) of 1268 subjects and underweight for 571 (45%) of 1268 subjects. Obesity was more likely to be associated with male gender, non-cardiac medical illness, and cancer and inversely associated with heart failure. Underweight was more likely to be associated with male gender, cardiac surgery, and prematurity and inversely associated with age and cancer. Self-reported, process-of-care, CPR quality was generally worse for obese children. With adjustment for important potential confounding factors, obesity was independently associated with worse odds of event survival (adjusted odds ratio: 0.58 [95% confidence interval: 0.35-0.76]) and survival to hospital discharge (adjusted odds ratio: 0.62 [95% confidence interval: 0.38-0.93]) after in-hospital, pediatric CPR. Underweight was not associated with worse outcomes. Conclusions: Childhood obesity is associated with a lower rate of survival to hospital discharge after in-hospital, pediatric CPR.

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Left circumflex (LC) - related acute myocardial infarction (AMI) presenting without ST-T changes has been under diagnosed in the emergency department. There is little information on its clinical features and significance. The aims of the study were to investigate the clinical characteristics and outcomes of LC-related AMI without ST-T changes. Ninety-six patients were admitted for LC-related AMI. Comparisons between those with and without ST-T changes were analyzed. Twenty-two patients (23%) did not have ST-T changes, whereas 74 patients (77%) had them. Patients without ST-T changes had younger age (55.6 +/- 16.8 vs 62.6 +/- 12.0 years, P = .03), fewer presented as Killip III/IV (4.5% vs 27.4%, P = .02) and with lower creatine kinase (1647.3 +/- 1602.2 vs 2778.2 +/- 2343.3 IU/L, P = .037) and creatine kinase-MB (136.8 +/- 130.3 vs 247.7 +/- 200.0 IU/L, P = .017), and more were with concurrent culprit lesion in the middle or distal LC and right- or balanced-dominant coronary circulation (86.4% vs 44.6%, P < .001). During follow-up, the need for repeat percutaneous coronary intervention (48.6% vs 45.5%, P = .40) and recurrent infarction (13.5% vs 13.6%, P = .62) were similar between the 2 groups. The 30-day mortality (0% vs 5.4%, P = .35) and overall mortality rate (4.5% vs 12.2%, P = .28) between them were not different statistically. The relatively lower prevalence of LC-related AMI without ST-T changes in the study might be underestimated.
These patients have smaller infarct size than patients with ST-T changes without differences in the short- and long-term outcomes between them.

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**Study objective:** Survival after out-of-hospital cardiac arrest depends on the links in the chain of survival. The Utstein elements are designed to assess these links and provide the basis for comparing outcomes within and across communities. We assess whether these measures sufficiently predict survival and explain outcome differences. **Methods:** We used an observational, prospective data collection, case-series of adult persons with non traumatic out-of-hospital cardiac arrest from December 1, 2005, through March 1, 2007, from the multisite, population-based Resuscitation Outcomes Consortium Epistry–Cardiac Arrest. We used logistic regression, receiver operating curves, and measures of variance to estimate the extent to which the Utstein elements predicted survival to hospital discharge and explained outcome variability overall and between 7 Resuscitation Outcomes Consortium sites. Analyses were conducted for all emergency medical services–treated cardiac arrests and for the subset of bystander-witnessed patient arrests because of presumed cardiac cause presenting with ventricular fibrillation or ventricular tachycardia. **Results:** Survival was 7.8% overall (n=833/10,681) and varied from 4.6% to 14.7% across Resuscitation Outcomes Consortium sites. Among bystander-witnessed ventricular fibrillation or ventricular tachycardia, survival was 22.1% overall (n=323/1459) and varied from 12.5% to 41.0% across sites. The Utstein elements collectively predicted 72% of survival variability among all arrests and 40% of survival variability among bystander-witnessed ventricular fibrillation. The Utstein elements accounted for 43.6% of the between-site survival difference among all arrests and 22.3% of the between-site difference among the bystander-witnessed ventricular fibrillation subset. **Conclusion:** The Utstein elements predict survival but account for only a modest portion of outcome variability overall and between Resuscitation Outcomes Consortium sites. The results underscore the need for ongoing investigation to better understand characteristics that influence cardiac arrest survival.

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Increasing evidence indicates that health professionals often may not achieve guideline standards for cardiopulmonary resuscitation (CPR). Little is known about layperson CPR performance. The investigation was a retrospective cohort study of cardiac arrest patients treated by layperson CPR and one model of automated external defibrillator (AED) as part of the Public Access Defibrillation Trial (n=26). CPR was measured using software that integrates the event log, ECG signal, and thoracic impedance signal. We assessed chest compression fraction (proportion of attempted resuscitation spent performing chest compressions), prompted compression fraction (proportion of attempted resuscitation spent performing compressions during AED-prompted periods), compression rate, and
compressions per minute. Of the 26 cases, 13 presented with ventricular fibrillation and 13 with non shockable rhythms. Overall, during the period when patients did not have spontaneous circulation, the median chest compression fraction was 34% (IQR 17 - 48%), median prompted chest compression fraction was 49% (IQR 30 - 66%), and the median chest compression rate was 96/min (IQR 90 - 110/min). Taken together, the median chest compression delivered per minute among all arrests was 29 (IQR 20 - 42). CPR characteristics differed according to initial rhythm: median chest compression per minute was 20 (IQR 13 - 29) among ventricular fibrillation and 42 (IQR 28 - 47) among non shockable rhythms (p=0.003). In this study of trained laypersons, CPR varied substantially and often did not achieve guideline parameters. The findings suggest a need to improve CPR training, consider changes to CPR protocols, and/or improve the AED - rescuer interface.


This observational study aims to describe: (1) the use of positive pressure ventilation (PPV) for resuscitation in the delivery room among newly born near-term infants; (2) the methods used for PPV resuscitation [e.g., bag - facial mask (BFM), laryngeal mask airway (LMA), endotracheal tube (ETT)]; and (3) the association of each device with short-term neonatal outcomes. We identified near-term (34 0/7 - 36 6/7 weeks) infants delivered at the Padua University Hospital (Padua, Italy) during the years 2002 - 2006. The mode of delivery, gestational age, birth weight, Apgar scores, methods of resuscitation and respiratory outcome after NICU admission were analysed. During the 5-year study period, 921 (4.9%) near-term infants were identified from a total of 18,641 live births. PPV was provided in the delivery room to 86 (9.3%) of these infants. Among them, 36 (41.8%) were managed by LMA, 34 (39.5%) by BFM and 16 (18.6%) by ETT. Thirty-four (39.5%) resuscitated near-term infants were admitted to the Neonatal Intensive Care Unit (NICU): 15 (44.1%) after BFM, 12 (75%) after ETT and seven (19.4%) after LMA. Resuscitation with an ETT was associated with an increased rate of respiratory distress syndrome when compared with either BFM or LMA. Resuscitation with an LMA was associated with a lower rate of NICU admission and shorter length of stay when compared with either BFM or ETT. The LMA is an effective device for primary airway management of near-term infants and for secondary airway management among near-term infants failing BFM or ETT resuscitation.


BACKGROUND: Dispatcher-assisted cardiopulmonary resuscitation (CPR) instructions can increase bystander CPR and thereby increase the rate of survival from cardiac arrest. The risk of bystander CPR for patients not in arrest is uncertain and has implications for how assertive dispatch is in instructing CPR. We determined the frequency of dispatcher-assisted CPR for patients not in arrest and the frequency and severity of injury related to chest compressions. METHODS AND RESULTS: The investigation was a prospective cohort study of adult patients not in cardiac arrest for whom dispatchers provided CPR instructions in King County, Washington, between June 1, 2004, and January 31, 2007. The study focused on those who received chest compressions. Information was collected through review
of the audio and written dispatch report, written emergency medical services report, hospital record, and telephone survey. Of the 1700 patients for whom dispatcher CPR instructions were initiated, 55% (938 of 1700) were in arrest, 45% (762 of 1700) were not in arrest, and 18% (313 of 1700) were not in arrest and received bystander chest compressions. Of the 247 not in arrest who received chest compressions and had complete outcome ascertainment, 12% (29 of 247) experienced discomfort, and 2% (6 of 247) sustained injuries likely or possibly caused by bystander CPR. Only 2% (5 of 247) suffered a fracture, and no patients suffered visceral organ injury.

**CONCLUSIONS:** In this prospective study, the frequency of serious injury related to dispatcher-assisted bystander CPR among non arrest patients was low. When coupled with the established benefits of bystander CPR among those with arrest, these results support an assertive program of dispatcher-assisted CPR.

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Objective: We have previously demonstrated that nasopharyngeal cooling initiated during cardiopulmonary resuscitation improves the success of resuscitation. In this study, we compared the effects of nasopharyngeal cooling with cold saline infusion initiated during cardiopulmonary resuscitation on resuscitation outcome in a porcine model of prolonged cardiac arrest. We hypothesized that nasopharyngeal cooling initiated during cardiopulmonary resuscitation would yield better resuscitation outcome when compared with cold saline infusion. Design: Randomized, prospective animal study. Setting: University-affiliated research laboratory. Subjects: Yorkshire-X domestic pigs (Sus scrofa). Interventions: Ventricular fibrillation was induced in 14 pigs weighing 38 +/- 2 kg. After 15 mins of untreated ventricular fibrillation, cardiopulmonary resuscitation was performed for 5 mins before defibrillation. Coincident with the start of cardiopulmonary resuscitation, animals were randomly assigned to receive nasopharyngeal cooling with the aid of the RhinoChill Device (BeneChill, San Diego, CA) or cold saline infusion with 30 mL/kg 4[degrees]C saline. One hour after restoration of spontaneous circulation, surface cooling was begun with the aid of a water blanket in both groups and maintained for 4 hrs. Measurements and Main Results: Jugular vein temperature significantly decreased in animals subjected to nasopharyngeal cooling in comparison with those receiving cold saline infusion (p < .01). Core temperature, however, decreased only in animals receiving cold saline infusion (p < .01). Coronary perfusion pressure was significantly higher in the animals treated with nasopharyngeal cooling (p = .02). All seven animals treated with nasopharyngeal cooling were successfully resuscitated in contrast to only two animals resuscitated in the cold saline infusion group (p = .02). Conclusion: In this model, nasopharyngeal cooling initiated during cardiopulmonary resuscitation improved the success of resuscitation compared to cooling with cold saline infusion.
REVIEW ARTICLES

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PURPOSE OF REVIEW: This review will analyze and comment on selected recent literature pertaining to airway management and initial fluid resuscitation in the trauma patient. It will also review airway devices currently being used in the trauma setting. RECENT FINDINGS: Although a recent study has questioned the efficacy of manual inline immobilization, this technique continues to be endorsed by trauma guidelines and is safely used in most trauma centers. Clinicians have also incorporated the use of videolaryngoscopy and other adjuncts for difficult airway management in trauma patients. However, no single airway management tool has proven to be superior in this setting. Crystalloid solutions remain frontline therapy for the initial resuscitation of the hemorrhagic trauma patient, as studies with hypertonic saline and vasopressors have not shown superior results. Conversely, increased amounts of fresh frozen plasma and fibrinogen have been reported to increase survival in trauma patients. SUMMARY: As trauma continues to be a major cause of morbidity and mortality worldwide, the use of newer airway adjuncts needs to be specifically investigated in trauma patients, as this population frequently has airway management difficulties. Further research is also required to elucidate the type and amount of fluid that will provide an adequate organ perfusion without increasing nonsurgical bleeding.

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BACKGROUND AND OBJECTIVES: This report provides an overview of advances in wound repair devised by our research team during the last four decades. This collective review is presented in two parts. DISCUSSION: The following components are included in Part I: 1) search and treat life-threatening trauma; 2) conduct a thorough history; 3) examine the wound using aseptic technique; 4) anesthetize the wound before cleansing; 5) hair removal, skin disinfection, hemostasis, surgical debridement, and mechanical cleansing; 6) antibiotics, drains, and open wound management. CONCLUSION: On the basis of these comprehensive research studies, we have noted a marked reduction in the incidence of wound infection in traumatic wounds.

The risk of complications of cardiopulmonary resuscitation (CPR) does not outweigh the benefit of a successful restoration of a spontaneous circulation. Despite the frequent occurrence of gastric distension (caused by air entering the stomach because of too forceful and/or too quick rescue breathing), there are few reports of massive gastric distension causing gastric rupture and pneumoperitoneum after CPR. We reviewed all 67 case reports of gastric perforation that have been reported after CPR. Although uncommon, this review stresses the need to consider this potentially lethal complication after initial successful resuscitation.


PURPOSE OF REVIEW: The field of pediatric cardiac arrest experienced recent advances secondary to multicenter collaborations. This review summarizes developments during the last year and identifies areas for further research. RECENT FINDINGS: A large retrospective review demonstrated important differences in cause, severity, and outcome of in-hospital vs. out-of-hospital pediatric cardiac arrest. This distinction is relevant to interpretation of retrospective studies that may not distinguish between these entities, and in planning therapeutic clinical trials. Hypothermia was further evaluated as a treatment strategy after neonatal hypoxia and leaders in the field of neonatology recommend universal use of hypothermia in term neonates at risk. In infants and children after cardiac arrest, there are inadequate data to make a specific recommendation. Two retrospective studies evaluating hypothermia in children after cardiac arrest found that it tended to be administered more frequently to sicker patients. However, similar or worse outcomes of patients treated with hypothermia were observed. Use of extracorporeal membrane oxygenation is another emerging area of research in pediatric cardiac arrest, and surprisingly good outcomes have been seen with this modality in some cases. SUMMARY: Therapeutic hypothermia and extracorporeal membrane oxygenation continue to be the only treatment modalities over and above conventional care for pediatric cardiac arrest. New approaches to monitoring, treatment, and rehabilitation after cardiac arrest remain to be explored. [References: 47]


Although considerable advances have been made in the diagnosis and management of acute myocardial infarction (AMI), the disorder is still a major cause of morbidity and mortality worldwide and continues to pose significant therapeutic challenges. The use of biomarkers to aid the diagnosis of AMI is now increasing and has enabled better understanding of the pathophysiology of the disorder and identification of patients who require urgent reperfusion therapy. Early percutaneous coronary intervention (PCI) appears to be beneficial when performed in a timely manner with a door-to-balloon time <90 min. The goal of PCI is now shifting from simple revascularization of occluded coronary arteries to optimum reperfusion at the microvascular level. Effective strategies and
pharmacological agents need to be developed for better cardiac protection during AMI. Most deaths resulting from AMI occur within 1 h of its onset, and half of them occur before hospital admission. Thus, an effective pre-hospital lifeline system should be an important priority, achieved through the chain of survival, including the immediate implementation of definitive resuscitative efforts and rapidly transporting the patients to the hospital. [References: 98]

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Joy, R. and R. Joy "Question 1: is room air better than 100% oxygen for the resuscitation of the depressed full-term newborn?" Archives of Disease in Childhood 95(1): 68-70. (Review)

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The management of the trauma patient presents the practitioner with a host of challenges, and the pace, variety of venues, and multidisciplinary nature of the field combine to create a system complexity that is laden with potential pitfalls. This review summarizes some of the general principles of medical errors and examines some of the more common pitfalls encountered in the initial resuscitation and evaluation of the major trauma patient. [References: 61]

ANIMAL / MANIKIN / CADAVER STUDIES

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Objective: The current standard of manual chest compression during cardiopulmonary resuscitation requires pauses for rhythm analysis and shock delivery. However, interruptions of chest compression greatly decrease the likelihood of successful defibrillations, and significantly better outcomes are reported if this interruption is avoided. We therefore undertook a prospective randomized controlled animal study in an electrically induced ventricular fibrillation pig model to assess the effects of timing of defibrillation on the manual chest compression cycle on the defibrillation threshold. Design: Prospective, randomized, controlled animal study. Setting: University-affiliated research laboratory. Subjects: Yorkshire-X domestic pigs (Sus scrofa). Interventions: In eight domestic male pigs weighing between 24 and 31 kg, ventricular fibrillation was electrically induced and untreated for 10 secs. Manual chest compression was then performed and continued for 25 secs with the protection of an isolation blanket. The depth and frequency of chest compressions were guided by a cardiopulmonary resuscitation prompter. Animals were randomized to receive a biphasic electrical shock in five different
compression phases with a predetermined energy setting. A control phase was chosen at a constant 2 secs after discontinued chest compression. A grouped up-down defibrillation threshold testing protocol was used to compare the success rate at different coupling phases. After a recovery interval of 4 mins, the sequence was repeated for a total of 60 test shocks for each animal. Measurements and Main Results: No difference in coronary perfusion pressure before delivering of the shock was observed among the six study phases. The defibrillation success rate, however, was significantly higher when shocks were delivered in the upstroke phase of manual chest compression. Conclusion: Defibrillation efficacy is maximal when electrical shock is delivered during the upstroke phase of manual chest compression.

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It is well recognized that brain death starts to occur just 4-6 min after cardiac arrest, and few attempts at resuscitation succeed after 10 min of severe cerebral ischemia and anoxia. We sought to determine the therapeutic window of selective cerebral profound hypothermia of primates following severe cerebral ischemia in primates. Fourteen rhesus monkeys with severe cerebral ischemia were divided into four groups: normothermia (n = 3); profound hypothermia I (n = 4), with cooling initiated 10 min after ischemia; profound hypothermia II (n = 4), with cooling initiated 15 min after ischemia; and profound hypothermia III (n = 3), with cooling initiated 20 min after ischemia. Severe cerebral ischemia was induced by clamping both the internal and external carotid arteries, as well as the internal and external jugular veins. Profound cerebral hypothermia (15.8 degrees +/- 0.9 degrees C) was achieved and maintained for 60 min, and the animals were then re-warmed gradually. All four animals in hypothermia group I survived without any neurological deficits. Only 1 animal survived and 3 animals died in hypothermia group II. All 4 animals died in both hypothermia group III and the normothermia group. Neurological functions were normal in all surviving animals, and MRI scans showed no cerebral infarction in these animals. Microscopic examination showed no injured neurons in the hippocampus and cerebral cortex of the surviving animals, and showed that the heart, lung, liver, and kidneys were normal in these animals. Our data indicate that post-ischemic profound cerebral hypothermia provided significant cerebral protection with no systemic complications, and that the effective therapeutic window is more than 10 min, but less than 15 min, after severe cerebral ischemia.

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Total liquid ventilation (TLV) with cooled perfluorocarbons has been demonstrated to induce an ultrafast cardio-protective cooling in rabbits. However, it remains unknown whether this technically challenging strategy would be actually more potent than a conventional external cooling after a prolonged ischemia inducing transmural myocardial infarction. Anesthetized rabbits were randomly submitted to 60min of coronary artery occlusion (CAO) under normothermic conditions (Control group, n=7) or with cooling started at the 5th min of
CAO (target left atrial temperature: 32°C). Cooling procedures were either external cooling using cold blankets (EC group, n=7) or ultrafast cooling initiated by 20min of TLV (TLV group, n=6). An additional group underwent a similar ultrafast cooling protocol started at the 20th min of CAO (TLV delayed group, n=6). After reperfusion, all hypothermic animals were re-warmed and infarct size was assessed after 4h. In the EC group, the target temperature was reached only at 60min of CAO whereas this time-interval was dramatically reduced to 15 and 25min of CAO in TLV and TLV delayed, respectively. Infarct sizes were significantly reduced in TLV and TLV delayed but not in EC groups as compared to Control (45+/-18%, 58+/-5%, 78+/-10% and 82+/-7% of the risk zone, respectively). Similar significant differences were observed for the sizes of the no-reflow zones (15+/-9%, 23+/-8%, 49+/-11% and 58+/-13% of the risk zone, respectively). Cooling induced by TLV afforded a potent cardio protection and prevented transmural infarction following prolonged and severe ischemia, even when started later than a surface cooling in rabbits.

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The present study was undertaken to determine whether sustained manual abdominal compression (SMAC) using left paramedian compression technique can improve coronary perfusion pressure (CPP) during cardiopulmonary resuscitation (CPR) and resuscitation outcomes without causing liver laceration. Ventricular fibrillation was induced in 14 pigs, and circulatory arrest was maintained for 6 min. Animals were resuscitated either by standard CPR (control group) or by standard CPR with SMAC (SMAC-CPR group). Mean blood pressure, aortic diastolic pressure and right atrial diastolic pressure in the SMAC-CPR group were significantly greater than in the control group throughout simulated basic life support. However, since the increases in aortic and right atrial diastolic pressures were similar, no significant intergroup difference was found in terms of CPP. Return of spontaneous circulation (ROSC) was attained in four of seven animals in the control group and in six of seven animals in the SMAC-CPR group (p=0.55). Three animals in the control group and four in the SMAC-CPR group survived 24 h after ROSC (p=1.00). Two of the seven animals in the SMAC-CPR group had a ruptured liver, but no such injury occurred in the control group. SMAC using left paramedian compression technique failed to improve CPP during CPR and resuscitation outcomes. Furthermore, this method could not avoid liver laceration.

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BACKGROUND: Experimental studies of uncontrolled hemorrhage demonstrated that permissive hypotension (PH) reduces blood loss, but its effect on clot formation remains unexplored. Desmopressin (DDAVP) enhances platelet adhesion promoting stronger clots. We hypothesized PH and DDAVP have additive effects and reduce bleeding in uncontrolled hemorrhage. METHODS: Rabbits (n = 42) randomized as follows: sham; normal blood pressure (NBP) resuscitation; PH resuscitation-60% baseline mean arterial pressure; NBP plus DDAVP 1 hour before (DDAVP NBP) or 15 minutes after beginning of shock (DDAVP T1 NBP); and PH plus DDAVP 1 hour before
(DDAVP PH) or 15 minutes after beginning of shock (DDAVP T1 PH). Fluid resuscitation started 15 minutes after aortic injury and ended at 85 minutes. Intra-abdominal blood loss was calculated, aortic clot sent for electron microscopy. Activated partial thromboplastin time, platelet count, thromboelastometry, arterial blood gases, and complete blood count were performed at baseline and 85 minutes. Analysis of variance was used for comparison. RESULTS: NBP received more fluid volume and had greater intra-abdominal blood loss. DDAVP, when administered pre-shock, significantly reduced blood loss in NBP and fluid requirement when given postshock. Platelets, arterial blood gas, complete blood count, and activated partial thromboplastin time were similar at 85 minutes. NBP delayed clot formation and worsened thrombo-dynamic potential on thromboelastometry, whereas PH and DDAVP improved. Electron microscopy showed lack of fibrin on NBP clots, whereas DDAVP and PH clots displayed exuberant fibrin/platelet aggregates. DDAVP NBP presented intermediate clots. CONCLUSION: PH reduced bleeding and improved hemostasis compared with normotensive resuscitation. DDAVP given pre-shock exerted similar effects with normotensive resuscitation.


OBJECTIVES: To evaluate the effect of no assisted ventilation cardiopulmonary resuscitation on neurologically intact survival compared with ten positive pressure ventilations/minute cardiopulmonary resuscitation in a pig model of cardiac arrest. DESIGN: Prospective randomized animal study. SETTING: Animal laboratory. SUBJECTS: Sixteen female intubated pigs (25.2 +/- 2.1 kg) anesthetized with propofol. INTERVENTIONS: After 8 mins of untreated ventricular fibrillation, the intubated animals were randomized to 8 mins of continuous chest compressions (100/min) and either no assisted ventilation (n = 9) or 10 positive pressure ventilations/min (Smart Resuscitator Bag with 100% O2 flow at 10 L/min) (n = 7). The primary end point, neurologically intact 24-hr survival, was evaluated using a pig cerebral performance category score by a veterinarian blinded to the cardiopulmonary resuscitation method. MEASUREMENTS, AND MAIN RESULTS: During cardiopulmonary resuscitation, aortic and coronary perfusion pressure were similar between groups but cerebral perfusion pressure was significantly higher in the positive pressure ventilation group (33 +/- 15 vs. 14 +/- 14, p = .04). After 7.5 mins of cardiopulmonary resuscitation, arterial pO2 (mm Hg) and mixed venous O2 saturation (%) were significantly higher in the positive pressure ventilation compared with the no assisted ventilation group (117 +/- 29 and 41 +/- 21 vs. 40 +/- 24 and 10.8 +/- 7; p = .01 for both). Paco2 was significantly lower in the positive pressure ventilation group (48 +/- 10 vs. 77 +/- 26, p = .01). After 24 hrs, four of nine no assisted ventilation pigs were alive with a mean cerebral performance category score of 3 +/- 0 vs. five of seven alive and neurologically intact positive pressure ventilation pigs with a cerebral performance category score of 1 +/- 0.3 (p < .001 for cerebral performance category score). CONCLUSIONS: No assisted ventilation cardiopulmonary resuscitation results in profound hypoxemia, respiratory acidosis, and significantly worse 24-hr neurologic outcomes compared with positive pressure ventilation cardiopulmonary resuscitation in pigs.

Pulseless electrical activity is an important cause of cardiac arrest. Our purpose was to determine if induction of hypothermia with a cold perfluorocarbon-based total liquid ventilation (TLV) system would improve resuscitation success in a swine model of asphyxial cardiac arrest/PEA. Twenty swine were randomly assigned to control (C, no ventilation, n=11) or TLV with pre-cooled PFC (n=9) groups. Asphyxia was induced by insertion of a stopper into the endotracheal tube, and continued in both groups until loss of aortic pulsations (LOAP) was reached, defined as a pulse pressure less than 2mmHg. The TLV animals underwent asphyxial arrest for an additional 2min after LOAP, followed by 3min of hypothermia, prior to starting CPR. The C animals underwent 5min of asphyxia beyond LOAP. Both groups then underwent CPR for at least 10min. The endpoint was the resumption of spontaneous circulation maintained for 10min. Seven of 9 animals achieved resumption of spontaneous circulation (ROSC) in the TLV group vs. 5 of 11 in the C group (p=0.2). The mean pulmonary arterial temperature was lower in total liquid ventilation animals starting 4min after induction of hypothermia (TLV 36.3+/−0.2°C vs. C 38.1+/−0.2°C, p<0.0001). Arterial pO2 was higher in total liquid ventilation animals at 2.5min of CPR (TLV 76+/−12mmHg vs. C 44+/−2mmHg; p=0.03). Induction of moderate hypothermia using perfluorocarbon-based total liquid ventilation did not improve ROSC success in this model of asphyxial cardiac arrest.


In adults, first responders to a cardiopulmonary arrest provide better ventilation using a laryngeal mask airway than a facemask. It is unclear if the same is true in children. We investigated this by comparing the ability of 36 paediatric ward nurses to ventilate the lungs of 99 anaesthetised children (a model for cardiopulmonary arrest) using a laryngeal mask airway and using a facemask with an oropharyngeal airway. Anteroposterior chest wall displacement was measured using an ultrasonic detector. Nurses achieved successful ventilation in 74 (75%) of cases with the laryngeal mask airway and 76 (77%) with facemask and oropharyngeal airway (p = 0.89). Median (IQR [range]) time to first breath was longer for the laryngeal mask airway (48 [39-65 [8-149]]) s than the facemask/airway (35 [25-53 [14-120]]) s; p < 0.0001. In 10 cases (10%) the lungs were ventilated using the laryngeal mask airway but not using the facemask/oropharyngeal airway. We conclude that ventilation is achieved rapidly using a facemask and oropharyngeal airway, and that the laryngeal mask airway may represent a useful second line option for first responders.

The importance of circulation during cardiopulmonary resuscitation has led to efforts to decrease time without chest compressions (‘no-flow time’). The no-flow time from the interruption of chest compressions until defibrillation is referred to as the ‘pre-shock pause’. A shorter pre-shock pause increases the chance of successful defibrillation. It is unclear whether drug administration affects the length of the pre-shock pause. Our study compares pre-shock pause with and without drug administration in a full-scale simulation. This was an observational study in an ambulance including 72 junior physicians and a cardiac arrest scenario. Data were extracted by reviewing video recordings of the resuscitation. Sequences including defibrillation and/or drug administration were identified and assigned to one out of four categories: Defibrillation only (DC-only) and drug administration just prior to defibrillation (Drug+DC) for which the pre-shock pause was calculated, and drug administration alone (Drug-only) for which pre-drug time was calculated. DC-only sequences were identified in 68/72 simulations, Drug+DC in 24/72, and Drug-only in 33/72. Median pre-shock pauses were 18s (DC-only) and 32 (Drug+DC), and median pre-drug pause 6. The variation between pauses was statistically significant (p<0.001). DC-only and Drug+DC sequences was found in 22/72 simulations. A statistically significant difference of 8s was found between the median pre-shock pauses: 17s (DC-only) and 25 (Drug+DC) (p<0.001). For un-paired observations, the pre-shock pause increased with 78% and for paired observations 47%. Drug administration prior to defibrillation was associated with significant increases in pre-shock pauses in this full-scale simulation study.

CASE SERIES / CASE STUDIES / LETTERS / EDITORIALS


Extracorporeal membrane oxygenation (ECMO) systems have undergone rapid technological improvements and are now feasible options for medium-term support of severe cardiac or pulmonary failure. Intractable ventricular arrhythmia is a rare but well-established indication for heart transplantation. We report a case of persistent ventricular fibrillation (VF) that was rescued by insertion of peripheral veno-arterial ECMO during cardiopulmonary resuscitation, which provided support for 30 h of continuous VF and subsequently permitted urgent heart transplantation.

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EDUCATION / ETHICS

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To assess the reliability and validity of scoring instruments designed to measure clinical performance during simulated resuscitations requiring the use of Pediatric Advanced Life Support (PALS) algorithms. Pediatric residents were invited to participate in an educational trial involving simulated resuscitations that employ PALS algorithms. Each subject participated in a session comprised of four scenarios (asystole, dysrhythmia, respiratory arrest, shock). Video-recorded sessions were independently reviewed and scored by four raters using instruments designed to measure performance in terms of timing, sequence, and quality. Validity was assessed by two-factor analysis of variance with postgraduate year (PGY-1 versus PGY-2) as an independent variable. Reliability was assessed by calculation of overall interrater reliability (IRR) as well as a generalizability study to estimate variance components of individual measurement facets (scenarios, raters) and associated interactions. 20 subjects were scored by four raters. Based on a two-factor ANOVA, PGY-2s outperformed PGY-1s (p<0.05); significant differences in difficulty existed between the four scenarios, with dysrhythmia scores being the lowest. Overall IRR was high (0.81) and most variance could be attributed to subject (17%), scenario (13%), and the interaction between subject and scenario (52%); variance attributable to rater was minimal (1.4%). The instruments assessed in this study measure clinical performance during PALS scenarios in a reliable and valid manner. Measurement error could be minimized further through the use of additional scenarios but additional raters, for a given scenario, would not improve reliability. Further studies should assess validity of measurement with respect to actual clinical performance during resuscitations.

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Background: The sniffing position’ is widely promoted for teaching airway positioning before intubation, but whether this analogy results
in novices placing the head and neck appropriately has not been evaluated. We compared performance following the sniffing position instructions with an alternate analogy, win with the chin'. We also compared performance following simple anatomic instructions and no instructions. Methods: A randomized controlled study of medical students and PGY1 registrars in Surgery and Internal Medicine was performed. Subjects independently positioned a simulator manikin head and neck based upon their understanding of four written instructions in random order: (i) the sniffing position'; (ii) the win with the chin' analogy, (iii) anatomic instructions; and (iv) no instructions (control). Digital photographs following each instruction were analysed by two airway experts for (i) adequacy of overall positioning and (ii) the three components of airway positioning. Results: Eighty-one volunteers participated. The positioning was adequate most often (43.2%) following the win with the chin' analogy when compared with the other instructions (37.0% anatomic instructions; 19.8% control; 14.8% sniffing position' analogy). Positioning following the sniffing position' instructions was not different from no instruction (P=0.53). The win with the chin' and anatomic instructions were significantly better than no instructions (P=0.002 and 0.023, respectively). Conclusions: The win with the chin analogy resulted in adequate airway positioning significantly more often than the sniffing position' or control. It also maintained atlanto-occipital extension compared with anatomic instructions. Overall, win with the chin' was a superior teaching analogy and could replace the sniffing position' analogy.


The present study aims to investigate whether the distribution of the Basic Life Support and Automated External Defibrillation (BLS/AED) manual, 4 weeks prior to the course, has an effect on skill acquisition, theoretical knowledge and skill retention, compared with courses where manuals were not distributed. A total of 303 laypeople were included in the present study. The courses were randomised with sealed envelopes in 12 courses, where manuals were distributed to participants (group A) and in 12 courses, where manuals were not distributed to participants (group B). The participants were formally evaluated at the end of the course, and at 1, 3 and 6 months after each course. The evaluation procedure was the same at all time intervals and consisted of two distinct parts: a written test and a simulated cardiac arrest scenario. No significant difference was observed between the two groups in skill acquisition at the time of initial training. Furthermore, there was no significant difference between the groups in performing BLS/AED skills at 1, 3 and 6 months after initial training. Theoretical knowledge in either group at the specified time intervals did not exhibit any significant difference. Significant deterioration of skills was observed in both groups between initial training and at 1 month after the course, as well as between the first and third month after the course. The present study shows that distribution of BLS/AED manuals 1 month prior to the course has no effect on theoretical knowledge, skill acquisition and skill retention in laypeople.

Objective: Poor communication and teamwork may contribute to errors during neonatal resuscitation. Our objective was to evaluate whether interns who received a 2-hour teamwork training intervention with the Neonatal Resuscitation Program (NRP) demonstrated more teamwork and higher quality resuscitations than control subjects. Methods: Participants were noncertified 2007 and 2008 incoming interns for pediatrics, combined pediatrics and internal medicine, family medicine, emergency medicine, and obstetrics and gynecology (n = 98). Pediatrics and combined pediatrics/internal medicine interns were eligible for 6-month follow-up (n = 34). A randomized trial was conducted in which half of the participants in the team training arm practiced NRP skills by using high-fidelity simulators; the remaining practiced with low-fidelity simulators, as did control subjects. Blinded, trained observers viewed video recordings of high-fidelity-simulated resuscitations for teamwork and resuscitation quality. Results: High-fidelity training (HFT) group had higher teamwork frequency than did control subjects (12.8 vs 9.0 behaviors per minute; P < .001). Intervention groups maintained more workload management (control subjects: 89.3%; low-fidelity training [LFT] group: 98.0% [P < .001]; HFT group: 98.8%; HFT group versus control subjects [P < .001]) and completed resuscitations faster (control subjects: 10.6 minutes; LFT group: 8.6 minutes [P = .040]; HFT group: 7.4 minutes; HFT group versus control subjects [P < .001]). Overall, intervention teams completed the resuscitation an average of 2.6 minutes faster than did control subjects, a time reduction of 24% (95% confidence interval: 12%-37%). Intervention groups demonstrated more frequent teamwork during 6-month follow-up resuscitations (11.8 vs 10.0 behaviors per minute; P = .030). Conclusions: Trained participants exhibited more frequent teamwork behaviors (especially the HFT group) and better workload management and completed the resuscitation more quickly than did control subjects. The impact on team behaviors persisted for at least 6 months. Incorporating team training into the NRP curriculum is a feasible and effective way to teach interns teamwork skills. It also improves simulated resuscitation quality by shortening the duration.

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Objective: To describe relationships between teamwork behaviours and errors during neonatal resuscitation. Methods: Trained observers viewed video recordings of neonatal resuscitations (n = 12) for the occurrence of teamwork behaviours and errors. Teamwork state behaviours (such as vigilance and workload management, which extend for some duration) were assessed as the percentage of each resuscitation that the behaviour was observed and correlated with the percentage of observed errors. Teamwork event behaviours (such as information sharing, inquiry and assertion, which occur at specific times) were counted in 20-s intervals before and after resuscitation steps, and a generalised linear mixed model was calculated to evaluate relationships between these behaviours and errors. Results: Resuscitation teams who were more vigilant committed fewer errors (Spearman's rho for vigilance and errors = -0.62, 95% CI -0.07 to -0.87, p = 0.031). Assertions were more likely to occur before errors than correct steps (OR = 1.44, 95% CI 1.10 to 1.89, p = 0.008) and teaching/advising occurred less frequently after errors (OR = 0.59, 95% CI 0.37 to 0.94, p = 0.028). Though not statistically significant, there was less information sharing before errors (OR = 0.90, 95% CI 0.77 to 1.05, p = 0.172). Conclusions: Vigilance is an important behaviour for error management. Assertion may have caused errors, or perhaps was an indicator for some other factor that caused errors. Teams may have preferred to resolve errors directly, rather than using errors as opportunities to teach their teammates.
These observations raise important questions about the appropriate use of some teamwork behaviours and how to include them in team training programmes.

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Nurses in the hospital setting must be knowledgeable about resuscitation procedures and proficient in the delivery of care during an emergency. They must be ready to implement their knowledge and skills at a moment's notice. A common dilemma for many nurses is that cardiopulmonary emergencies (Code Blues) are infrequent occurrences. Therefore, how do nurses remain competent and confident in their implementation of emergency skills while having limited exposure to the equipment and minimal experience in emergency situations? A team of nurse educators at a regional medical center in Washington State applied adult learning theory and accelerated learning techniques to develop and present a series of learning activities to enhance the staff's familiarity with emergency equipment and procedures. The series began with a carnival venue that provided hands-on practice and review of emergency skills and was reinforced with subsequent random unannounced code drills led by both educators and charge nurses.