Clinical trials and systematic reviews


Background: Infusion of a vasopressor during cardiopulmonary resuscitation (CPR) in humans increases end decompression (diastolic) arterial blood pressure, and consequently increases vital organ perfusion pressure and survival. Several vasoactive drugs have been tested alone or in combination, but their hemodynamic effects have not been investigated clinically in humans. Study Objective: We tested the hypothesis that epinephrine (1 mg) co-administered with vasopressin (40 IU) ± nitroglycerin (300 ug) results in higher diastolic blood pressure than epinephrine alone. Study Design: A prospective, randomized, double-blinded controlled trial in the prehospital setting. The study included 48 patients with witnessed cardiac arrest. Patients received epinephrine alone (E alone) or epinephrine plus vasopressin (E+V) or epinephrine plus vasopressin plus nitroglycerin (E+V+N). A femoral arterial catheter was inserted for arterial pressure measurement. Outcome Measures: The primary endpoint was diastolic blood pressure during CPR, 15 min after the first drug administration (T = 15 min). Results: After exclusions, a total of 44 patients were enrolled. Diastolic blood pressures (mm Hg) at T = 15 min were not statistically different between groups (median [interquartile range]: 20 [10], 15 [6], and 15 [13] for E alone, E+V, and E+V+N, respectively. The rate of return of spontaneous circulation was 63% (n = 10) in the epinephrine group, 43% (n = 6) in the epinephrine plus vasopressin group, and 36% (n = 5) in the triple therapy group (NS). Conclusions: Addition of vasopressin or vasopressin plus nitroglycerin to epinephrine did not increase perfusion blood pressure compared to epinephrine alone in humans in cardiac arrest, suggesting the absence of benefit in using these drug combination(s).

Guideline 11.5: Medications in adult ALS


Background: The impedance threshold device (ITD-7) augments the vacuum created in the thorax with each inspiration, thereby enhancing blood flow from the extra-thoracic venous systems into the heart. Objectives: To the best of our knowledge, the ITD-7 has not previously been investigated in hypotensive patients in the emergency department (ED) or the prehospital setting. The objective of this study was to determine whether the ITD-7 would increase systolic arterial pressures in hypotensive spontaneously breathing patients. Methods The ED study was a prospective, randomized, double-blind, sham control design. Patients with a systolic blood pressure <= 95 mm Hg were randomized to breathe for 10 min through an active or sham ITD. The primary endpoint was the change in systolic blood pressure measured non-invasively. The prehospital study was a prospective, non-blinded evaluation of the ITD-7 in hypotensive patients. Results: In the ED study, the mean ± standard deviation rise in systolic blood pressure was 12.9 ± 8.5 mm Hg for patients (n = 16) treated with an active ITD-7 vs. 5.9 ± 5.9 mm Hg for patients
(n = 18) treated with a sham ITD-7 (p < 0.01). In the prehospital study, the mean systolic blood pressure before the ITD-7 was 79.4 ± 10.2 mm Hg and 107.3 ± 17.6 mm Hg during ITD-7 use (n = 47 patients) (p < 0.01). Conclusion: During this clinical evaluation of the ITD-7 for the treatment of hypotensive patients in the ED and in the prehospital setting, use of the device significantly increased systolic blood pressure and was safe and generally well tolerated.

**Guideline 11.6: Equipment & techniques in adult ALS**

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**Observational studies**


Background: Pesticides are extensively used in developed and developing countries. Objectives: The present study was designed to evaluate the clinical course of patients with carbamate or organophosphate poisoning presenting to a University-based emergency department (ED).

Methods: All consecutive patients admitted to our ED due to intoxication with carbamate or organophosphate compounds over a 2-year period were enrolled prospectively.

Results: A total of 49 consecutive patients (26 females) were diagnosed with carbamate or organophosphate poisoning in the 24-month study period. The mean age of the patients was 32 ± 13.1 years (range 16–70 years). Signs and symptoms most frequently noted in patients with organophosphate or carbamate poisoning were perspiration, vomiting, and bronchorrhea. Abdominal pain was reported by 65.3% of the patients. Abdominal ultrasonography was performed in 22 patients who complained of abdominal pain as a leading symptom. Among these, 63.6% were found to have abdominal free fluid. Pancreatitis and peritonitis developed in one case. Atropine treatment was administered for approximately 24–36 h, with a mean total dose of 13.75 ± 6.75 mg. Pralidoxime was administered to 70.9% of patients with organophosphate poisoning, but was not used in patients intoxicated with carbamates. Endotracheal intubation and mechanical ventilatory support were required in 14.2% of the patients. Mean duration of mechanical ventilation was 3.7 ± 2.2 days. The overall mortality rate was 10.2%. Conclusion: Patients with a diagnosis of organophosphate poisoning should be screened for acute abdomen. The findings in our study suggest that these patients should undergo routine abdominal ultrasonography, especially in cases with abdominal pain along with other abdominal complaints.

**Guideline 9.5.1 Emergency Management of a Victim who has Been Poisoned**


There have been few studies on the effectiveness of bystander automated external defibrillator (AED) use in out-of-hospital cardiac arrest. The
objective of this study was to determine whether actual use of onsite or dispatched AED reduces the time to first shock compared with no AED use and thereby improves survival. Methods and Results: We performed a population-based cohort study of 2833 consecutive patients with a nontraumatic out-of-hospital cardiac arrest before emergency medical system arrival between 2006 and 2009. The primary outcome, neurologically intact survival to discharge, was compared by use of multivariable logistic regression analysis. An onsite AED had been applied in 128 of the 2833 cases, a dispatched AED in 478, and no AED in 2227. Onsite AED use reduced the time to first shock from 11 to 4.1 minutes. Neurologically intact survival was 49.6% for patients treated with an onsite AED compared with 14.3% without an AED (unadjusted odds ratio, 5.63; 95% confidence interval, 3.91, 8.10). The odds ratio remained statistically significant after adjustment for confounding (odds ratio, 2.72; 95% confidence interval, 1.77, 4.18). Dispatched AED use reduced the time from call to first shock to 8.5 minutes. Neurologically intact survival was 17.2% for patients treated with a dispatched AED (unadjusted odds ratio, 1.07; 95% confidence interval, 0.82, 1.39). Every year, onsite AEDs saved 3.6 lives per 1 million inhabitants; dispatched AEDs saved 1.2 lives. Conclusions: The use of an onsite AED leads to a doubling of neurologically intact survival. In our system, the survival benefit of dispatched AED use was much smaller than that of onsite AED use. Guideline 7: External automated defibrillation in BLS


Recognition of critically abnormal vital signs has been used to identify critically ill patients for activation of rapid response teams. Most studies have only analyzed vital signs obtained at the time of admission. The intent of this study was to examine the association of critical vital signs occurring at any time during the hospitalization with mortality. All vital sign measurements were obtained for hospitalizations from January 1, 2008 to June 30, 2009 at a large academic medical center. There were 1.15 million individual vital sign determinations obtained in 42,430 admissions on 27,722 patients. Critical vital signs were defined as a systolic blood pressure < 85 mmHg, heart rate >120 bpm, temperature <35°C or >38.9°C, oxygen saturation <91%, respiratory rate <12 or >24, and level of consciousness recorded as anything but 'alert'. The presence of a solitary critically abnormal vital sign was associated with a mortality of 0.92% vs. a mortality of 23.6% for three simultaneous critical vital signs. Of those experiencing three simultaneous critical vital signs, only 25% did so within 24h of admission. The Modified Early Warning Score (MEWS) and VitalPAC Early Warning Score (VIEWS) were validated as good predictors of mortality at any time point during the hospitalization. The simultaneous presence of three critically abnormal vital signs can occur at any time during the hospital admission and is associated with very high mortality. Early recognition of these events presents an opportunity for decreasing mortality.


To examine the impact of changing dispatcher CPR instructions (400 compressions: 2 breaths, followed by 100:2 ratio) on rates of bystander CPR and survival in adults with presumed cardiac out-of-hospital arrest (OHCA) in Melbourne, Australia. The Victorian Ambulance Cardiac Arrest Registry (VACAR) was searched for OHCA where Emergency Medical Services (EMS) attempted CPR between August 2006 and August
2009. OHCA included were: (1) patients aged ≥18 years old; (2) presumed cardiac etiology; and (3) not witnessed by EMS. For the pre- and post-study periods, 1021 and 2101 OHCAs met inclusion criteria, respectively. Rates of bystander CPR increased overall (45 - 55%, p<0.001) and by initial rhythm (shockable 55 - 70%, p<0.001 and non-shockable 40 - 46%, p=0.01). In VF/VT OHCA, there were improvements in the number of patients arriving at hospital with a return of spontaneous circulation (ROSC) (48 - 56%, p=0.02) and in survival to hospital discharge (21 - 29%, p=0.002), with improved outcomes restricted to patients receiving bystander CPR. After adjusting for factors associated with survival, the period of time following the change in CPR instructions was a significant predictor of survival to hospital discharge in VF/VT patients (OR 1.57, 95% CI: 1.15, 2.20, p=0.005). Following changes to dispatcher CPR instructions, significant increases were seen in rates of bystander CPR and improvements were seen in survival in VF/VT patients who received bystander CPR, after adjusting for factors associated with survival.


Background: Direct current cardioversion (DCC) has been shown to be effective for the management of atrial fibrillation (AF) in the emergency department (ED). Pharmacological cardioversion was compared with a strategy including DCC on patients with uncomplicated, recent-onset (<48h) AF managed in a short observation unit (SOU). Methods: A prospective observational study was undertaken over a period of 13 months in two institutions. A DCC-centred protocol was applied to 171 AF cases in a hospital (DCC-cohort) and pharmacological cardioversion to 151 AF cases in another hospital (P-cohort). Patients remaining in AF after 24h were admitted. The outcomes were rate of discharge in sinus rhythm, length of stay in the ED-SOU, rate of hospitalisation and complications of treatment. Data collected were analysed using Student t test and χ2 statistics. Results: Discharge in sinus rhythm was achieved in 159/171 cases in the DCC-cohort and 77/151 cases in the P-cohort (93% vs 51%; number needed to treat (NNT) 2.4; 95% CI 2.0 to 3.1, p<0.001), whereas mean length of stay was 7+7h in the DCC-cohort and 9+6h in the P-cohort (p=0.43). Eleven cases from the DCC-cohort and 67 from the P-cohort were admitted (admission rate 6% vs 44%; NNT 2.6; 95% CI 2.2 to 3.5, p<0.001). Three short-term complications occurred in the DCC-cohort and five in the P-cohort (2% vs 3%, p=0.59). Two strokes were registered in the DCC-cohort during 6-month follow-up (p undefined). Conclusions: Electrical cardioversion of recent-onset AF in the SOU is safe, effective and reduces hospitalisations. Further studies are needed to identify the most cost-effective strategy for the management of AF patients in emergency settings.

Guideline 11.9: Managing acute dysrhythmias


In the setting of ST-segment elevation myocardial infarction (STEMI), early reperfusion yields better patient outcomes. Emergency medical services (EMS) is the first medical contact for half of the afflicted population, and prehospital thrombolysis may result in considerably faster reperfusion compared with percutaneous coronary intervention (PCI) in rural settings. However, there are few reports of prehospital thrombolysis in rural EMS systems. Objective. To describe a rural EMS system's experience with tenecteplase in STEMI. Methods. Data were retrospectively abstracted from the medical records of patients receiving tenecteplase using standard chart review guidelines. Primary outcomes
included time saved by EMS-initiated thrombolysis, aborted infarctions, serious bleeding events, and in-hospital mortality. Secondary outcomes included re-infarction, rescue angioplasty, and appropriateness of treatment. Time savings was defined as transport time after tenecteplase administration plus 90 minutes, which is the typical door-to-balloon time for PCI laboratories. Aborted infarction was defined as resolution of the cumulative ST-segment elevation to ≤50% of that on the initial electrocardiogram (ECG) within two hours after treatment, and peak creatine kinase (CK)/CK-MB levels less than or equal to twice the upper limit of normal. Results. Seventy-three patients received prehospital tenecteplase; this treatment was determined to be appropriate in 86.4% of cases. The mean patient age was 59 years, and 71.6% of the patients were male. Mean (± standard deviation) scene-arrival-to-drug time was 26.2 (±11.4) minutes, the mean scene-arrival-to-hospital-arrival time was 73.0 (±20.6) minutes, and the mean transport time was 46.0 (± 11.1) minutes. Tenecteplase was administered 35.9 (±25.0) minutes prior to hospital arrival, and the estimated reperfusion time savings over PCI was 125.9 (±25.0) minutes. Aborted infarctions were observed in 24.1% of patients, whereas 9.6% suffered re-infarction, 47.9% underwent rescue angioplasty, and 16.7% required coronary artery bypass grafting (CABG). Serious bleeding events occurred in 15 patients (20.5%), and four (5.5%) died. Conclusion. In this retrospective review of rural STEMI patients, tenecteplase was administered 36 minutes prior to hospital arrival, saving approximately two hours over typical PCI strategies and resulting in aborted infarctions in one-fourth of patients. In a rural setting with lengthy transport times to PCI facilities, tenecteplase appears to be a feasible prehospital intervention. Randomized controlled trials are needed to fully evaluate the safety and effectiveness of this intervention prior to widespread adoption. Guideline 14: ACS

To measure the proportion of adult non-traumatic cardiac or respiratory arrest among calls for seizure to an emergency medical dispatch centre and to record whether known epileptic patients present cardiac or respiratory arrest together with seizure. Methods: This 2-year prospective observational investigation involved the collection of tape recordings of all incoming calls to the emergency medical dispatch centre, in which an out-of-hospital non-traumatic seizure was the chief complaint in patients >18 years, in addition to the paramedics' records of all patients who presented with respiratory or cardiac arrest. The authors also recorded whether the bystander spontaneously mentioned to the dispatcher that the victim was known to have epilepsy. Results: During the 24-month period, the call centre received 561 incoming calls for an out-of-hospital non-traumatic seizure in an adult. Paramedics classified twelve cases as cardiac or respiratory arrest. In one case, the caller spontaneously mentioned that the victim had a history of epilepsy. The proportion of cardiac or respiratory arrest among calls for seizure was 2.1%. Conclusion: Although these cases are rare, dispatchers should closely monitor seizure patients with the help of bystanders to exclude an out-of-hospital cardiac or respiratory arrest, in which case the dispatcher can offer telephone cardiopulmonary resuscitation advice until the paramedics arrive. Whenever the activity of the centre allows it and no new incoming call is on hold, this can be achieved by staying on the line with the caller or by calling back. A history of epilepsy should not modify the type of monitoring performed by the dispatcher as those patients may also have an arrest together with seizure.

Aims: To describe trends in incidence, outcome, and background characteristics among people who suffered an out-of-hospital cardiac arrest
with validated myocardial infarction aetiology (OHCA-V). Methods and results: People from the northern Sweden MONICA myocardial registry (1989 - 2007) with OHCA-V (n = 2977) were divided in two age groups (25 - 64 and 65 - 74 years). Both those who were resuscitated outside hospital and those who died before resuscitation was started were included in the study. The younger age group was studied during 1989 - 2007 and the older group during 2000 - 2007. The incidence of OHCA-V decreased in both the younger group (men p < 0.0001, women p = 0.04) and the older group (men p < 0.0001, women p < 0.0007, respectively). The proportion with a history of ischaemic heart disease prior to the event decreased (p < 0.0001). The proportion of previous myocardial infarction decreased (p < 0.0001), diabetes mellitus increased (p = 0.001), coronary interventions increased (p < 0.0001), and survival after OHCA-V increased (p < 0.0001) in the younger group but not in the older group. Long-term survival after OHCA-V was better in the younger than in the older group (p = 0.026). Conclusion: The incidence of OHCA-V decreased in both sexes. The proportion surviving after OHCA-V was small but increased, and long-term survival (>28 days) was better in the younger age group. Primary preventive measures may explain most of the improvements. However, the effects of secondary preventive measures cannot be excluded.

Patients with acute myocardial infarction are at high risk of dying within the first hours after onset of coronary ischemia. Therefore, pharmacological intervention should be started in the prehospital setting. This study investigates the effect of the prehospital administration of bivalirudin on short-term morbidity and mortality compared to heparin plus abciximab in patients with ST-segment-elevation myocardial infarction (STEMI). Methods: One hundred ninety-eight patients with STEMI treated with bivalirudin in the prehospital setting were prospectively collected. Coronary angiography was performed to identify the infarct-related artery. In case of a percutaneous coronary intervention, bivalirudin was given according to the guidelines. The historic control group consisted of 171 consecutive patients from the same myocardial infarction network treated with unfractioned heparin and abciximab administration before the admission to the emergency department of the percutaneous coronary intervention center. The primary outcome parameter was the incidence of major adverse cardiac events (recurrent myocardial infarction, stroke, death, target vessel revascularization for ischemia) within 30 days after the primary event. Results The overall rate of major adverse cardiac events was significantly lower in the bivalirudin group compared to the abciximab group (7.6% vs 14.6%; P = .04). The number of major bleedings was significantly higher in the abciximab group compared to the bivalirudin group (11.8% vs 3.8%; P = .03). Conclusions: The use of bivalirudin in the prehospital setting leads to a reduced rate of major cardiovascular events compared to a standard treatment with abciximab plus heparin. Bivalirudin is a reasonable choice of treatment in the prehospital setting for patients with STEMI. Guideline 14: ACS

This study reports invasive arterial pressures before and after the rhythm analysing pauses during CPR and evaluates the possible association of the quality of CPR and the length of the pause with blood pressure around the pause. Five patients who experienced out-of hospital or in-hospital cardiac arrest were included in the study. Using a monitor/defibrillator with sensing capabilities, the parameters of CPR quality including chest compression depth, rate, force and the duration of interruption were recorded and compared to blood pressure. Altogether 42 pauses were observed in five patients with a duration of 9±5s (mean±SD). The values for systolic (SAP), mean (MAP) and diastolic arterial pressures...
(DAP) were 107±30, 44±12 and 14±12mmHg before the pause and 119±34, 49±13 and 14±14mmHg after the pause, respectively. There was a statistically significant increase in both SAP (12.1±28.2mmHg; p=0.021) and MAP (4.2±8.7mmHg (p=0.008) and the duration of the pause was identified as an independent factor for that in a linear mixed model. The pause duration up to ten seconds maintained the pressure achieved if the compression depth was immediately according to the guidelines (p=0.046). Contrary to the previous animal studies, this preliminary study in humans demonstrates that blood pressures achieved before the rhythm analysis pause do not necessarily decrease after the pause but may even increase if the duration of the pause is under ten seconds and the quality of CPR is good both before and after the pause.

**Guideline 8: Cardiopulmonary resuscitation**

13. Kellett J, Li M, Rasool S, Green GC, Seely A. *Comparison of the heart and breathing rate of acutely ill medical patients recorded by nursing staff with those measured over 5 min by a piezoelectric belt and ECG monitor at the time of admission to hospital.* Resuscitation 2011; 82 (11): 1381-6

Heart and breathing rates are predictors of disease severity and of a poor outcome. However, few reports have compared their machine measurements with traditional manual methods. Setting: A small rural Irish hospital. The heart and breathing rates of 377 acutely ill medical patients (mean age 68.3 SD 16.8 years) recorded by nursing staff at the time of admission to hospital was compared with those measured over 5 min by a piezoelectric belt and ECG monitor (the BT16 acquisition system). The mean breathing rate measured by the nursing staff (20.9 SD 4.8 breaths per min) and that measured by the BT16 piezoelectric belt (19.9 SD 4.5 breaths per min) were significantly different (p = 0.004), as were the nurse and BT16 measured heart rates (85.4 SD 21.3 vs. 81.2 SD 18.7, p = 0.004), and the correlation coefficient between the two methods of breathing and heart rate measurement were low. Nurse measured breathing rate measurements were clustered around rates of 18, 20 and 22 breaths per min. Unlike those obtained by nurses, BT16 measured heart and breathing rates were shown by logistic regression to be independent predictors of in-hospital mortality. There is a poor correlation between breathing and heart rates measured by traditional methods and those obtained by the BT16 device. BT16 derived breathing and heart rates, but not those measured manually, were independent predictors of in-hospital mortality.


Objective: Severe thermal injury induces inflammatory and hypermetabolic responses that are associated with morbidity and mortality. However, it is not well-documented whether the causes of burns affect inflammation, hypermetabolism, and morbidity. The aim of the present study was to determine whether there is a difference in degree of inflammation, hypermetabolism, endocrine and acute-phase response, and clinical outcome between pediatric patients with scald and flame burns. Interventions: None. Measurements and Main Results: Children with burns requiring surgical intervention were enrolled in this cohort study and divided into two groups, scald or flame burn. In a second assignment, we analyzed the study populations in representative subgroups containing individuals with third-degree burns of 40% to 60% total body surface area. We determined clinical outcomes, resting energy expenditures, cytokine profiles, acute-phase proteins, constitutive proteins, and hormone panels. Statistical analysis was evaluated by analysis of variance, Student's t test corrected with the Bonferroni post hoc test, and the propensity score. Statistical significance was set at p < .05. A total of 912 patients were identified. Six hundred seventy-four had a flame burn and 238 had a scald burn. There was a significant difference (p < .05) in burn size (flame, 48% ± 23%; scald, 40% ± 21%), third-degree burn (flame, 39% ± 27%;
scald 22% ± 25%), age (flame, 8 ± 5 yrs; scald, 3 ± 3 yrs), and mortality between groups. Propensity analysis confirmed the type of burn as a significant risk factor for morbidity and mortality. Subanalysis conducted in a representative patient group suffering from 40% to 60% burn total body surface area revealed that flame burns lead to significantly increased hypermetabolic, inflammatory, and acute-phase responses when compared to scald burns (p < .05). The frequency of sepsis was 3% in the scald burn group, while it was 14% in the flame group (p < .001). Multiorgan failure occurred in 14% of the scald patients, while it occurred in 17% of flame patients. The mortality in patients suffering from a scald burn was 3% compared to 6% in the flame-burned group (p < .05). Conclusion: The type of burn affects hypermetabolism, inflammation, acute-phase responses, and mortality postburn.

Guideline 9.1.3: Burns


Background: Acute aortic dissection (AAD) is often missed on initial assessment. Purpose: The aim of our study was to identify features associated with misdiagnosis of acute aortic dissection (AAD). Methods and results: We examined a total of 109 emergency room (ER) patients who were ultimately diagnosed with AAD. Misdiagnosis of AAD was defined as failure to diagnose AAD at the end of the initial assessment in the ER, and occurred in 17 patients (16%). The alternate diagnosis consisted of acute coronary syndrome (n = 10), other cardiovascular disease (n = 3), abdominal disease (n = 3), and cerebral infarction (n = 1). In the misdiagnosed patients, walk-in mode of admission to the ER (29% vs. 10%, p = 0.042) and anterior chest pain (71% vs. 41%, p = 0.025) were more frequent, and widened mediastinum (25% vs. 55%, p = 0.023) was less frequent than in diagnosed patients. The number of imaging studies performed per patient was also fewer in misdiagnosed patients than in diagnosed patients (0.82 ± 0.81 vs. 1.53 ± 0.52, p < 0.001). However, there was no significant difference in in-hospital mortality (18% vs. 15%, p = 0.520). Multivariate analysis showed that the strongest predictor of misdiagnosis was walk-in mode of admission (odds ratio 4.777; 95% confidence interval 1.267–18.007; p = 0.021). Conclusions: Both diversity of symptoms and variability of the severity of symptoms, especially walk-in mode of admission lead ER physicians to miss AAD in about 1 in 6 cases of AAD. It is therefore important to keep AAD as a differential diagnosis in mind, even when patients present with mild enough symptoms that allow them to walk into the ER.


Objective. To determine the predictive value of the mechanism-of-injury step of the American College of Surgeons Field Triage Decision Scheme for determining trauma center need. Methods. Emergency medical services (EMS) providers caring for injured adult patients transported to the regional trauma center in three midsized communities over two years were interviewed upon emergency department (ED) arrival. Included was any injured patient, regardless of injury severity. The interview collected patient physiologic condition, apparent anatomic injury, and mechanism of injury. Using the 1999 Scheme, patients who met the physiologic or anatomic steps were excluded. Patients were considered to need a trauma center if they had non-orthopedic surgery within 24 hours, had intensive care unit admission, or died prior to hospital discharge. Data were analyzed by calculating positive likelihood ratios (+LRs) and 95% confidence intervals (CIs) for each mechanism-of-injury criterion. Results. A total of 11,892 provider interviews were conducted. Of those, one was excluded because outcome data were not available, and 2,408 were excluded because they met the other steps of the Field Triage Decision Scheme. Of the remaining 9,483 cases,
2,363 met one of the mechanism-of-injury criteria, 204 (9%) of whom needed the resources of a trauma center. Criteria with a +LR ≥5 were death of another occupant in the same vehicle (6.8; CI: 2.7–16.7), fall >20 feet (5.3; CI: 2.4–11.4), and motor vehicle crash (MVC) extrication time >20 minutes (5.1; CI: 3.2–8.1). Criteria with a +LR between >2 and <5 were intrusion >12 inches (4.2; CI: 2.9–5.9), ejection (3.2; CI: 1.3–8.2), and deformity >20 inches (2.5; CI: 1.9–3.2). The criteria with a +LR ≤2 were MVC speed >40 mph (2.0; CI: 1.7–2.4), pedestrian/bicyclist struck at a speed >5 mph (1.2; CI: 1.1–1.4), bicyclist/pedestrian thrown or run over (1.2; CI: 0.9–1.6), motorcycle crash at a speed >20 mph (1.2; CI: 1.1–1.4), rider separated from motorcycle (1.0; CI: 0.9–1.2), and MVC rollover (1.0; CI: 0.7–1.5). Conclusion. Death of another occupant, fall distance, and extrication time were good predictors of trauma center need when a patient did not meet the anatomic or physiologic conditions. Intrusion, ejection, and vehicle deformity were moderate predictors.


Objective: The incidence and incidence over time of cardiac arrest in hospitalized patients is unknown. We sought to estimate the event rate and temporal trends of adult inhospital cardiac arrest treated with a resuscitation response. Design: Three approaches were used to estimate the inhospital cardiac arrest event rate. First approach: calculate the inhospital cardiac arrest event rate at hospitals (n = 433) in the Get With The Guidelines-Resuscitation registry, years 2003 - 2007, and multiply this by U.S. annual bed days. Second approach: use the Get With The Guidelines-Resuscitation inhospital cardiac arrest event rate to develop a regression model (including hospital demographic, geographic, and organizational factors), and use the model coefficients to calculate predicted event rates for acute care hospitals (n = 5445) responding to the American Hospital Association survey. Third approach: classify acute care hospitals into groups based on academic, urban, and bed size characteristics, and determine the average event rate for Get With The Guidelines-Resuscitation hospitals in each group, and use weighted averages to calculate the national inhospital cardiac arrest rate. Annual event rates were calculated to estimate temporal trends. Setting: Get With The Guidelines-Resuscitation registry. Patients: Adult inhospital cardiac arrest with a resuscitation response. Measurements and Main Results: The mean adult treated inhospital cardiac arrest event rate at Get With The Guidelines-Resuscitation hospitals was 0.92/1000 bed days (interquartile range 0.58 to 1.2/1000). In hospitals (n = 150) contributing data for all years of the study period, the event rate increased from 2003 to 2007. With 2.09 million annual U.S. bed days, we estimated 192,000 inhospital cardiac arrests throughout the United States annually. Based on the regression model, extrapolating Get With The Guidelines-Resuscitation hospitals to hospitals participating in the American Hospital Association survey projected 211,000 annual inhospital cardiac arrests. Using weighted averages projected 209,000 annual U.S. inhospital cardiac arrests. Conclusions: There are approximately 200,000 treated cardiac arrests among U.S. hospitalized patients annually, and this rate may be increasing. This is important for understanding the burden of inhospital cardiac arrest and developing strategies to improve care for hospitalized patients.


Background. Intraosseous (IO) access is attempted when intravenous access cannot be established during an emergency. The U.S. Food and Drug Administration–cleared semiautomatic IO access device (EZ-IO; Vidacare Corp., Shavano Park, TX) has been shown to be safe and effective. Objective. To examine the characteristics of pediatric patients receiving IO infusions, primary clinical impressions of emergency
medical services providers, success rates, and subsequent treatment after use of a manual IO device or the semiautomatic IO device. Methods. A mid-western, 12-site, statewide ambulance service began using the semiautomatic device instead of a manual IO device in 2007. Retrospective review included analysis of device placement rates and subsequent treatment of children (younger than 18 years) who underwent an IO access procedure with either the manual device (January 2003 through February 2007) or the semiautomatic device (March 2007 through May 2009). Results. First-attempt success was achieved in 80.6% of patients (25 of 31) in the manual device group and in 83.9% of patients (52 of 62) in the semiautomatic device group (p = 0.98). In the manual device group, there were 37 attempts for 25 successful device placements (67.6% success), and in the semiautomatic group, there were 72 attempts for 58 successful placements (80.6% success) (p = 0.52). Intravenous attempts were made before IO attempts in 35.5% of patients (11 of 31) in the manual group and in 1.7% of patients (1 of 60) in the semiautomatic group (p < 0.001). Treatment (medication use, excluding lidocaine for local anesthetic purposes and intravenous crystalloid) was administered IO in 84.0% of the patients (21 of 25) in the manual device group and in 73.2% of the patients (41 of 56) in the semiautomatic device group. Conclusions. For the pediatric cohort, use of a semiautomatic IO access device in place of a manual device offered no statistically significant difference in first-attempt success (3.3%) or in success per attempt (13.0%). However, the rate at which IO access was used by emergency medical services providers more than tripled with use of the semiautomatic device.

**Guideline 12.4 Medications & Fluids in Paediatric Advanced Life Support**


The use of therapeutic hypothermia is recommended for unconscious adult patients with return of spontaneous circulation (ROSC) after out-of-hospital ventricular fibrillation cardiac arrest. There is evidence that the time taken to achieve target temperature impacts survival. Objectives: To audit the performance of an emergency department (ED) in implementing therapeutic hypothermia and achieving target temperature in survivors of out-of-hospital cardiac arrest admitted to the intensive care unit (ICU). Methods: Data were extracted from the medical records of patients admitted to the ICU from the ED in the Royal United Hospital following out-of-hospital cardiac arrest (OHCA) between June 2002 and October 2008. The intervals between ROSC and initiation of cooling and between initiation of cooling and achieving the core temperature of 34°C were recorded. Results: During this period, 83 patients were admitted to the ICU following OHCA. Of these, 67 (81%) were actively cooled. All 16 patients who were not cooled had recognised exclusion criteria. The median time (IQR) from ROSC to initiation of cooling was 60 (40' 165) minutes and the median time (IQR) to reach 34°C was 175 (40' 420) minutes. Of the 67 who were cooled, 44 (66%) achieved the temperature of 34°C within 4h, the audit standard published by the Royal College of Anaesthetists. In 29 (43%) patients, the temperature increased after leaving the ED. Conclusions: Among OHCA patients who met recognised inclusion criteria, therapeutic hypothermia was implemented successfully by the ED staff. The temperature should be measured continuously from the same site in both the ED and the ICU. This will provide consistent and continuous temperature monitoring between the ED and the ICU and will enable prompt intervention to prevent temperature increases.

**Guideline 11.8 Therapeutic Hypothermia after Cardiac Arrest**

20. Pinheiro JMB, Boynton S, Furdon SA, Dugan R, Reu-Donlon C. *Use of Chemical Warming Packs During Delivery Room*

Hypothermia is an independent contributor to neonatal mortality. All very low-birth-weight (VLBW) newborns have the potential to undergo cold stress or frank hypothermia during delivery room stabilization. Thus, clinicians aiming to maintain normothermia in VLBW neonates are compelled to use multiple adjuncts of unknown efficacy or safety. OBJECTIVE: To evaluate the effectiveness of thermoregulation procedures in maintaining normothermia during delivery room resuscitation and to assess the impact of an unanticipated change in equipment at our institution on the admission temperatures of VLBW newborns. DESIGN/METHODS: Institutional review board-approved, retrospective analysis of quality assurance data submitted to the Vermont-Oxford Network (VON) for 24 consecutive months starting January 2006. We compared the rate of hypothermia (admission temperature < 36.5°C) in our NICU during 2006 with the aggregate rates reported by VON. We then compared the rates of hypothermia and mean admission temperatures in our NICU during period 1 (when chemical warming packs were used routinely, in addition to plastic wrapping and warm blankets) and period 2 (after packs were discontinued owing to an incident of focal skin injury). RESULTS: In 2006, 42% of VLBW babies in our NICU had an admission temperature of less than 36.5°C compared with the VON rate of 61% (interquartile range 48%, 76%). During period 1, 39% of 183 VLBW neonates were hypothermic compared with 68% of 103 during period 2 (P < .001). Mean admission temperatures during periods 1 and 2 were 36.5°C and 36.1°C, respectively (P < .001). A control chart showed the shift in temperatures occurring as period 2 began. No change in practice other than discontinuation of the warming packs was instituted during period 2. The incidence of temperatures greater than 38°C (hyperthermia) was 1.6% during period 1 and 1.0% during period 2. CONCLUSIONS: The results associated with this isolated change in practice at our institution suggest that chemical warming packs were a useful adjunct in achieving above-average rates of normothermia during delivery room resuscitation of VLBW newborns. Their potential adverse effects should be weighed against the increased risk of mortality associated with hypothermia in this population.

Guideline 13: Resuscitation of the newborn infant


Objective: The objective of this study was to describe the injuries and distribution of casualties resulting from the crash of Turkish Airlines flight TK 1951 near Schiphol Airport in the Netherlands on 25 of February 2009. Methods: This was a retrospective, descriptive study. Based on a review of the hospital records for all casualties of the airplane crash, triage at the scene, time to emergency department, Abbreviated Injury Scale (AIS) and Injury Severity Score (ISS), mortality, length of hospital stay and surgical procedures were abstracted. Results: Of the 135 passengers, nine died on-scene. A total of 126 survivors were examined in 15 hospitals; data for all survivors were available for the study. Median time between crash and arrival at an emergency department was 3.5 hours (range 1.25-5.5 hours). Six passengers were uninjured and 66 were admitted to hospital. A total of 305 injuries were recorded. The majority were head and facial injuries (92), spinal injuries (35), and fractures of extremities (38). Eighteen percent of the patients had a spinal injury. The mean ISS was 6.3 (range = 1, 57). The ISS score was >15 for 13 patients. Surgical procedures (80) were necessary in 23 patients. There was no in-hospital mortality. Conclusions: Although the accident was in an urban area, there was a significant delay between the time of the accident and the arrival of the casualties at hospital emergency departments. The Turkish Airlines crash provides extensive information for research into mass-casualty or disaster management, triage, plane crash injuries, and survivability. The 'Medical Research Turkish Airlines Crash' (MOTAC) study group currently is investigating several of these

In the prehospital setting opioid overdose is often treated with naloxone. In our physician-based medical emergency care unit (MECU) we have adopted a discharge-on-scene policy, where patients are released on scene if no residual signs of opioid intoxication are found after treatment. The aim of this study was to describe our experience with the discharge-on-scene policy used during a 10-year-period with focus on the frequency of rebound opioid toxicity. Data were prospectively recorded in our MECU database and we reviewed all cases of opioid overdose between 1994 and 2003. The MECU database was cross-referenced with the Central Personal Registry. For patients who died within 48h of MECU contact we reviewed the forensic autopsy reports to establish whether rebound opioid toxicity was likely. We found 4762 cases of acute opioid overdose. In 3245 cases positive identification was obtained. Over this ten year period fourteen patients who were released on-scene after having been treated with naloxone died within 48h, but only in 3 of these we found a rebound opioid toxicity to be the likely cause of death, corresponding to 0.13% of those 2241 released on scene who were identified. Prehospital discharge-on-scene after naloxone treatment is associated with a low risk of death due to rebound toxicity.

Reviews


Caring in the emergency department for the patient with return of spontaneous circulation after cardiac arrest is challenging. A coordinated and systematic approach to post-cardiac arrest care can improve the mortality and the chance of meaningful neurologic recovery. By achieving appropriate targets for oxygenation, ventilation, and hemodynamic parameters, along with initiating therapeutic hypothermia and arranging early percutaneous coronary intervention, the emergency physician can have the most significant impact on patients who have just been revived from death.


Myocardial disease and death from cardiac arrest remain significant public health problems. Sudden death events and out-of-hospital cardiac arrests (OHCA) are encountered frequently by emergency medical services. Despite more than 30 years of research, survival rates remain extremely low. This article reviews access and presentations, demographics, OHCA outcomes, and response systems and processes in treatment of patients with arrest in this setting.


Even the best conventional manual cardiopulmonary resuscitation (CPR) is highly inefficient, producing only a fraction of normal cardiac output.
Over the past several decades, many therapeutic devices have been designed to improve on conventional CPR during cardiac arrest and increase the probability of survival. This article reviews several adjuncts and mechanical alternatives to conventional CPR for use during cardiac arrest. Recent clinical studies comparing conventional resuscitation techniques with the use of devices during cardiac arrest are reviewed, with a focus on clinical implications and directions for future research.


After resuscitation of the cardiac arrest patient, reperfusion to the brain begins a cascade of events that may lead to permanent brain damage. Cooling suppresses the inflammatory response related to ischemia and metabolic demand, improving oxygen supply to anoxic areas. Until recently, cooling was only performed in the hospital setting. Recent studies have questioned whether initiating the cooling process immediately after resuscitation is beneficial in the pre-hospital setting. The primary purpose of this study was to examine the feasibility and safety of pre-hospital hypothermia via data extraction from randomized controlled trials and statistical meta-analysis. Studies included in this analysis did show a significant statistical difference with the ability to lower the body temperature when beginning pre-hospital cooling immediately, making it feasible to start therapeutic hypothermia in the pre-hospital setting. Further research is needed to determine neurological and discharge outcomes as the studies were not powered to determine statistical significance.


In certain cardiac arrest situations, modifications to current cardiac resuscitation algorithms may improve patient outcome. These situations are often rare, but when they occur they house the potential for severe time and resource use, and in some cases specialized skill sets. The decision to apply these modifications to standard care for the cardiac arrest patient may be obvious in some cases or may be applied due to suspicion from the presenting medical history, history of present illness, or physical examination. However, with rare exception, general care of any cardiac arrest patient should include continuous high-quality chest compressions and appropriate airway and ventilatory management.


Cardiac arrest remains a common problem throughout the world. This article explores several factors that aid in determining prognosis after cardiac arrest. It is broadly divided into pre-arrest factors, intra-arrest factors, and postarrest factors. Pre-arrest factors predominantly concern the presence or absence of a shockable rhythm. Intra-arrest factors look at the partial pressure of end-tidal CO2 and the presence of cardiac standstill on ultrasound. Postarrest factors include early outcome measures as well as a more comprehensive algorithmic approach to predicting neurologic outcome.


Rapid response systems (RRS) are both intuitive and supported by data, but the institution of an RRS is not a panacea for in-hospital cardiac arrest or unexpected deaths. RRS implementation should be one component of an institution-wide effort to improve patient safety that includes adequate nursing education and staffing, availability and involvement of a patient’s primary caregivers, and hospital provision of sufficient
Pulseless electrical activity (PEA), a cardiac arrest rhythm scenario with an associated poor prognosis, is defined as cardiac electrical activity without a palpable pulse. Considering both outpatient and inpatient cardiac arrest presentations, PEA as a rhythm group has been increasing over the past 10 to 20 years with a corresponding decrease in the 'shockable rhythms', such as pulseless ventricular tachycardia and ventricular fibrillation. This review focuses on electrocardiographic findings encountered in PEA cardiac arrest presentations with an emphasis on recognition of patients with a potential opportunity for successful resuscitation.

Recognition and appropriate treatment of ventricular fibrillation or pulseless ventricular tachycardia is an essential skill for healthcare providers. Appropriate defibrillation can improve survival and benefit patient outcome. Similarly, increased public access to automatic electronic defibrillators has been shown to improve out-of-hospital survival for cardiac arrest. When combined with high-quality cardiopulmonary resuscitation, electrical therapies are an important aspect of resuscitation in the patient with cardiac arrest. This article focuses on the use of electrical therapies, including defibrillation, cardiac pacing, and automated external defibrillators, in cardiac arrest.

In-hospital sudden cardiac arrest and resuscitation is distinct from out-of-hospital sudden cardiac arrest (OOHSCA) and warrants specific attention. Sudden cardiac arrest (SCA) is a manifestation of an underlying process rather than a disease itself. The complex, multi-organ system dysfunction common among the inpatient population can precipitate SCA by both similar and very different mechanisms than OOHSCA. The diagnostic and treatment algorithms of SCA remain largely the same between the inpatient and outpatient arenas. The application of complex diagnostic and therapeutic interventions is permissible, but such tools must not interrupt or delay the important basics of cardiac arrest management in the inpatient setting, including adequate chest compressions and timely defibrillation when appropriate.

Airway management has been emphasized as crucial to effective resuscitation of patients in cardiac arrest. However, recent research has shown that coronary and cerebral perfusion should be prioritized rather than airway management. Endotracheal intubation has been deemphasized. This article reviews the current state of the literature regarding airway management of the patient in cardiac arrest. Ventilatory management strategies are also discussed.

Cardiopulmonary resuscitation (CPR) is vital therapy in cardiac arrest care by lay and trained resucuers. Chest compressions are the key component of CPR. Ventilation and airway management should be secondary to high-quality and continuous chest compressions in patients receiving CPR. Only after the patient has had return of spontaneous circulation or completed a cycle of CPR with defibrillation (if appropriate)
should attempts at securing an advanced airway be made. Even then, interruptions of chest compressions should be minimized to maintain cardiocerebral perfusion and increase survival. Finally, the ventilation rate should be no more than 8 to 10 breaths per minute.

Solutions to improve care provided during cardiac arrest resuscitation attempts must be multifaceted and targeted to the diverse number of care providers to be successful. In this article, new approaches to improving cardiac arrest resuscitation performance are reviewed. The focus is on a continuous quality improvement paradigm highlighting improving training methods before actual cardiac arrest events, monitoring quality during resuscitation attempts, and using quantitative debriefing programs after events to educate frontline care providers.

The goal of treating patients who present with cardiac arrest is to intervene as quickly as possible to affect the best possible outcome. The mainstays of these interventions, including early activation of the emergency response team, early initiation of cardiopulmonary resuscitation, and early defibrillation, are essential components with demonstrated positive impact on resuscitation outcomes. Conversely, the use of the code drugs as a component of advanced life support has not benefited these patients to the same extent as the basic interventions in a general. Although short-term outcomes are improved as a function of these medications, the final outcome has not been altered significantly in most instances.

Background: Many studies over the past decade have investigated delaying initial defibrillation to perform cardiopulmonary resuscitation (CPR), as it has been associated with increased rates of restoration of spontaneous circulation and/or survival. Since 2006, a number of studies have investigated these procedures. The objective of this study was to undertake a literature review examining the commencement of CPR before defibrillation in the out-of-hospital setting. Methods: A literature review was undertaken using the electronic medical databases Ovid Medline, EMBASE, CINHAL Plus, Cochrane Systematic Review and Meditext, from their commencement to the end of June 2011. Keywords used in the search included: CPR, defibrillation, ventricular fibrillation, VF, EMS, EMT, paramedic, emergency medical service, emergency medical technician, prehospital, out-of-hospital and ambulance. References of relevant articles were also reviewed. Findings: Of the 3079 articles located, 10 met the inclusion criteria. The results of these studies showed conflicting results. All retrospective studies (n=6) indicated a benefit in performing pre-shock CPR on patients with ventricular fibrillation for durations between 90 and 180s. Conversely, all randomised controlled trials demonstrated no benefit from providing CPR before defibrillation compared with immediate defibrillation for return of spontaneous circulation, neurological outcome and/or survival to hospital discharge. However, none of the studies reported evidence that CPR before defibrillation is harmful. Conclusion: Conflicting evidence remains regarding the benefit of CPR before defibrillation. The establishment of a consistent timeframe of chest compressions before defibrillation in the out-of-hospital setting will provide uniformity in standards in clinical practice and
education and training.

Cardiac arrest in children is, fortunately, a relatively infrequent event. Mortality rate after cardiac arrest is greater than 50%. This article discusses strategies to increase the chance of survival to discharge. These strategies focus on suggestions for organizing a system prepared to care for critically ill children, incorporating the 2010 American Heart Association resuscitation guidelines into clinical practice, and encouraging physicians to become advocates of decreasing the occurrence of pediatric cardiac arrest. Providing the best-prepared system available to care for critically ill children will, it is hoped, decrease the number of preventable deaths in children.

39. Wyllie J. Recent changes to UK newborn resuscitation guidelines. Arch Dis Child Fetal Neonat 2011; Online first (November 9)
The new UK newborn resuscitation guidelines were published online on the 18th of October 2010 simultaneously with the European guidelines. Both are based upon evidence derived from a critical evaluation of relevant scientific publications over the preceding 5 years organised and co-ordinated by the International Liaison Committee on Resuscitation (ILCOR), with simultaneous publication of guidelines and evidence. This article summarises both the process and changes...

Animal, manikin & cadaver models

Six different supraglottic airway devices: Combitube™, laryngeal mask airway, intubating laryngeal mask airway (Fastrach™), i-gel™, Laryngeal Tube™ and Pro- Seal™ laryngeal mask airway were assessed by 58 paramedic students for speed and ease of insertion in a manikin, whilst wearing either chemical, biological, radiation, nuclear-personal protective equipment (CBRN-PPE) or a standard uniform. All devices took significantly longer to insert when wearing CBRN-PPE compared with standard uniform (p < 0.001). In standard uniform, insertion time was shorter than 45 s in 90% of attempts for all devices except the Combitube, for which 90% of attempts were completed by 53 s. Whilst wearing CBRN-PPE the i-gel was the fastest device to insert with a mean (SD (95% CI)) insertion time of 19 (8 (17–21))s, p < 0.001, with the Combitube the slowest with mean (65 (23 (59–71)))s. Wearing of CBRN-PPE has a negative impact on supraglottic airway insertion time.

The objective was to validate an existing theoretical model for the mechanics of constant peak displacement cardiopulmonary resuscitation (CPR) using experimental data taken using various back support surfaces at different chest compression (CC) rates. Methods: A CPR simulator was used to perform constant peak displacement CC on a weighted full-body CPR training manikin supported on surfaces of varying
stiffness at different CC rates. The net sternum-to-spine displacement, combined chest and mattress displacement, and axial reaction force were measured during each test. The experimental results were compared to theoretical predictions from the constant peak displacement CPR model. Results: The theoretical model predictions matched the experimental data to within a mean difference of 11.7% at a CC rate of 42 compressions per minute (cpm), 10.0% at a CC rate of 60 cpm, and 10.1% at a CC rate of 96 cpm, for a target maximum sternal displacement of 5.0 cm. The model predictions also show that when the back support stiffness is less than 250 N/cm, the benefit of using a backboard is greater than for stiffer support surfaces. Conclusions: Good quantitative agreement between the experimental data and the theoretical model suggests that the constant peak displacement CPR model provides reasonable prediction of CC mechanics during CPR over a wide range of CC rates. Conflicts in the literature are also explained by showing that backboards can significantly enhance CPR CC performance when the back support stiffness is less than 250 N/cm, while for surfaces with higher stiffness, the benefit of using a backboard is reduced.

42. Davis DP and Davis PW. A structural model of perfusion and oxygenation in low-flow states. Resuscitation 2011; 82 (11): 1444-52
Recent investigations underscore the critical importance of ventilation strategies on resuscitation outcomes. In low perfusion states, such as cardiac arrest and traumatic shock, the rise in intrathoracic pressure that accompanies positive-pressure ventilation can significantly impede venous return and lead to a decrease in cardiac output. The optimal ventilation strategy in these 'low-flow' states remains unclear. To create a mathematical model of perfusion and oxygenation to predict the effects of PPV with both normotension and hypotension. The lung pressure-volume relationship was modelled using a novel formula allowing manipulation of various lung characteristics. A separate formula was then derived to predict mean intrathoracic pressure (MITP) for specific minute ventilation values using the pressure-volume formula. The addition of positive end-expiratory pressure was also modeled. Finally, a formula was derived to model oxygen absorbance as a function of alveolar surface area and flow based on ventilation rate and MITP. Mathematical models of the lung pressure-volume relationship, MITP, and absorbance were successfully derived. Manipulation of total lung capacity, compliance, upper and lower inflection points, positive end-expiratory pressure, and minute ventilation allowed prediction of optimal ventilation rate and tidal volume for a normal lung and with various abnormal characteristics to simulate particular disease states, such as acute respiratory distress syndrome (ARDS). For a normal lung, ventilation rates of 4 – 6 breaths/min with higher tidal volumes (15 - 20mL/kg) resulted in the lowest predicted MITP values (5cm H2O) and the highest absorbance. The input of lung parameters that would simulate ARDS resulted in optimal ventilation rates of 10 – 12 breaths/min with lower tidal volumes (8 -10mL/kg) and higher predicted MITP values (10 - 15cmH2O). A mathematical model of ventilation was successfully derived allowing manipulation of multiple pulmonary physiological variables to predict MITP and potentially identify optimal ventilation strategies. This model suggests the use of lower ventilation rates and larger tidal volumes to minimize the hemodynamic effects of positive pressure ventilation in patients with hypoperfusion but normal lung characteristics.

In confined-space airway emergencies, prehospital personnel may need to perform cricothyrotomy when conventional airway techniques cannot be utilized or have failed. This study is a prospective, cross-over, randomized controlled trial that compares two widely-known techniques using two commercially available kits. Methods: Twenty residents at Palmetto Health Richland Department of Emergency Medicine participated in the study. Their performance was assessed using the time required to placement and correctness of placement for each device. The residents
performed the procedures on an Air-Man manikin that had been situated in a confined space. The residents also indicated which kit they would prefer in a confined-space, emergency airway situation. Results: All of the devices were placed in the airway. The mean time to placement for the Melker and Quicktrach kits was 108.5 seconds and 23.9 seconds, respectively. This yielded a mean difference of 84.5 seconds, which provided a t-statistic of 8.88 (p < 0.0001). There was no evidence of a carry-over effect (p = 0.292) or a period effect (p = 0.973). All residents preferred using the Quicktrach kit. Conclusions: Use of the Quicktrach kit resulted in the fastest time to placement, was placed correctly in the airway, and was preferred by each of the residents. Its small, simple, and sturdy design, with few parts and easy manipulation, allow the Quicktrach to be a valuable option in prehospital situations involving confined spaces. The Melker kit, with its many parts, and need for greater manipulation, is not as easily utilized or preferred in a confined space scenario.

Conducted electrical weapons (CEWs) are used by law enforcement for control of subjects by causing neuromuscular incapacitation. There has been scrutiny of CEWs and their potential role in the occasional sudden death of subjects in custody. There is a hypothesized causal relationship due to induced cardiac dysrhythmia. Previous work has not shown dysrhythmia induction in resting humans. However, these devices are not often used on resting individuals in the field. Objective: We sought to determine if exposure to a CEW in a physically exhausted human sample population caused detectable change in the 12-lead electrocardiogram (ECG). Methods: Human volunteers were enrolled. All subjects had a baseline ECG obtained and then underwent an exercise regimen until exhaustion. The volunteers then received a continuous 15-s application from a TASER X26 CEW (TASER International, Scottsdale, AZ). CEW electrodes were placed on random positions of their anterior thoraces. Electrode positions involved at least a 12-inch spread and always encompassed the normal anatomic position of the heart. An ECG was obtained immediately after CEW exposure. A blinded cardiologist interpreted ECGs. Results: At baseline, 24/25 ECGs were normal. One baseline ECG was abnormal due to several monomorphic premature ventricular complexes. After CEW exposure, all 25 ECGs were interpreted as normal. Conclusions: Prolonged CEW application in an exhausted human sample did not cause a detectable change in their 12-lead ECGs. Theories of CEW-induced dysrhythmia in non-rested humans are not supported by our findings.

Cervical orthoses are commonly used for extrication, transportation, and definitive immobilization for cervical trauma patients. Various designs have been tested frequently in young, healthy individuals. To date, no one has reported the effectiveness of collar immobilization in the presence of an unstable mid-cervical spine. Study Objectives: To determine the extent to which cervical orthoses immobilize the cervical spine in a cadaveric model with and without a spinal instability. Methods: This study used a repeated-measures design to quantify motion on multiple axes. Five lightly embalmed cadavers with no history of cervical pathology were used. An electromagnetic motion-tracking system captured segmental motion at C5 - C6 while the spine was maneuvered through the range of motion in each plane. Testing was carried out in intact conditions after a global instability was created at C5 - C6. Three collar conditions were tested: a one-piece extraction collar (Ambu Inc., Linthicum, MD), a two-piece collar (Aspen Sierra, Aspen Medical Products, Irvine, CA), and no collar. Gardner-Wells tongs were affixed to the skull and used to apply motion in flexion-extension, lateral bending, and rotation. Statistical analysis was carried out to evaluate the conditions:
collar use by instability (3 x 2). Results: Neither the one- nor the two-piece collar was effective at significantly reducing segmental motion in the stable or unstable condition. There was dramatically more motion in the unstable state, as would be expected. Conclusion: Although using a cervical collar is better than no immobilization, collars do not effectively reduce motion in an unstable cervical spine cadaver model. Further study is needed to develop other immobilization techniques that will adequately immobilize an injured, unstable cervical spine.


The 2005 guidelines for cardiopulmonary resuscitation (CPR) do not include a statement on performance of basic life support by a single healthcare professional using a bag-valve-mask device. Three positions are possible: chest compressions and ventilations from over the head of the casualty (over-the-head CPR), from the side of the casualty (lateral CPR), and chest compressions from the side and ventilations from over the head of the casualty (alternating CPR). The aim of this study was to compare CPR quality of these three positions. Methods: 102 healthcare professionals were randomised to a crossover design and performed a 2-min CPR test on a manikin for each position. Results: The hands-off time over a 2-min interval was not significantly different between over-the-head (median 31s) and lateral (31s) CPR, but these compared favourably with alternating CPR (36s). Over-the-head CPR resulted in significantly more chest compressions (155) compared with lateral (152) and alternating CPR (149); the number of correct chest compressions did not differ significantly (119 vs 122 vs 109). Alternating CPR resulted in significantly less inflations (eight) compared with over-the-head (ten) and lateral CPR (ten). Lateral CPR led to significantly less correct inflations (three) compared with over-the-head (five) and alternating CPR (four). Conclusions: In the case of a single healthcare professional using a bag-valve-mask device, the quality of over-the-head CPR is at least equivalent to lateral, and superior to alternating CPR. Because of the potential difficulties in bag-valve-mask ventilation in the lateral position, the authors recommend over-the-head CPR.


OBJECTIVE: To examine the hypothesis that pediatric resuscitation providers hyperventilate patients via bag-valve-mask (BVM) ventilation during performance of cardiopulmonary resuscitation (CPR), quantify the degree of excessive ventilation provided, and determine if this tendency varies according to provider type. METHODS: A retrospective, observational study was conducted of 72 unannounced, monthly simulated pediatric medical emergencies 'mock codes' in a tertiary care, academic pediatric hospital. Responders were code team members, including pediatric residents and interns (MDs), respiratory therapists (RTs), and nurses (RNs). All sessions were video-recorded and reviewed for the rate of BVM ventilation, rate of chest compressions, and the team members performing these tasks. The type of emergency, location of the code, and training level of the team leader were also recorded. RESULTS: Hyperventilation was present in every mock code reviewed. The mean rate of BVM ventilation for all providers in all scenarios was 40.6 ± 11.8 breaths per minute (BPM). The mean ventilation rates for RNs, RTs, and MDs were 40.8 ± 14.7, 39.9 ± 11.7, and 40.5 ± 10.3 BPM, respectively, and did not differ among providers (P = .94). All rates were significantly higher than the recommended rate of 8 to 20 BPM (per Pediatric Advanced Life Support guidelines, varies with patient age) (P < .001). The mean ventilation rate in cases of isolated respiratory arrest was 44.0 ± 13.9 BPM and was not different from the mean BVM ventilation rate in cases of cardiopulmonary arrest (38.9 ± 14.4 BPM; P = .689). CONCLUSIONS: Hyperventilation occurred in simulated pediatric resuscitation and did not vary according to provider type. Future educational interventions should focus on avoidance of excessive

During circulatory arrest, effective external chest compression (ECC) is a key element for patient survival. In 2005, international emergency medical organisations changed their recommended compression-ventilation ratio (CVR) from 15:2 to 30:2 to acknowledge the vital importance of ECC. We hypothesised that physical fitness, biometric data and gender can influence the quality of ECC. Furthermore, we aimed to determine objective parameters of physical fitness that can reliably predict the quality of ECC. METHODS: The physical fitness of 30 male and 10 female healthcare professionals was assessed by cycling and rowing ergometry (focussing on lower and upper body, respectively). During ergometry, continuous breath-by-breath ergospirometric measurements and heart rate (HR) were recorded. All participants performed two nine-minute sequences of ECC on a manikin using CVRs of 30:2 and 15:2. We measured the compression and decompression depths, compression rates and assessed the participants' perception of exhaustion and comfort. The median body mass index (BMI; male 25.4 kg/m² and female 20.4 kg/m²) was used as the threshold for subgroup analyses of participants with higher and lower BMI. RESULTS: HR during rowing ergometry at 75 watts (HR75) correlated best with the quality of ECC (r = -0.57, p < 0.05). Participants with a higher BMI and better physical fitness performed better and showed less fatigue during ECC. These results are valid for the entire cohort, as well as for the gender-based subgroups. The compressions of female participants were too shallow and more rapid (mean compression depth was 32 mm and rate was 117/min with a CVR of 30:2). For participants with lower a BMI and higher HR75, the compression depth decreased over time, beginning after four minutes for the 15:2 CVR and after three minutes for the 30:2 CVR. Although found to be more exhausting, a CVR of 30:2 was rated as being more comfortable. CONCLUSION: The quality of the ECC and fatigue can both be predicted by BMI and physical fitness. An evaluation focusing on the upper body may be a more valid predictor of ECC quality than cycling based tests. Our data strongly support the recommendation to relieve ECC providers after two minutes.


Uncontrolled hemorrhage remains the primary cause of preventable battlefield mortality and a significant cause of domestic civilian mortality. Rapid hemorrhage control is crucial for survival. ChitoGauze and Combat Gauze are commercially available products marketed for rapid hemorrhage control. These products were selected because they are packable gauze that work via differing mechanisms of action (tissue adhesion versus procoagulant). Objective. To compare the effectiveness of ChitoGauze and Combat Gauze in controlling arterial hemorrhage in a swine model. Methods. Fourteen swine were studied. Following inguinal dissection and after achieving minimum hemodynamic parameters (mean arterial pressure [MAP] ≥70 mmHg), a femoral arterial injury was created using a 6-mm vascular punch. Free bleeding was allowed for 45 seconds, and then the wound was packed alternatively with ChitoGauze or Combat Gauze. Direct pressure was applied to the wound for 2 minutes, followed by a three-hour monitoring period. Resuscitation fluids were administered to maintain an MAP of ≥65 mmHg. Time to hemostasis, hemodynamic parameters, total blood loss, and amount of resuscitation fluid were recorded every 15 minutes. Data were analyzed using the Wilcoxon rank sum test. Histologic sections of the vessels were examined using regular and polarized light. Results. No statistically significant differences were found between the groups regarding any measured end point. Data trends, however, favor ChitoGauze over
Combat Gauze for time to hemostasis, fluid requirements, and blood loss. There was no evidence of retained foreign material on histologic analysis. Conclusion. ChitoGauze and Combat Gauze appear to be equally efficacious in their hemostatic properties, as demonstrated in a porcine hemorrhage model.

Studies investigating the quality of cardiopulmonary resuscitation (CPR) have revealed frequent unnecessary interruptions of life support. The primary objective of the study is to analyse what happens during interruptions. We investigated (a) whether interruptions are filled with 'secondary activities' i.e., activities only indirectly related to the primary task of providing life support (e.g., preparatory and diagnostic activities), and (b) whether all group members focus on the same secondary activity during interruptions, thus impeding group coordination, and detracting from the primary task of providing life support. Prospective observational study. Twenty teams of general practitioners were videotaped during a simulated cardiac arrest. Resuscitation performance was assessed as hands-on time according to resuscitation guidelines. Unnecessary interruptions were defined as periods the patient received no hands-on support. Teams of general practitioners achieved hands-on time in accordance with the resuscitation guidelines (chest compression/ventilation/defibrillation) during 62% of the time the patient had no pulse. Unnecessary interruptions consumed 32% of the available time. During most of the unnecessary interruption time, team members engaged in secondary medical activities, particularly observing the monitor (47%) and dealing with the defibrillator (47%). During 56% of the unnecessary interruption time, all team members focussed their attention on the same secondary activity, thus neglecting the need for task distribution among team members. Unnecessary interruptions of CPR occur frequently and consume approximately one-third of the time patients should receive continuous life support. Unnecessary interruptions are mainly characterized by secondary medical activities that may be perceived as meaningful. During the majority of unnecessary interruptions, all team members focus on the same secondary activity, indicating shortcomings in task distribution in the resuscitation team. The findings emphasize the importance of team training with particular emphasis on situational awareness and task distribution.

Case studies, letters & editorials

.....One promising method to improve patient safety is the use of new technologies such as smartphones that provide real-time information to
rescuers to ensure correct treatments are delivered in a timely manner. The use of feedback/prompt devices can improve skill acquisition and retention during cardiopulmonary resuscitation (CPR) training and may be useful in clinical practice as part of an overall strategy to improve CPR quality. Additionally, the 2010 International Liaison Committee on Resuscitation (ILCOR) Consensus on Science and Treatment Recommendation stated "It is reasonable to use cognitive aids (e.g., checklists) during resuscitation, provided that they do not delay the start of resuscitative efforts. Aids should be validated using simulation or patient trials." Smartphones, and particularly the iPhone, with medical applications ('apps') are increasingly used by clinicians. These medical applications can provide quick access to information, function as a checklist, prompt or feedback device, or even perform calculations (for medications or otherwise), and have the potential to improve the quality of resuscitation care....

52. Braun P and Wenzel V. Pauses during CPR - Are breaks hindering our efforts? Resuscitation 2011; 82 (11): 1379-80 [Editorial] During cardiopulmonary resuscitation (CPR), the importance of the duration of pauses has not been sufficiently recognized for many years. During this time recommendations for chest compression rates have varied between 60 and 100 per min; accordingly, pause duration between individual chest compressions has also varied. The impact on outcome of pauses for ECG rhythm analysis and tracheal intubation has been poorly understood for a long time. In the last ten years, efforts have been made to reduce pauses in chest compressions, partly because animal studies have shown that the coronary perfusion pressure drops rapidly, even during 10 s breaks for ECG analysis. In contrast to these animal studies, Hoppu et al. (Abstract 12 in this report) observed in five CPR attempts in Helsinki, Finland a statistically significant increase in systolic and mean arterial blood pressures during 42 ECG rhythm analysing pauses. As the authors point out, this phenomenon occurred only when the pauses for ECG analysis during CPR were <10 s, and when CPR quality was good. However, the standard deviation of all the measured blood pressure values was large, indicating that, after randomising the remaining 95 cases, the final results of the ongoing study in Helsinki could be eventually be different to that described in these initial five cases...

53. de Vincentis PA. Increasing ambulance demand requires enhanced indicators of quality and safety Med J Aust 2011; 195 (9): 515 [Letter] To the Editor: My observations over the past 10 years as an ambulance paramedic are consistent with the growth in demand for emergency and non-emergency ambulance services in Melbourne. Strong demand has been forecast to continue because 60% of patients who are eligible for emergency transport do not currently use ambulance services. The increasing demand for ambulance services — an essential component of the Australian health care network — necessitates the development of valid, reliable indicators of quality and safety in prehospital health care, to maintain and improve the quality of that care.

As part of the Australian Commission on Safety and Quality in Health Care’s National Indicators Project, the Australian Institute of Health and Welfare (AIHW) has proposed 55 indicators of quality and safety in health care that represent a whole-of-system approach. However, this cannot be achieved without the inclusion of ambulance indicators. The AIHW indicators focus mainly on facility-based services (eg, hospitals) and underestimate the interdependence of the health care network. Ambulance services routinely collect information from the wider health care community, representing transported and non-transported patients, including clinical intervention and outcome parameters. These data can be used to identify interventions and outcomes attributable to prehospital health care practice. Improvements in patient sequence management, based on Ambulance Victoria research and data from
specialised trauma and cardiac arrest registries, suggest that ambulance interventions can result in tangible benefits.

Ambulance-specific process and outcome indicators would enable more precise attribution of outcomes to prehospital care and assist in apportioning health outcomes across the wider health network. This would directly benefit hospitals because pressure for increased public accountability currently ascribes performance based on risk factors that hospitals cannot influence. Enhanced prehospital indicators could supplement and expand the range of risk parameters that hospitals currently use to adjust hospital performance indicators; this would help mitigate the limitations inherent in comparative public reporting.

Longer-term benefits include the implementation of alternative models of evidence-based practice, encompassing “treat-and-leave protocols”, and identification of non-hospital referral avenues. Safety is a crucial aspect of alternative practices, and protocols must be formulated and monitored in the light of valid and reliable indicators.

Inclusion of ambulance indicators in the National Indicators Project would place ambulance services in a key position to ensure that timely access to safe, high-quality health care is maintained and improved.

In 2010, the CRASH-2 collaborators announced the results of a multinational randomised trial of tranexamic acid versus placebo in adult trauma patients with significant bleeding. When given within 8 h of injury, tranexamic acid significantly reduced the risk of all-cause mortality by about a tenth and death due to bleeding by about a sixth, with no increased risk of thromboembolic side-effects. A cost-effectiveness analysis showed that tranexamic acid could save 372 life-years per 1000 trauma patients in a low-income country such as Tanzania, 315 per 1000 in a middle-income country such as India, and 755 per 1000 in a high-income country such as the UK, at a cost per life-year saved of US$48, $66, and $64, respectively.

Despite these compelling findings, an audit of UK hospitals in 2011 showed that, of 412 trauma patients who were ill enough to need a blood transfusion and therefore be eligible for tranexamic acid treatment, only 12 (3%) received the drug. The implementation rate in low-income and middle-income countries could well be lower still. The CRASH-2 trial results were published in this journal, widely reported in the international media, and presented at many trauma and intensive care conferences. How else could researchers reach out to practising clinicians and make them aware of this life-saving treatment?

An enterprising idea that the CRASH-2 team rolls out today involves an adaptation of the concept of viral marketing—ie, a compelling video that internet users pass on to their online contacts. Drawing on the elements that tend to increase sharing (humour, surprise, emotion), the collaborators made a stop-motion animation in which a clay trauma victim, blood squirting heartily from a gaping hole in his abdomen, happily avoids imminent exsanguination by means of a timely injection. The video ends with an invitation to view the CRASH-2 trial results.

The discordant juxtaposition of cartoon-like character and death at its messiest will no doubt appeal to the South Park generation. But will it impress them to the extent that it changes their practice? If branded pens and sticky notes can boost prescription of blockbuster drugs (and we know that they can), there is every hope that patients whose doctors view this animation can reap a much greater reward.

Link to video: http://www.thelancet.com/crash-2-2010

Neonatal resuscitation is practiced according to consensus guidelines, but there are variations in practice between units. These unit practices can be classified into one of the 3 stages. In the first stage, initial cynicism is counterbalanced by a desire to use the new technology better than other units that have reported their experience. In the second stage, as outcomes improve, the practice becomes integrated into the unit’s culture as standard accepted care, but staff are prepared to try other methods. The third stage is the most dangerous when staff become convinced that their practice is the best and refuse to accept or consider any contradictory data. The lack of evidence for existing resuscitation practices have persuaded clinicians in many practices to move from stage 3 to 2, while new interventions, such as use of the laryngeal mask airway (LMA), are being investigated.

In recent years, with improved understanding of the physiology and transition of the newborn, new practices have found their place during resuscitation. This includes use of continuous distending pressure, plastic bags, optimising use of oxygen and the search for an ideal respiratory interface. For decades, facemasks have been used as the respiratory interface during resuscitation, but unacceptable air leaks and operator dependent efficacy have raised questions about their use. For neonatal resuscitation, the use of LMAs is being explored but widespread use is limited by the non-availability of small sizes for very preterm babies.


Not news to readers of Resuscitation, out of hospital cardiopulmonary resuscitation (CPR) has dismal survival rates, ranging from 6.7% to 8.4%. Worse yet, despite the institution of tiered emergency response medical systems and CPR training of the public, this rate has not changed markedly in 30 years. Despite these discouraging trends, the 2005 CPR guideline revisions offer hope of better outcomes because they address a flaw in the fundamental approach to resuscitation, namely that perfusion and oxygenation had equal credibility in the post arrest period. These revised guidelines now put the emphasis of effort on chest compressions in order to augment cardiac and cerebral perfusion.

The term cardio-cerebral resuscitation (CCR) has come to mean CPR with minimal interruptions coupled with high quality and frequency chest compressions with the aim of maintaining coronary and cerebral artery mean arterial pressures consistently. It is based on a model in which cardiac arrest is divided into three time-dependent phases based on the underlying pathophysiology. The electrical phase accounts for the first 4 min of cardiac arrest. The next 6–8 min are the circulatory phase, in which maintenance of coronary and cerebral artery mean arterial pressures is crucial. Last, the metabolic phase refers to the period where metabolic debt must be repaid.

The electrical and circulatory phases almost always occur in the out-of-hospital setting, and it has been over a decade since the concept of emphasizing perfusion over ventilation during CPR was studied in this setting. These clinical studies were based on animal data suggesting: (1) survival and neurological outcomes were not different whether active ventilation was undertaken or not, and (2) that there is a huge difference in mean aortic pressures when CPR is continuous versus uninterrupted.

Also around that time, the practice of EMS dispatcher-assisted CPR was found to impact cardiac arrest outcomes. Whether delivered by EMS or bystanders early CPR without traditional ventilation has been shown to have outcome that is not inferior to CPR with ventilation.

Bray and colleagues (Abstract 6 in this report) in this issue of Resuscitation bring these two concepts together with intriguing results...

In 2002, when our colleagues in Europe and Australia ushered in the modern era of therapeutic hypothermia, they reported the most significant advancement in the field of resuscitation since CPR and electrical defibrillation. The subsequent adoption of contemporary post-resuscitation care has triggered a rapid escalation in the technology, resources, and expertise brought to bear upon a population whose survival was abysmal even a decade ago. While celebrating recent success, our research community now struggles to address a number of critical questions left unanswered, the most fundamental of which being, “for whom is this therapy indicated?”

The vast majority of the patients who survive out-of-hospital cardiac arrest (OHCA) arrive at the hospital comatose and at the mercy of post-cardiac arrest syndrome, a complex cascade of global ischemia and reperfusion injury. While some of these survivors will ultimately expire in the immediate post-arrest period despite aggressive support, most fall into a large undifferentiated cohort for whom the decision to initiate comprehensive post-resuscitation care, including therapeutic hypothermia, must be made rapidly. The inability to accurately determine which of these patients may benefit from modern therapy has driven institutions to adopt one of two unsustainable strategies for treating patients with return of spontaneous circulation (ROSC)...

Guideline 11.8: Therapeutic hypothermia after cardiac arrest


Emergency medical services (EMS) encountered an alert patient with sustained ventricular fibrillation with preserved hemodynamics via a left ventricular assist device (LVAD). Multiple firings of the patient’s implantable defibrillator were the only sign that this patient was experiencing the usually fatal ventricular arrhythmia. Initial attempts at rhythm conversion with amiodarone and 200-J biphasic shocks were unsuccessful. The patient was finally defibrillated to normal sinus rhythm after a 360-J biphasic shock. This case conference highlights the increasing prevalence of LVADs. These devices are used not only as a bridge to cardiac transplantation, but also as definitive therapy for patients in end-stage cardiac failure. Ventricular fibrillation has been shown to be well tolerated in patients with LVADs, and we discuss a standard of care for these patients. The occurrence of sustained ventricular fibrillation in patients with ventricular assist devices represents a challenging situation for EMS and emergency department providers and one that will be increasingly encountered in the future.


In this edition of Resuscitation, Kellett et al. (Abstract 13 in this report) demonstrate a worrying difference between breathing and heart rates of acutely ill patients recorded by fully trained, experienced nursing staff and those measured using a piezoelectric belt and ECG monitor (BT16 acquisition system). In general, BT16-measured heart and breathing rates were higher. Nurse-recorded breathing rate measurements were clustered around rates of 18, 20 and 22 breaths/min. Whilst nurses measured breathing rates manually, with the potential that nurse competency played a part in the accuracy of the recorded value, the lack of correlation between nurse-recorded and BT16-measured heart rates is especially concerning, as several other devices capable of providing a valid heart (or pulse) rate were immediately available to the nurses. How should we interpret these data? First, they come from a single hospital and it is impossible to infer if the disparities are due to measurement or recording errors. Only eight nurses recorded the clinical measurements, and no data is provided about inter-rater variability or the number of measurements recorded by each nurse. Could the results merely indicate the overwhelming influence of a single nurse with poor clinical technique? Further, the nurses in the study were given no specific instruction on how to measure or record the vital signs during the
study; consequently, there was no standardisation of measurement technique. It is not clear if the study actually compares BT16-derived heart rates with heart rates measured by chest auscultation, or whether the comparison is of BT16-derived heart rates with pulse rates derived by palpation or from a pulse oximeter display. For many patients this may be irrelevant, but in a population of unselected acutely ill medical patients, some of whom may have dysrhythmias, this may be important. Additionally, by the authors’ admission, the nurses’ measurements may not have been undertaken synchronously with those of the BT16...

A 50-year-old man presented with acute onset of shortness of breath. He was severely dyspneic and hypotensive on admission (blood pressure 70/55 mm Hg, heart rate 120 beats/min, respiratory rate 25 breaths/min, and oxygen saturation 90% on room air). An electrocardiogram showed right bundle branch block with right ventricular strain and sinus tachycardia. As there were no signs of fluid overload on either clinical examination or chest radiography (i.e., mild cardiomegaly with normal lung fields), fluid resuscitation was initiated with good response: blood pressure 115/60 mm Hg, heart rate 95 beats/min, respiratory rate 18 breaths/min, and oxygen saturation 95% on intra-nasal oxygen at 2 L/min. The patient was then transferred for urgent computed tomography (CT) pulmonary angiogram that showed massive pulmonary embolism with emboli in all the lobar branches of the pulmonary arteries, with the most severe in the lower lobes. Despite stable vital signs in the CT suite (heart rate 100 beats/min and blood pressure 110/65 mm Hg), CT scan demonstrated signs of circulatory shock. These included reflux of contrast into the coronary sinus, hepatic veins, right renal vein, and “contrast-fluid level” in the inferior vena cava (IVC). The patient became asystolic during transit from the CT scan suite back to the Emergency Department, and died 1 h later despite aggressive resuscitation including intubation and external cardiac massage, intra-venous fluids (3 L normal saline), and intravenous medication (adrenaline and atropine). Dependent contrast venous pooling on CT scan has been described in cardiac arrest and post-mortem patients. However, this case differs in that the patient was alive and had stable vital signs at the time of the scan. Further, the dependent venous pooling of contrast depicts a rare but perhaps more important situation: occult cardiogenic shock. This is an exceptional occasion where CT scan provides a glimpse into the hemodynamic status of the patient, and these findings have been described in hemodynamic instability due to other causes besides pulmonary embolism. After contrast injection into an upper limb vein, the reflux of contrast into the IVC and pooling in the dependent venous system (coronary sinus, hepatic, and right renal vein) reflects severely depressed right ventricular function, whereas an overall depressed cardiac output causes poor mixing of contrast and blood, causing the contrast-fluid level in the IVC. It is important to be aware of this ominous sign that is a harbinger of cardiac arrest.

Supporting CT Scans in original article

Education & ethics in resuscitation

This project examined the use of first aid by bystanders at road traffic crashes (RTC) and was undertaken in the context of increasing average
ambulance response times to RTC throughout Australia and the potential impact of early first aid intervention on the mortality and morbidity associated with RTC. The aim of this project was to acquire knowledge about the prevalence of first aid training; the incidence of being a bystander and of providing first aid; the range of first aid skills being utilized; the motivation to intervene; and, the perceived impact of first aid training. Methods: An Internet-based survey was distributed to a potential population of 12,500 road users and a total of 773 responded. Descriptive and comparative statistical analysis of quantitative data and thematic analysis of qualitative data were completed. Results: Seventy-seven percent (77%) of participants had first aid training at some stage in their lives; 28% held a current first aid certificate; 11% had provided first aid at RTC; 75.3% who had provided first aid were travelling in a vehicle. Having first aid training increased the likelihood of intervention and of owning a first aid kit or pocket mask. Conclusions: First aid training, even if it is not current, is an enabler for providing first aid at RTCs. The first aid skills most commonly used were changing posture, opening an airway, and providing comfort and reassurance. Key concerns for first aiders included a feeling of a lack of follow-up, and lack of an opportunity to debrief. Strategies to increase first aid training, to improve information and support, and to increase the knowledge of first aiders are discussed.


Family witnessed resuscitation is the practice of enabling patients’ family members to be present during resuscitation. Research is inconsistent as to the effectiveness or usefulness of this initiative. Aim: To evaluate the performance of two scales that assess perceptions of family witnessed resuscitation among a sample of health professionals, in an Australian non-teaching hospital, and explore differences in perceptions according to socio-demographic characteristics and previous experience. Design: Descriptive, replication study, using a cross-sectional survey. Method: An anonymous survey was distributed to 221 emergency department clinicians. Sociodemographic characteristics and perceptions of family witnessed resuscitation using the Family Presence Risk - Benefit and Family Presence Self-confidence Scales were assessed. Exploratory factor analysis was used to evaluate the performance of the scales. Results: One hundred and fourteen doctors and nurses returned the survey (response rate of 51.6%). Both Scales were found to have a single factor structure and a high level of internal consistency. Approximately two-thirds of participants considered that family presence was a right of patients and families, and almost a quarter of respondents had invited family presence during resuscitation on more than five occasions. We found no significant differences in scale scores between doctors and nurses. Conclusion: Our findings confirm the validity of the Family Presence Risk - Benefit and Family Presence Self - Confidence Scales in the Australian context, and highlight the need to support clinicians in the provision of family witnessed resuscitation to all families.

63. Cusack J and Fawke J. Neonatal resuscitation: are your trainees performing as you think they are? A retrospective review of a structured resuscitation assessment for neonatal medical trainees over an 8-year period. Arch Dis Child Fetal Neonat 2011; Online first (17 November)

Objective: To ascertain whether Newborn Life Support Course (NLS) accredited trainees could demonstrate resuscitation skills appropriate to their level of training by providing standardised assessments of both junior and senior paediatric trainees during their induction period. Design: Retrospective review of medical staff resuscitation assessments over an 8-year period from 2003 to 2010. Setting: A network-lead tertiary neonatal service with over 11 000 deliveries annually. Participants: Neonatal medical staff: junior (specialty trainee(ST) of years 1 - 3) and
senior trainees (ST 4-8 with tier 2 on-call responsibilities). Intervention: A standardised criterion-referenced assessment was performed by two NLS instructors. Junior trainee assessment focused on the basic airway skills learnt on an NLS course. Senior trainees demonstrated resuscitation of a baby with meconium-stained liquor, focusing on advanced life support, including intubation of the mannequin. Main outcome measures: Assessment outcomes were pass/fail; fails were categorised as algorithm failure, technical skills failure or both. For trainees who failed the first assessment, the outcome of the second assessment following appropriate feedback was recorded. Results: Two hundred and sixty-two assessments were performed: 160 junior and 102 senior trainees; 98/160 (61%) of junior and 57/102 (56%) of senior trainees passed their first assessment; 69% of junior trainees who failed the first assessment had a second assessment recorded. There was a 79% pass rate at second assessment; 89% of senior trainees who failed a first assessment had a second assessment recorded. There was an 85% pass rate at second assessment. The majority of trainees who failed an assessment had problems with both the resuscitation algorithm and technical skills. Conclusions: Significant numbers of trainees who have been formally trained in neonatal resuscitation skills previously do not pass the standardised resuscitation assessment, thus require an additional input to maintain their competence in neonatal resuscitation.


The purpose of this qualitative study was to explore inhibitors and enhancing factors surrounding the practice of allowing family presence in the emergency room. Staff and physician interviews were transcribed and decoded for themes. A visual model was built to depict the results. Inhibitors and enhancing factors included the following drivers: staff emotions, personalizing the patient, seeing/hearing everything, closure, emotional support of the family, and 'if it were me'. The following staff needs were also identified as important issues that needed to be addressed before practice could change further: staff education, optimize environment for privacy, and implementation of a family liaison. The use of qualitative research methods was effective in identifying organizational barriers to transition of evidence into practice.


Objective. To determine paramedics’ understanding of and accuracy using SALT (sort–assess–lifesaving interventions–treatment/transport) triage, a proposed national guideline for primary triage during mass-casualty incidents, immediately and four months after training. Methods. A 20-minute lecture on SALT triage was provided to all paramedics (n = 320) from a single county during mandatory continuing education. Triage concepts were reemphasized during a 10-minute small-group lecture throughout the study period as part of standard refresher training. After the initial training, all paramedics were asked to complete a posttest consisting of three general knowledge questions about SALT triage and 10 patient scenarios in which they had to assign a triage category. The same test was administered four months after the original educational session. Demographic and job experience information was also obtained. Responses were scored and matched for each paramedic and compared using paired t-test. Results. A total of 290 (91%) paramedics completed the initial posttest. They correctly answered an average (± standard deviation) of 10.7 ± 2.3 of the 13 questions (82%). For the 10 patient scenarios, they correctly triaged an average of 8.1 ± 2.0 patients. A total of 159 paramedics completed both tests. Sixty-seven percent had more than 10 years of emergency medical services (EMS) experience;
72% had prior mass-casualty drill experience; 51% had prior actual mass-casualty experience; and 23% had heard of SALT triage prior to the training. There were no statistically significant differences in initial test scores for any of these demographic groups. For those subjects who completed both tests, the mean overall score for the initial test was 10.9 ± 1.9 (84%) and for the later test was 11.0 ± 1.9 (85%) (p < 0.770; 95% confidence interval [CI] –0.3 to 0.3). For the 10 patient scenarios, the paramedics correctly triaged an average of 8.3 ± 1.7 patients on the initial test and 8.3 ±1.4 patients on the later test (p < 0.565; 95% CI –0.4 to 0.2). Conclusion. Following a short didactic course, paramedics were able to accurately perform SALT triage during a written scenario. Four months after the training, they had retained their understanding of and accuracy using SALT triage. It appears that a brief educational tool was effective for training EMS providers in SALT triage.


Aim: To compare the use of a drugs calculator on a smartphone with use of the British National Formulary for Children (BNFC) for accuracy, speed and confidence of prescribing in a simulated paediatric emergency. 28 doctors and 7 medical students in a paediatric department of a District General Hospital, were asked to prescribe both a dopamine infusion and an adrenaline infusion for a hypotensive child. For one calculation they used the BNFC as their reference source and for the other they used the 'PICU Calculator' on the iPhone. The drugs calculator on the smartphone was more accurate than the BNFC, with 28.6% of participants being able to correctly prescribe an inotropic infusion using the BNFC and 100% of participants being able to do so using the drugs calculator on the smartphone (p<0.001). The smartphone calculator was 376% quicker than the BNFC with the mean time saved being 5min and 17s per participant (p<0.001). Participants were more confident in their prescription when using the drugs calculator on the smartphone with a mean confidence score of 8.5/10 compared with 3.5/10 when using the BNFC (p<0.001). Utilising the smartphone was significantly more accurate and faster, with prescribers more confident in their calculations, than use of the BNFC. This applied irrespective of clinical experience with medical students utilising the smartphone technology outperforming Consultant Paediatricians when they used the BNFC.

A disaster is a situation that overwhelms the local population's capacity to respond, thus necessitating a request for assistance from outside the impacted area. In these circumstances, needs usually outweigh resources. The objective of response is to do the greatest good for the greatest number of people (the utilitarian principle). As such, some unique ethical considerations will arise that are not seen in day-to-day practice. The adoption of medical ethics principles is important in such situations, but certain provisions must be accepted. In large-scale, complex disasters, it may be impossible to provide optimal care to each patient. This paper will discuss some of the challenges for healthcare personnel at 'ground zero', how training in preventive ethics may help, and what principles can be applied when working in disaster-affected areas or when responding to disasters.

Objective: To determine the accuracy of emergency medical services (EMS) provider assessments of motor vehicle damage when compared with measurements made by a professional crash reconstructionist. Methods. EMS providers caring for adult patients injured during a motor
vehicle crash and transported to the regional trauma center in a midsized community were interviewed upon emergency department arrival. The interview collected provider estimates of crash mechanism of injury. For crashes that met a preset severity threshold, the vehicle's owner was asked to consent to having a crash reconstructionist assess the vehicle. The assessment included measuring intrusion and external automobile deformity. Vehicle damage was used to calculate change in velocity. Paired t-test, correlation, and kappa were used to compare EMS estimates and investigator-derived values. Results. Ninety-one vehicles were enrolled; of these, 58 were inspected and 33 were excluded because the vehicle was not accessible. Six vehicles had multiple patients. Therefore, a total of 68 EMS estimates were compared with the inspection findings. Patients were 46% male, 28% were admitted to hospital, and 1% died. The mean EMS-estimated deformity was 18 inches and the mean measured deformity was 14 inches. The mean EMS-estimated intrusion was 5 inches and the mean measured intrusion was 4 inches. The EMS providers and the reconstructionist had 68% agreement for determination of external automobile deformity (kappa 0.26) and 88% agreement for determination of intrusion (kappa 0.27) when the 1999 American College of Surgeons Field Triage Decision Scheme criteria were applied. The mean (± standard deviation) EMS-estimated speed prior to the crash was 48 ±13 mph and the mean reconstructionist-estimated change in velocity was 18 ± 12 mph (correlation –0.45). The EMS providers determined that 19 vehicles had rolled over, whereas the investigator identified 18 (kappa 0.96). In 55 cases, EMS and the investigator agreed on seat belt use; for the remaining 13 cases, there was disagreement (five) or the investigator was unable to make a determination (eight) (kappa 0.40). Conclusions. This study found that EMS providers are good at estimating rollover. Vehicle intrusion, deformity, and seat belt use appear to be more difficult for EMS to estimate, with only fair agreement with the crash reconstructionist. As expected, the EMS provider estimated speed prior to the crash does not appear to be a reasonable proxy for change in velocity.


Background: Concern exists that living wills are misinterpreted and may result in compromised patient safety. Objective To determine whether adding code status to a living will improves understanding and treatment decisions. Methods An Internet survey was conducted of General Surgery, and Family, Internal, and Emergency Medicine residencies between May and December 2009. The survey posed a fictitious living will with and without additional clarification in the form of code status. An emergent patient care scenario was then presented that included medical history and signs/symptoms. Respondents were asked to assign a code status and choose appropriate intervention. Questions were formatted as dichotomous responses. Correct response rate was based on legal statute. Significance of changes in response due to the addition of either clinical context (past medical history/signs/symptoms) or code status was assessed by contingency table analysis. Results Seven hundred sixty-eight faculty and residents at accredited training centers in 34 states responded. At baseline, 22% denoted 'full code' as the code status for a typical living will, and 36% equated 'full care' with a code status DNR. Adding clinical context improved correct responses by 21%. Specifying code status further improved correct interpretation by 28% to 34%. Treatment decisions were either improved 12 - 17% by adding code status ('Full Code' Hospice Care') or worsened 22% ('DNR'). Conclusion: Misunderstanding of advance directives is a nationwide problem. Addition of code status may help to resolve the problem. Further research is required to ensure safety, understanding, and appropriate care to patients.

72. Na JU, Sim MS, Jo IJ, Song HG and Song KJ. Basic life support skill retention of medical interns and the effect of clinical
experience of cardiopulmonary resuscitation. Emerg Med J 2011; Online first (1 November)

Objective: To investigate the level of basic life support (BLS) skill retention of medical interns 6 and 12 months after BLS education and analyse the correlation between clinical experience of cardiopulmonary resuscitation (CPR) and BLS skill retention. Materials and methods: The baseline performance of BLS skills in medical doctors during their internship was tested immediately after the BLS provider course. The subjects were divided into two groups, which were tested using the same method after 6 months or after 12 months. Data on the subjects’ CPR experience were collected through CPR records - specifically, the number of CPR experiences and the feedback given by the CPR team leaders. To evaluate BLS skill retention, baseline BLS skill performance was compared with the skill performances measured after 6 or 12 months. Results: Fifty-six subjects were enrolled in the 6 month group and 36 in the 12 month group. For non-compression skills, the points for skills declined from 12 to 6 points in the 6 month group and from 12 to 6 points in the 12 month group and the declines in both groups were statistically significant. For compression skills, in the 12 month group, the hands-off time improved from 9.9s to 8.7s, with statistical significance. In the multivariate linear regression test, the number of times feedback was given had a statistical relationship with improvement in hands-off time in the 12 month group (coefficient 0.58, 95% CI 0.12 to 1.05). Conclusions: In medical doctors, the compression skills were well preserved, but the retention of non-compression skills was poor.


The objective of this study was to assess the association between the performance of practicing paramedics on a validated cognitive exam and their field performance, assessed on a simulated emergency medical services (EMS) response. Methods: This was an observational study of paramedics from a single-tiered, urban, advanced life support EMS agency. A high-fidelity simulated response to a medical emergency on environmentally realistic sound stages, and the cognitive portion of the national paramedic certification exam, were each assessed as pass or fail. Participants were randomly assigned to one of six simulations designed by the agency’s educational staff, medical director, and representatives from the National Registry of EMTs to be equivalently difficult. Simulations were pilot tested to assess content and face validity. Each participant was classified as failing a simulation scenario if his or her score was one standard deviation (SD) below the population mean. Results: There were 107 paramedics who participated in the study. Participants reported a median of 7.7 years of service (interquartile range [IQR] = 4.1 to 12.8 years). Simulation scores were normally distributed. Ninety-two (86.0%) participants received a passing score for the simulation and 77 (72.0%) passed the cognitive exam. There were 70 (65.4%) individuals who passed both the simulation and the cognitive exam, eight (7.5%) who failed both the simulation and the cognitive exam, 22 (20.6%) who passed the simulation but failed the cognitive exam, and seven (6.5%) who failed the simulation but passed the cognitive exam. There was a significant association between passing the cognitive exam and passing the simulation (chi-square p-value = 0.02). Conclusions: This study simultaneously assessed cognitive knowledge and simulated field performance. Utilization of these measurement techniques allowed for the assessment and comparison of field performance and cognitive knowledge. Results demonstrated an association between a practicing paramedic’s performance on a cognitive examination and field performance, assessed by a simulated EMS response.

Advanced Life Support (ALS) certification has become a mandatory requirement for most critical care nurses in Australia. The purpose of this review is to critically evaluate current literature in relation to ALS training and certification for critical care nurses. There is some evidence in the literature that ALS training programs can improve patient outcome following cardiac arrest. Teaching methods vary including simulation training, e-learning and lecture based courses. Of continued concern is the consistent message that competence declines rapidly following ALS courses. Whilst many critical care units require evidence of annual ALS assessment there is little evidence that this translates into ongoing practical competence or confidence. Recommendations from regulatory bodies and ALS training literature reinforce that frequent, relevant and practical learning activities may be more effective, however it is unclear from the review if this occurs nor if critical care nurses remain confident in their skills as time passes.

And...two situations we come across regularly....


Body modifications or body art, whether tattooing, body piercing, or implants, have been practiced in societies across the world for thousands of years. In recent years, these practices have become more common and widespread, moving beyond what we might have previously considered a curious subculture of practitioners. The implications on emergency nursing care have also become more evident as we strive to understand and provide optimal care for this ever-increasing segment of our population. This article reviews the transfer technique of exchanging body piercing jewelry with an intravenous catheter to maintain piercing patency. In a recent study of U.S. undergraduate college students, 51% had something pierced besides their ears. That means that in this study, odds were better than a “coin flip” as to whether a young adult had body piercings (and 22% had tattoos as well). Although no formal statistics exist regarding the number of body piercings performed each year, it is estimated that at least several hundred thousand body piercings are performed annually, and that number is not declining.

With the recent “epidemic” of body piercings, it has become increasingly common to remove body jewelry for diagnostic imaging (computed tomography/magnetic resonance imaging) or surgical procedures. However, the question of whether removal of the jewelry is indeed necessary, especially for elective or non-emergency health care, continues to be debated in the medical literature. For example, does tongue jewelry need to be removed for emergent intubation? (No; intubate first, then worry about removing the jewelry later.) Do nipple piercings need to be removed prior to defibrillation? (No.) Does a piercing need to be removed if the site is infected? (No, or an abscess can form.) Does a penile piercing need to be removed prior to placement of a Foley urinary catheter? (Sometimes, depending on whether the piercing crosses the urethra.) For many medical procedures and types of body jewelry, the jury is still out and the verdict has yet to be decided.


People tend to hold overly favourable views of their abilities in many social and intellectual domains. The authors suggest that this overestimation occurs, in part, because people who are unskilled in these domains suffer a dual burden: not only do these people reach
erroneous conclusions and make unfortunate conclusions, but their incompetence robs them of the metacognitive ability to realise it. Across four studies, the authors found that participants scoring in the bottom quartile on tests of humour, grammar and logic grossly overestimated their test performance and ability. Although their test scores put them in the 12th percentile, they estimated themselves to be in the 62nd percentile. Several analyses linked this miscalibration to deficits in metacognitive skill, or the capacity to distinguish accuracy from error. Paradoxically, improving the skills of participants, and thus increasing their metacognitive competence helped them recognise the limitations of their abilities.