   
   **Objective:** To prospectively determine the percentage of cases of acute myocardial infarction (AMI) resulting in sudden death outside the hospital.
   
   **Methods:** Two groups of patients were defined by the emergency medical services. Group A comprised all out-of-hospital sudden deaths in 2004 meeting the criteria for possible or probable AMI (n=395 among 1072 sudden death patients, i.e., 37%). Group B comprised all in-hospital AMI in the district during the same year according to hospital registry records (n=731). The out-of-hospital sudden death rate due to AMI was determined by the ratio of the number of patients in group A over the total number of patients (A+B), and was found to be 35% (95% CI 32% to 38%).
   
   **Conclusion:** The estimated mortality of AMI appears to be 35% in this population. This figure suggests that significant improvement in the treatment of out-of-hospital cardiac arrest is still necessary.

   
   **Objective:** To systematically review the evidence from clinical trials comparing the use of crystalloids and colloids for fluid resuscitation in children with severe infection.
   
   **Data sources:** Medline (1950-2008), PubMed, the Cochrane Library, Embase (1980-2008), and reference lists.
   
   **Eligibility criteria:** Published studies comparing fluid resuscitation with crystalloid or colloidal solutions in severe infectious illness in children aged >1 month to ≤12 years. Controlled trials and randomised controlled trials were separately selected by two unblinded investigators who also independently extracted data.
   
   **Main outcome measures:** Efficacy in the treatment of shock, mortality, and reported adverse events.
   
   **Results:** Nine trials fulfilled criteria, eight of which compared crystalloids with colloids. All trials were conducted in settings with poor resources and predominantly included patients with malaria or dengue haemorrhagic shock. None of the trials had mortality as a primary outcome. Three out of six studies that reported at least one death showed better survival in children resuscitated with colloids compared with crystalloids (Peto fixed odds ratio ranging from 0.18 (95% confidence interval 0.02 to 1.42) to 0.48 (0.06 to 3.99)). Studies contributing data on mortality had some methodological limitations so caution is recommended when interpreting this finding. Studies were heterogeneous so combined estimates were not calculated. The review was limited by inclusion of only published studies.
   
   **Conclusions:** The current evidence on choice of fluids for resuscitation in children with infections is weak. While existing trials have provided important evidence in malaria and dengue, resuscitation in children with paediatric sepsis, for which colloids could theoretically be of benefit, has not been studied. The evidence from existing studies is not robust enough to make any definitive recommendations over the choice of resuscitation fluid and a definitive trial is required to address this.

*Section 12: Pediatric advanced life support*

The management of low-risk patients presenting to emergency departments is a common and challenging clinical problem entailing 8 million emergency department visits annually. Although a majority of these patients do not have a life-threatening condition, the clinician must distinguish between those who require urgent treatment of a serious problem and those with more benign entities who do not require admission. Inadvertent discharge of patients with acute coronary syndrome from the emergency department is associated with increased mortality and liability, whereas inappropriate admission of patients without serious disease is neither indicated nor cost-effective. Clinical judgment and basic clinical tools (history, physical examination, and electrocardiogram) remain primary in meeting this challenge and affording early identification of low-risk patients with chest pain. Additionally, established and newer diagnostic methods have extended clinicians' diagnostic capacity in this setting. Low-risk patients presenting with chest pain are increasingly managed in chest pain units in which accelerated diagnostic protocols are performed, comprising serial electrocardiograms and cardiac injury markers to exclude acute coronary syndrome. Patients with negative findings usually complete the accelerated diagnostic protocol with a confirmatory test to exclude ischemia. This is typically an exercise treadmill test or a cardiac imaging study if the exercise treadmill test is not applicable. Rest myocardial perfusion imaging has assumed an important role in this setting. Computed tomography coronary angiography has also shown promise in this setting. A negative accelerated diagnostic protocol evaluation allows discharge, whereas patients with positive findings are admitted. This approach has been found to be safe, accurate, and cost-effective in low-risk patients presenting with chest pain.

Guideline 8.2: Heart attack


The goal of out-of-hospital endotracheal intubation (ETI) is to reduce mortality and morbidity for patients with airway and ventilatory compromise. Yet several studies, mostly involving trauma patients, have demonstrated similar or worse neurologic outcomes and survival-to-hospital discharge rates after out-of-hospital ETI. To date, there is no study comparing out-of-hospital ETI to bag-valve-mask (BVM) ventilation for the outcome of survival to hospital discharge among nontraumatic adult out-of-hospital cardiac arrest (OOHCA) patients. Objectives: The objective was to compare survival to hospital discharge among adult OOHCA patients receiving ETI to those managed with BVM. Methods: In this retrospective cohort study, the records of all OOHCA patients presenting to a municipal teaching hospital from November 1, 1994, through June 30, 2008, were reviewed. The type of field airway provided, age, sex, race, rhythm on paramedic arrival, presence of bystander cardiopulmonary resuscitation (CPR), whether the arrest was witnessed, site of arrest, return of spontaneous circulation (ROSC), survival to hospital admission, comorbid illnesses, and survival to hospital discharge were noted. A univariate odds ratio (OR) was first computed to describe the association between the type of airway and survival to hospital discharge. A multivariable logistic regression analysis was performed, adjusting for rhythm, bystander CPR, and whether the arrest was witnessed. Results: A cohort of 1,294 arrests was evaluated. A total of 1,027 (79.4%) received ETI, while 131 (10.1%) had BVM, 131 (10.1%) had
either a Combitube or an esophageal obturator airway, and five (0.4%) had incomplete prehospital records. Fifty-five of 1,294 (4.3%) survived to hospital discharge; there were no survivors in the Combitube/esophageal obturator airway cohort. Even after multivariable adjustment for age, sex, site of arrest, bystander CPR, witnessed arrest, and rhythm on paramedic arrival, the OR for survival to hospital discharge for BVM versus ETI was 4.5 (95% confidence interval [CI] = 2.3–8.9; p<0.0001). Conclusions: In this cohort, when compared to BVM ventilation, advanced airway methods were associated with decreased survival to hospital discharge among adult nontraumatic OOHCA patients.

Guideline 11.7: Equipment and techniques in adult advanced life support


Background: Passive leg raising (PLR), to augment the artificial circulation, was deleted from cardiopulmonary resuscitation (CPR) guidelines in 1992. Increases in end-tidal carbon dioxide (pETCO₂) during CPR have been associated with increased pulmonary blood flow reflecting cardiac output. Measurements of pETCO₂ after PLR might therefore increase our understanding of its potential value in CPR. We also observed the alteration in pETCO₂ in relation to the return of spontaneous circulation (ROSC) and no ROSC. Methods and results The pETCO₂ was measured, subsequent to intubation, in 126 patients suffering an out-of-hospital cardiac arrest (OHCA), during 15 min or until ROSC. Forty-four patients were selected by the study protocol to PLR 35 cm; 21 patients received manual chest compressions and 23 mechanical compressions. The PLR was initiated during uninterrupted CPR, 5 min from the start of PETCO2 measurements. During PLR, an increase in pETCO₂ was found in all 44 patients within 15 s (p = 0.003), 45 s (p = 0.002) and 75 s (p = 0.0001). Survival to hospital discharge was 7% among patients with PLR and 1% among those without PLR (p = 0.12). Among patients experiencing ROSC (60 of 126), we found a marked increase in pETCO₂ 1 min before the detection of a palpable pulse. Conclusion: Since PLR during CPR appears to increase pETCO₂ after OHCA, larger studies are needed to evaluate its potential effects on survival. Further, the measurement of pETCO₂ could help to minimise the hands-off periods and pulse checks.

Guideline 7: Cardiopulmonary resuscitation


Objectives: Mobile medical teams (MMTs) provide specialized care on-scene with the purpose to improve outcome. However, this additional care could prolong the on-scene time (OST), which is related to mortality. The purpose of this study was to assess the effects of MMT involvement on the mortality rate and on the OST, in a Dutch consecutive cohort of Level I trauma patients. Methods: All patients who required presentation in the trauma resuscitation room in an urban Level I trauma center were included in this prospective study during the period of November 2005 till November 2007. For data collection, we used both pre- and in-hospital registration systems. Outcome measures were 30-day mortality and OST. Results: In total, 1,054 patients were analyzed. In 172 (16%) patients, the MMT was involved. Mortality was significantly higher in the MMT group compared with patients treated without MMT involvement; 9.9% versus 2.7%, respectively (p < 0.001). Significantly higher Injury Severity Scores, intervention rates, and a significantly lower Triage Revised
Trauma Score were found in patients treated by MMT. After adjustment for patient and injury characteristics, no association could be found between MMT involvement and higher mortality (95% CI, 0.581-3.979; p = 0.394). In patients with severe traumatic brain injury (GCS score <= 8) in whom a MMT was involved, the mortality was 25.5%, compared with 32.7% in those without MMT involvement (p = 0.442). The mean OST was prolonged (2.7 minutes) when MMT was involved (26.1 vs. 23.4 minutes; p = 0.003). Conclusions: In this study, OSTs were long compared with PHTLS recommendations. MMT involvement slightly prolonged the OST. Trauma patients with MMT involvement had a high mortality, but after correction for patient and injury characteristics, the mortality rate did not significantly differ from patients without MMT involvement.


The objective of this study was to characterize emergency department (ED) visits for pediatric sport-related concussion (SRC) in pre-high school- versus high school-aged athletes. Method: A stratified probability sample of US hospitals that provide emergency services in the National Electronic Injury Surveillance System (1997-2007) and All Injury Program (2001-2005) was used. Concussion-related ED visits were analyzed for 8- to 13- and 14- to 19-year-old patients. Population data were obtained from the US Census Bureau; sport participation data were obtained from National Sporting Goods Association. Results: From 2001 to 2005, US children who were aged 8 to 19 years had an estimated 502,000 ED visits for concussion. The 8- to 13-year-old group accounted for ~35% of these visits. Approximately half of all ED visits for concussion were SRC. The 8- to 13-year-old group sustained 40% of these, which represents 58% of all concussions in this group. Approximately 25% of all SRC visits in the 8- to 13-year-old group occurred during organized team sport (OTS). During the study period, ~4 in 1000 children aged 8 to 13 years and 6 in 1000 children aged 14 to 19 years had an ED visit for SRC, and 1 in 1000 children aged 8 to 13 years and 3 in 1000 children aged 14 to 19 years had an ED visit for concussion sustained during OTS. From 1997 to 2007, although participation had declined, ED visits for concussions in OTS in 8- to 13-year-old children had doubled and had increased by >200% in the 14- to 19-year-old group. Conclusion: The number of SRCs in young athletes is noteworthy. Additional research is required.


Aim: The aim of this investigation was to estimate and contrast the global incidence and outcome of out-of-hospital cardiac arrest (OHCA) to provide a better understanding of the variability in risk and survival of OHCA. Methods: We conducted a review of published English-language articles about incidence of OHCA, available through MEDLINE and Embase. For studies including adult patients and both adult and paediatric patients, we used Utstein data reporting guidelines to calculate, summarize and compare incidences per 100,000 person-years of attended OHCA, treated OHCA, treated OHCA with a cardiac cause, treated OHCA with ventricular fibrillation (VF), and survival-to-hospital discharge rates following OHCA. Results: Sixty-seven studies from Europe, North America, Asia or Australia met inclusion criteria. The weighted incidence estimate was significantly higher in studies including adults than in those including adults and paediatrics for treated OHCA (62.3 vs 34.7; P < 0.001); and for treated OHCA with a cardiac cause (54.6 vs 40.8; P = 0.004). Neither
survival to discharge rates nor VF survival to discharge rates differed statistically significant among studies. The incidence of treated OHCAs was higher in North America (54.6) than in Europe (35.0), Asia (28.3), and Australia (44.0) (P < 0.001). In Asia, the percentage of VF and survival to discharge rates were lower (11% and 2%, respectively) than those in Europe (35% and 9%, respectively), North America (28% and 6%, respectively), or Australia (40% and 11%, respectively) (P < 0.001, P < 0.001). Conclusions: OHCA incidence and outcome varies greatly around the globe. A better understanding of the variability is fundamental to improving OHCA prevention and resuscitation.

Current resuscitation guidelines (2005 guidelines [G2005]) accelerate ventricular fibrillation (VF) recurrence. We investigated whether patients resuscitated under G2005 spend more time in VF and have better survival rates than patients treated under the 2000 guidelines (G2000). Methods and Results: We analyzed continuous ECG recordings of out-of-hospital cardiac arrests prospectively collected from January 2006 to January 2008. Patients treated according to G2000 (n=282) or G2005 (n=240) with VF as initial rhythm were included. We measured the total time a patient was in recurrent VF (the sum of all intervals from each onset of recurrent VF to each next successful shock) and the time a patient was in initial VF (time interval from rescuer arrival to first effective shock). The primary outcome measure was neurologically intact survival to discharge. The median time in recurrent VF was 2.7 minutes (quartile 1 to 3, 0.4 to 9.0 minutes) under G2000 versus 4.0 minutes (quartile 1 to 3, 0.2 to 11.6 minutes) under G2005 (P=0.03). Median time in initial VF was 2.7 minutes (quartile 1 to 3, 1.7 to 4.3 minutes) versus 3.9 minutes (quartile 1 to 3, 2.3 to 6.5 minutes), respectively (P<0.001). Increased time in recurrent VF was significantly associated with decreased neurologically intact survival in both G2000 use (odds ratio, 0.92; 95% confidence interval, 0.87 to 0.97; P=0.001) and G2005 use (odds ratio, 0.94; 95% confidence interval, 0.90 to 0.99; P=0.02). Neurologically intact survival decreased significantly with increasing time in initial VF under G2000 (odds ratio, 0.86; 95% confidence interval, 0.74 to 0.99; P=0.04). This observation was nonexistent in patients treated under G2005. Neurologically intact survival was 29% (82 of 282) under G2000 versus 27% (65 of 240) under G2005 (P=0.61). Conclusions: With G2005, the time in recurrent VF remains associated with worse outcome. Studies of immediate defibrillation for recurrent VF are warranted.

Introduction: Immobilization of patients utilizing rigid spine boards (RSBs) is standard practice in the management of trauma patients. Pressure ulcers have been associated with prolonged immobilization, and the possibility exists that formation may begin when the patient is initially immobilized on the RSB. The effects may not be fully recognized because of limited research on the direct tissue effects of prolonged immobilization. Near-infrared spectroscopy is an emerging tool to measure peripheral tissue oxygen saturation (StO2). The purpose of this research was to study the effects of prolonged spinal immobilization on an RSB on sacral tissue oxygenation of healthy volunteers. Methods: This experimental study measured StO2 in healthy volunteers at baseline and again after 30 minutes of immobilization on an RSB at two sites: the sacral area (intervention) and 8–10 cm above the buttocks (control). Tissue oxygenation was
measured with the InSpectra Tissue Oxygenation Monitor (Hutchinson Technology, Hutchinson, MN) by placing the probe at the measurement site and waiting for 15 seconds for equilibration prior to recording StO2. Data were analyzed utilizing mixed-model and within-subjects analysis of variance (ANOVA), chi-square, and t-tests. Results: Seventy-three participants were included in the analysis. A slight majority of participants were female (55%), the average age was 38 years, the average height was 170 cm, and the average weight was 82 kg. There was a significant increase in the StO2 percentage at the sacral (intervention) area following immobilization, \( p < 0.001 \), point biserial correlation \( (r_{pb}) = 0.48 \). Significant changes in oxygenation were not noted at the control site. Conclusion: An increase in sacral tissue oxygenation following immobilization was a finding consistent with other research. This is likely a result of initial, rapid tissue reperfusion at the time of pressure release. Rapid reperfusion indicates that a period of previous hypoperfusion has occurred. This research indicates that there are detrimental effects of spine board immobilization in healthy volunteers, which suggests that pressure ulcer formation may begin prior to hospital admission with immobilization on an RSB.

11. Bin SS, Schutzman SA and Greenes DS, Validation of a Clinical Score to Predict Skull Fracture in Head-Injured Infants. Pediatr Emerg Care 2010: 26(9); 633-9

Objectives: To validate a previously derived clinical score that uses clinical signs to determine which head-injured infants are at risk of skull fracture. The clinical score is calculated on the basis of the patient's age, the scalp hematoma size, and the location of the hematoma, with a total value between 0 and 8. Methods: We performed a prospective observational study of children younger than 2 years with blunt head trauma presenting to an urban pediatric emergency department. Among subjects who had head imaging performed (validation set), we assessed the utility of our clinical score to detect skull fracture and intracranial injury. Results: In the 203 patients with imaging, 51 (25%) were diagnosed with skull fracture and 29 (14%) with intracranial injury. A clinical score of 4 or greater identified 90% (46/51) of patients with skull fracture with a sensitivity of 0.90 (95% confidence interval [CI], 0.78-0.96) and a specificity of 0.78 (95% CI, 0.70-0.84). A clinical score of 3 or greater identified 93% (27/29) of those with an intracranial injury with a sensitivity of 0.93 (95% CI, 0.76-0.99) and a specificity of 0.42 (95% CI, 0.35-0.50). A score of 3 or greater identified 100% of intracranial injury among asymptomatic patients. Conclusions: We have validated our clinical scoring system as an accurate way of determining an infant's risk of skull fracture. Whereas a clinical score of 4 or greater maximizes the trade-off between sensitivity and specificity for identifying skull fracture, a clinical score of 3 or greater may be preferable for detecting intracranial injury.


Objectives: Recently, attempts have been made to identify the utility of ultrasound in the management of patients in the prehospital setting. However, in the UK there is no directly relevant supporting evidence that prehospital ultrasound may reduce patient mortality and morbidity. The evidence available to inform this debate is almost entirely obtained from outside the UK, where emergency medical services (EMS) routinely use doctors as part of their model of service delivery. Using a structured review of the literature available, this paper examines the evidence to determine 'Is there a place for paramedic ultrasound in the management of patients in the prehospital setting?' Method: A structured review of the literature to identify clinical trials which examined the use of ultrasound by non-physicians in
the prehospital setting. Results: Four resources were identified with sufficient methodological rigour to accurately inform the research question. Conclusion: The theoretical concept that paramedic-initiated prehospital ultrasound may be of benefit in the management of critically ill patients is not without logical conceptual reason. Studies to date have demonstrated that with the right education and mentorship, some paramedic groups are able to obtain ultrasound images of sufficient quality to positively identify catastrophic pathologies found in critically ill patients. More research is required to demonstrate that these findings are transferable to the infrastructure of the UK EMS, and in what capacity they may be used to help facilitate optimal patient outcomes.


Background and aim: Prehospital care of trauma patients is a matter of great debate. The optimal transport method remains undecided, with conflicting data comparing helicopter and ground emergency medical transfer. This study systematically reviews the evidence comparing helicopter and ground transfer of trauma patients from the scene of injury. Methods: A systematic literature review of all population-based studies evaluating the impact on mortality of helicopter transfer of trauma patients from the scene of injury. We searched MEDLINE, CINAHL and EMBASE from January 1980 to December 2008 and selected and reviewed potentially relevant studies. Results: A search of the literature revealed 23 eligible studies. 14 of these studies demonstrated a significant improvement in trauma patient mortality when transported by helicopter from the scene. 5 of the 23 studies were of level II evidence with the remainder being of level III evidence. Data were then entered into an evidence table and reference made to transport staffing, intubation rate, time at scene and time/distance of transfer. Conclusions: The role and structure of HEMS in a modern trauma service is a debate that is likely to continue. Prehospital care design should be specific to critical incident frequency, geographical arrangements of hospital facilities and travel times within each trauma network. It is also important to consider the benefits and capabilities of the emergency medical team separately from the transport method being considered. An effective helicopter EMS will ultimately depend on effective operating procedures and tasking protocols, clinical governance, and auditing of the helicopter EMS activity.

14. Cattermole GN, Leung PYM, Mak PSK, Graham CA and Rainer TH, Mid-arm circumference can be used to estimate children's weights. Resuscitation 2010: 81(9); 1105-10

Introduction: Accurate measurement of children’s weight is rarely possible in paediatric resuscitation, and rapid estimates are made to ensure appropriate drug and fluid doses and equipment selection. Weight is commonly estimated from formulae based on children’s age, or from their height using the Broselow tape. Foot-length and mid-arm circumference have also been suggested as the basis of weight-estimation formulae. Objectives: To determine which of age, height, foot-length or mid-arm circumference had the strongest relationship with weight in healthy children, to derive a simple weight-estimation formula from the strongest correlate, and to compare its performance with existing weight-estimation tools. Methods: This was a population-based prospective observational study of Hong Kong Chinese children aged 1-11 years old last birthday. Weight was measured to the nearest 0.2 kg; height, foot-length and mid-arm circumference to the nearest 0.1 cm. Multiple regression analysis was used to determine the strongest independent relationships with weight, and linear regression analysis derived a weight-estimation formula. Accuracy and precision of this formula were compared with
standard age-based and height-based weight-estimation methods. Results: Mid-arm circumference had the strongest relationship with weight, and this relationship grew stronger with age. The formula, weight [kg] = (mid-arm circumference [cm] - 10) x 3, was at least as accurate and precise as the Broselow method and outperformed the age-based rule in school-age children, but was inadequate in preschool children. Conclusion: This weight-estimation formula based on mid-arm circumference is reliable for use in school-age children, and an arm-tape could be considered as an alternative to the Broselow tape in this population.

Section 12: Paediatric advanced life support

15. Dami F, Carron PN, Praz L, Fuchs V and Yersin B, Why Bystanders Decline Telephone Cardiac Resuscitation Advice. Acad Emerg Med 2010: 17(9); 1012-15

Objectives: The aim of this study was to evaluate the rate and reason for refusal of telephone-based cardiopulmonary resuscitation (CPR) instruction by bystanders after the implementation of the dispatch center's systematic telephone CPR protocol. Methods: Over a 15-month period the authors prospectively collected all case records from the emergency medical services (EMS) dispatch center when CPR had been proposed to the bystander calling in and recorded the reason for declining or not performing that the bystander spontaneously mentioned. All pediatric and adult traumatic and nontraumatic cases were included. Situations when resuscitation had been spontaneously initiated by bystanders were excluded. Results: During the study period, dispatchers proposed CPR on 264 occasions: 232 adult nontraumatic cases, 17 adult traumatic cases, and 15 pediatric (traumatic and nontraumatic) cases. The proposal was accepted in 163 cases (61.7%, 95% confidence interval [CI] = 54.6% to 66.5%), and CPR was eventually performed in 134 cases (51%, 95% CI = 43.2% to 55.3%). In 35 of the cases where resuscitation was not carried out, the condition of the patient or conditions at the scene made this decision medically appropriate. Of the remaining 95 cases, 55 were due to physical limitations of the caller, and 33 were due to emotional distress. Conclusions: The telephone CPR acceptance rate of 62% in this study is comparable to those of other similar studies. Because bystanders’ physical condition is one of the keys to success, the rate may not improve as the population ages.

Guideline 7: Cardiopulmonary resuscitation


Previous studies of paediatric cardiac arrest have reported a low survival rate but there is limited data from Australia. We sought to determine the characteristics and outcomes of paediatric out-of-hospital cardiac arrest in Melbourne, Australia. Methods: Between October 1999 and June 2007, all cases of out-of-hospital cardiac arrest attended by emergency medical services in Melbourne, Australia were entered into a database (the Victorian Ambulance Cardiac Arrest Registry). Data on patients aged less than 16 years in cardiac arrest on arrival of ambulance paramedics was analysed. Results: There were 209 children in cardiac arrest on arrival of paramedics during the study period. Of these, resuscitation was not attempted in 16 children due to signs of definite death. Of the 193 children who had attempted resuscitation, 143 (74%) had an initial cardiac rhythm of asystole, 36 (18%) were in pulseless electrical activity and 14 (7%) were in ventricular fibrillation. There were 49 patients (25%) with return of spontaneous circulation at arrival to hospital of whom 14 (7%) survived to hospital discharge. Of 138 patients without return of a circulation, 120 were transported to hospital with continuing
resuscitation and one survived (0.9%). Survival was higher in patients with an initial cardiac rhythm of ventricular fibrillation (5/14; 35%) compared with other rhythms (10/179; 4%), OR 9.38, 95% CI 2.64-33.2. Conclusions: Overall, 7.7% of paediatric patients with out-of-hospital cardiac arrest survive to leave hospital. Increased survival was seen if the initial cardiac rhythm was ventricular fibrillation. Survival was very rare (<1%) unless there was return of spontaneous circulation prior to hospital arrival.

Advances in care such as damage control surgery, hemostatic resuscitation, protocol-driven cerebral perfusion management, and lung-protective ventilation have promised to improve survival after major trauma. We examined injury severity, mortality, and preventability in a mature trauma system during a 12-year period to assess the overall benefits of these and other improvements. Methods: Using the institutional trauma registry and the quality management database, we analyzed the outcome and the cause of death for all primary trauma admissions from July 1, 1996, to June 30, 2008, and linked these data with patient demographics, hospital length of stay, time to death, predicted probability of survival, and peer review of in-hospital deaths. Results: Through fiscal year (FY) 2007, primary trauma admissions increased in number, injury severity, and age. Performance benchmarked against predicted probability of survival improved. Mortality through this era ranged from 3% to 3.7% and worsened slightly overall (p = 0.04). However, among those patients admitted with Injury Severity Score 17-25, survival improved significantly (p = 0.0003). Traumatic brain injury (TBI) accounted for 51.6% of deaths; acute hemorrhage, 30%; and multiple organ failure, 10.5%. Median time to death for uncontrollable hemorrhage, TBI, multiple organ failure was 2 hours, 24 hours, and 15 days, respectively. These patterns did not change significantly over time. Conclusion: Survival after severe trauma and survival benchmarked against predicted risk improved significantly at our center during the past 12 years despite generally increasing age and worsening injuries. Advances in trauma care have kept pace with an aging population and greater severity of injury, but overall survival has not improved.

18. Fesmire FM, Utilization of ST-segment deviation sum and change scores to identify acute myocardial infarction. The American Journal of Emergency Medicine 2010: 28(7); 790-7
No information is currently available regarding the optimal cutoff values of the baseline ST-segment deviation sum (STDsumbaseline) and 60-minute ST-segment deviation change (STDchange60min) for predicting acute myocardial infarction (AMI). Methods: A retrospective study was performed in 783 admitted patients with chest pain who had suspected acute coronary syndrome and absence of left ventricular hypertrophy or bundle branch block on the initial electrocardiogram (ECG). The STDsumbaseline was defined as the sum in millimeters (1 mm = 0.1 mV) of the absolute value of ST-segment deviations in all 12 leads at the initiation of continuous 12-lead ECG monitoring session. The STDchange60min was defined as the absolute value of the difference between the baseline and 60-minute STDsum. Three cutoff values are reported and represent the smallest values in which the positive likelihood ratio (+LR) for AMI was greater than or equal to 5, 10, and 20, respectively. Results Acute myocardial infarction occurred in 162 (20.7%) patients. The smallest cutoff value of the STDsumbaseline for AMI with a +LR equal to or greater than 5, 10, and 20 was 9.6, 12.4, and 14.1 mm, respectively. In the subset of 699 patients without ST-segment elevation AMI on initial ECG, the smallest cutoff value of the STDchange60min for AMI with
a +LR equal to or greater than 5, 10, and 20 was 2.4, 3.5, and 7.9 mm, respectively. Conclusions: Clinical studies need to be performed to determine if STDsum and STDchange, in conjunction with physician pretest probability of AMI, can be used to select patients who may benefit from emergent reperfusion therapy and other aggressive medical management strategies.

Objective: The objective of this study was to describe the clinical spectrum of patients presenting with shock or developing shock in a pediatric emergency department (ED) during an 8-year period. Methods: An observational study of all pediatric ED patients with shock between September 1998 and September 2006 was performed. Trauma activations were excluded. A structured, explicit chart review using a standardized abstraction form and case definition was completed by 3 physicians’ board certified in pediatric emergency medicine. Interrater reliability was monitored. Results: A total of 147 cases of shock were identified. Septic shock was the underlying physiology in 57% of cases. A pathogen was identified in 45% of these cases. Hypovolemic shock due to gastroenteritis, metabolic disease, surgical emergencies, or hemorrhage was the cause in 24% of cases. Distributive shock represented 14% of cases. Cardiogenic shock contributed to 5% of cases. Patients with septic shock received a mean of 58 mL/kg of crystalloid or colloid versus 50 mL/kg in patients with other causes. Intubation and vasopressor use was required in 41% and 21% of cases, respectively. Clinical signs of shock developed in the ED after initially presenting without clinical signs of shock in 14% of study subjects. Nearly half of these episodes occurred after the administration of antimicrobials or performance of a lumbar puncture. Mortality was 6% overall and 5% in septic shock patients. Conclusions: Pediatric ED patients with shock represent a diverse population with substantial mortality. Of 147 patients, 21 presented without clinical signs of shock and deteriorated to a clinical condition meeting the definition of shock during the ED course.

The use of therapeutic hypothermia after cardiac arrest is a well-practised treatment modality in the intensive care unit (ICU). However, recent evidence points to advantages in starting the cooling process as soon as possible after the return of spontaneous circulation (ROSC). There are no data on implementation of this treatment in the emergency department. Methods: A telephone survey was conducted of the 233 emergency departments in the UK. The most senior available clinician was asked if, in cases where they have a patient with a ROSC after an out-of-hospital cardiac arrest, would therapeutic hypothermia be started in the emergency department. Results: Of the 233 hospitals called, 230 responded, of which 35% would start cooling in the emergency department. Of this 35%, over half (56%) said the decision to start cooling was made by the emergency physician before consultation with the ICU. Also, of the 35% who would begin cooling in the emergency department, 55% would cool only for ventricular fibrillation/ventricular tachycardia, 66% would monitor temperature centrally, and 14% would use specialised cooling equipment. Conclusions: There is often a delay in getting patients to ICU from the emergency department, and thus the decision not to start cooling in the emergency department may impact significantly on patient outcome. The dissemination of these data may persuade emergency physicians that starting treatment in the emergency department is an appropriate and justifiable decision that is becoming a more accepted practice throughout the UK.
Guideline 11.9: Therapeutic hypothermia after cardiac arrest

Therapeutic hypothermia (32-34 °C) is recommended for comatose survivors of cardiac arrest; however, the optimal technique for cooling is unknown. We aimed to compare therapeutic hypothermia using either surface or endovascular techniques in terms of efficacy, complications and outcome. Design: Retrospective cohort study. Setting: Thirty-bed teaching hospital intensive care unit (ICU). Patients All patients (n = 83) undergoing therapeutic hypothermia following cardiac arrest over a 2.5-year period. The mean age was 61 ± 16 years; 88% of arrests occurred out of hospital, and 64% were ventricular fibrillation/tachycardia. Interventions: Therapeutic hypothermia was initiated in the ICU using iced Hartmann’s solution, followed by either surface (n = 41) or endovascular (n = 42) cooling; choice of technique was based upon endovascular device availability. The target temperature was 32-34 °C for 12-24 h, followed by rewarming at a rate of 0.25 °C h⁻¹. Measurements and main results: Endovascular cooling provided a longer time within the target temperature range (p = 0.02), less temperature fluctuation (p = 0.003), better control during rewarming (0.04), and a lower 48-h temperature load (p = 0.008). Endovascular cooling also produced less cooling-associated complications in terms of both overcooling (p = 0.05) and failure to reach the target temperature (p = 0.04). After adjustment for known confounders, there were no differences in outcome between the groups in terms of ICU or hospital mortality, ventilator free days and neurological outcome. Conclusion: Endovascular cooling provides better temperature management than surface cooling, as well as a more favorable complication profile. The equivalence in outcome suggested by this small study requires confirmation in a randomized trial.

Guideline 11.9: Therapeutic hypothermia after cardiac arrest

Rural environments have consistently been characterized by high injury mortality rates. Although injury prevention efforts might be directed to reduce the frequency or severity of injury in rural environments, it is plausible that interventions directed to improve injury care in the rural settings might also play a significant role in reducing mortality. To test this hypothesis, we set out to examine the relationship between rurality and the setting in which patient death was most likely to occur. Methods: This is a population-based retrospective cohort study evaluating all trauma deaths occurring in the province of Ontario, Canada, over the interval 2002 to 2003. Patient cohorts were defined by their potential to access trauma center care using two different approaches, rurality and timely access to trauma center care. Results: There were 3,486 deaths over the study interval, yielding an overall injury mortality rate of 14.6 per 100,000 person-years. Overall, more than half of deaths occurred before reaching an emergency department (ED). Prehospital deaths were twice as likely in the most rural locations and in those with limited access to timely trauma center care. However, among patients surviving long enough to reach hospital, there was a threefold increase in the risk of ED death among those injured in a region with limited access to trauma center care. Conclusions: We demonstrate that a significant proportion of deaths occur in rural EDs. This study provides new insights into rural trauma deaths and suggests the potential value of targeted interventions at the policy and provider level to improve the
delivery of preliminary trauma care in rural environments.


Objective: The Standardized Assessment of Concussion (SAC) is a validated tool for identifying the effects of mild traumatic brain injury (mTBI). Previous research focused on sport-related sideline evaluation of adolescents and adults. Our goal was to evaluate performance of the SAC among subjects with and without head injury in a pediatric emergency department (ED). Methods: This was an observational study of children 6 to 18 years of age who presented to an ED with blunt head injury (case-patients) or minor extremity injury (controls). SAC and graded-symptom-checklist scores were compared. American Academy of Neurology concussion grades, presence of loss of consciousness and posttraumatic amnesia were also compared with SAC and graded-symptom-checklist scores among case-patients.

Results: Three hundred forty-eight children were enrolled. SAC scores trended lower (greater cognitive deficits) for case-patients compared with controls but did not reach significance. Graded-symptom-checklist scores were significantly higher among case-patients. Presence of altered mental status magnified this effect. There was no correlation between SAC scores and other indicators of mTBI. There was a positive correlation between graded-symptom-checklist scores and posttraumatic amnesia and American Academy of Neurology concussion grade.

Conclusions: The graded symptom checklist reliably identified mTBI symptoms for all children aged 6 years and older. SAC scores tended to be lower for case-patients compared with controls but did not reach significance. Patients with altered mental status at the time of injury manifest an increased number and severity of symptoms. Additional research into strategies to identify cognitive deficits related to mTBI and classify mTBI severity in children is needed.

Guideline 8.11: Head injury


The Advanced Trauma Life Support system classifies the severity of shock. The aim of this study is to test the validity of this classification. Methods: Admission physiology, injury and outcome variables from adult injured patients presenting to hospitals in England and Wales between 1989 and 2007 and stored on the Trauma Audit and Research Network (TARN) database, were studied. Patients were divided into groups representing the four ATLS classes of shock, based on heart rate (HR) systolic blood pressure (SBP), respiratory rate (RR) and Glasgow Coma Score (GCS). The relationships between variables were examined by classifying the cohort by each recorded variable in turn and deriving the median and interquartile range (IQR) of the remaining three variables. Patients with penetrating trauma and major injuries were examined in sub-group analyses. Results: In blunt trauma patients grouped by HR, the median SBP decreased from 128 mm Hg in patients with HR < 100 BPM to 114 mm Hg in those with HR > 140 BPM. The median RR increased from 18 to 22 bpm and the GCS reduced from 15 to 14. The median HR in hypotensive patients was 88 BPM compared to 83 BPM in normotensive patients and the RR was the same. When grouped by RR, the HR increased with increasing RR but there were no changes in SBP. Conclusion: In trauma patients there is an inter-relationship between derangements of HR, SBP, RR and GCS but not to the same degree as that suggested by the ATLS classification of shock.
Guideline 8.4: Shock


Aim: To investigate the factors associated with adverse clinical features presented by drug overdose/self-poisoning patients and the treatments provided. Methods: Historical patient records collected over 3 months from ambulance crews attending non-fatal overdoses/self-poisoning incidents were reviewed. Logistic regression was used to investigate predictors of adverse clinical features (reduced consciousness, obstructed airway, hypotension or bradycardia, hypoglycaemia) and treatment. Results: Of 22,728 calls attended to over 3 months, 585 (rate 26/1000 calls) were classified as overdose or self-poisoning. In the 585 patients identified, paracetamol-containing drugs were most commonly involved (31.5%). At least one adverse clinical feature occurred in 103 (17.7%) patients, with higher odds in men and opiate overdose or illegal drugs. Older patients and patients with reduced consciousness were more likely to receive oxygen. The latter also had a greater chance of receiving saline. Conclusion: Non-fatal overdose/self-poisoning accounted for 2.6% of patients attended by an ambulance. Gender, illegal drugs or opiates were important predictors of adverse clinical features. The treatments most often provided to patients were oxygen and saline.

Guideline 8.12: Emergency management of a victim who has been poisoned


Background: Traumatic coagulopathy contributes to early death by exsanguination and late death in multiple organ failure. Recombinant Factor VIIa (rFVIIa, NovoSeven) is a procoagulant that might limit bleeding and improve trauma outcomes. Methods: We performed a phase 3 randomized clinical trial evaluating efficacy and safety of rFVIIa as an adjunct to direct hemostasis in major trauma. We studied 573 patients (481 blunt and 92 penetrating) who bled 4 to 8 red blood cell (RBC) units within 12 hours of injury and were still bleeding despite strict damage control resuscitation and operative management. Patients were assigned to rFVIIa (200 [mu]g/kg initially; 100 [mu]g/kg at 1 hour and 3 hours) or placebo. Intensive care unit management was standardized using evidence-based trauma "bundles" with formal oversight of compliance. Primary outcome was 30-day mortality. Predefined secondary outcomes included blood products used. Safety was assessed through 90 days. Study powering was based on prior randomized controlled trials and large trauma center databases. Results: Enrollment was terminated at 573 of 1502 planned patients because of unexpected low mortality prompted by futility analysis (10.8% vs. 27.5% planned/predicted) and difficulties consenting and enrolling sicker patients. Mortality was 11.0% (rFVIIa) versus 10.7% (placebo) (p = 0.93, blunt) and 18.2% (rFVIIa) versus 13.2% (placebo) (p = 0.40, penetrating). Blunt trauma rFVIIa patients received (mean +/- SD) 7.8 +/- 10.6 RBC units and 19.0 +/- 27.1 total allogeneic units through 48 hours, and placebo patients received 9.1 +/- 11.3 RBC units (p = 0.04) and 23.5 +/- 28.0 total allogeneic units (p = 0.04). Thrombotic adverse events were similar across study cohorts. Conclusions: rFVIIa reduced blood product use but did not affect mortality compared with placebo. Modern evidence-based trauma lowers mortality, paradoxically making outcomes studies increasingly difficult.

Background: The burden of harm associated with alcohol misuse is disproportionately high in rural areas of Australia, and a considerable proportion of this burden is borne by the health system. The health impact of alcohol in rural areas has been measured in terms of the contribution of alcohol to hospital inpatient admissions and mortality rates, despite many more alcohol-related cases presenting to emergency departments (EDs). This study aims to estimate the proportion of presentations to EDs in rural Australia that are alcohol-related and to identify the associated patient and presentation characteristics. Methods: Patients aged ≥14 years presenting to four EDs in rural NSW were assessed on two measures: (1) Clinician judgment of alcohol consumption, and (2) patient self-report of alcohol consumption in the 6h preceding the onset of their condition. Results: Preliminary analyses revealed sample selection biases in two of the EDs, and these samples were consequently excluded from further analyses. In the two remaining EDs, 46% of presentations were assessed, of which 9% were identified as alcohol-related. Presentations for mental disorders, those with more urgent triage categories and those occurring on weekends or at night were more often alcohol-related. Conclusions: The prevalence of alcohol-related ED presentations observed was at the lower end of the documented range, probably due to methodological differences and limitations, as well as geographic variation. Despite this, alcohol-related presentations were associated with a substantial impact on the ED. Policies and programs to reduce the impact of alcohol on rural emergency departments are needed.


We assessed survival from out-of-hospital cardiac arrest after community-wide implementation of 2005 American Heart Association guidelines. Methods: This was an observational multiphase before-after cohort in an urban/suburban community (population 840,000) with existing advanced life support. Included were all adults treated for cardiac arrest by emergency responders. Excluded were patients younger than 16 years and trauma patients. Intervention phases in months were baseline 16; phase 1, new cardiopulmonary resuscitation 12; phase 2, impedance threshold device 6; and phase 3, full implementation including out-of-hospital-induced hypothermia 12. Primary outcome was survival to discharge. Other survival and neurologic outcomes were compared between study phases, and adjusted odds ratios with 95% confidence intervals (CIs) for survival by phase were determined by multivariate regression. Results: One thousand three hundred sixty-five cardiac arrest patients were eligible for inclusion: baseline n=425, phase 1 n=369, phase 2 n=161, phase 3 n=410. Across phases, patients had similar demographic, clinical, and emergency medical services characteristics. Overall and witnessed ventricular fibrillation and ventricular tachycardia survival improved throughout the study phases: respectively, baseline 4.2% and 13.8%, phase 1 7.3% and 23.9%, phase 2 8.1% and 34.6%, and phase 3 11.5% and 40.8%. The absolute increase for overall survival from baseline to full implementation was 7.3% (95% CI 3.7% to 10.9%); witnessed ventricular fibrillation/ventricular tachycardia survival was 27.0% (95% CI 13.6% to 40.4%), representing an additional 25 lives saved annually in this community. Conclusion: In the context of a community-wide focus on resuscitation, the sequential implementation of 2005 American Heart Association guidelines for compressions,
ventilations, and induced hypothermia significantly improved survival after cardiac arrest. Further study is required to clarify the relative contribution of each intervention to improved survival outcomes.

Venous thromboembolism is common after major trauma. Strategies to prevent fatal pulmonary embolism (PE) are widely utilized, but the incidence and risk factors for fatal PE are poorly understood. Methods: Using linked data from the intensive care unit, trauma registry, Western Australian Death Registry, and post-mortem reports, the incidence and risk factors for fatal PE in a consecutive cohort of major trauma patients, admitted between 1994 and 2002, were assessed. Non-linear relationships between continuous predictors and risk of fatal PE were modelled by logistic regression. Results: Of the 971 consecutive trauma patients considered in the study, 134 (13.8%) died after their injuries. Fatal PE accounted for 11.9% of all deaths despite unfractionated heparin prophylaxis being used in 44% of these patients. Fatal PE occurred in those who were older (mean age 51 - vs 37-yr-old, P=0.01), with more co-morbidities (Charlson’s co-morbidity index 1.1 vs 0.2, P=0.01), had a larger BMI (31.8 vs 24.5, P=0.01), and less severe head and systemic injuries when compared with those who died of other causes. Sites of injuries were not significantly related to the risk of fatal PE. Fatal PE occurred much later than deaths from other causes (median 18 vs 2 days, P=0.01), and the estimated attributable mortality of PE was 49% (95% confidence interval 36 - 62%). Conclusions: Fatal PE appeared to be a potential preventable cause of late mortality after major trauma. Severity of injuries, co-morbidity, and BMI were important risk factors for fatal PE after major trauma.

Airway management is a key component of prehospital care for seriously ill and injured patients. Oral endotracheal intubation (OETI) is the definitive airway of choice in most emergency medical services (EMS) systems. However, OETI may not be an approved skill for some clinicians or may prove problematic in certain patients because of anatomic abnormalities, trauma, or inadequate relaxation. In these situations alternative airways are frequently employed. However, the reported success rates for these devices vary widely, and established benchmarks are lacking. Objective: We sought to determine pooled estimates of the success rates of alternative airway devices (AADs) and needle cricothyrotomy (NCRIC) and surgical cricothyrotomy (SCRIC) placement through a meta-analysis of the literature. Methods: We performed a systematic literature search for all English-language articles reporting success rates for AADs, SCRIC, and NCRIC. Studies of field procedures performed by prehospital personnel from any nation were included. All titles were reviewed independently by two authors using prespecified inclusion criteria. Pooled estimates of success rates for each airway technique were calculated using a random-effects meta-analysis model. Results: Of 2,005 prehospital airway titles identified, 35 unique studies were retained for analysis of AAD success rates, encompassing a total of 10,172 prehospital patients. The success rates for SCRIC and NCRIC were analyzed across an additional 21 studies totaling 512 patients. The pooled estimates (and 95% confidence intervals [CIs]) for intervention success across all clinicians and patients were as follows: esophageal obturator airway–esophageal gastric tube airway (EOA-EGTA) 92.6% (90.1%-94.5%); pharyngeotracheal lumen airway (PTLA) 82.1% (74.0%-88.0%); esophageal-tracheal Combitube (ETC)
85.4% (77.3%–91.0%); laryngeal mask airway (LMA) 87.4% (79.0%–92.8%); King Laryngeal Tube airway (King LT) 96.5% (71.2%–99.7%); NCRIC 65.8% (42.3%–83.59%); and SCRIC 90.5% (84.8%–94.2%). Conclusions: We provide pooled estimates for prehospital AAD, NCRIC, and SCRIC airway interventions. Of the AADs, the King LT demonstrated the highest insertion success rate (96.5%), although this estimate is based on limited data, and data regarding its ventilatory effectiveness are lacking; more data are available for the ETC and LMA. The ETC, LMA, and PTLA all had similar—but lower—success rates (82.1%–87.4%). NCRIC has a low rate of success (65.8%); SCRIC has a much higher success rate (90.5%) and should be considered the preferred percutaneous rescue airway.

Guideline 11.7: Equipment and techniques in adult advanced life support


Aim: Food asphyxiation is uncommon but unignorable cause of sudden death in the elderly. Several autopsy studies, which identified those at particular risk, have been conducted on the subject. Resuscitation profiles and outcomes of food asphyxiation victims presenting with out-of-hospital cardiac arrest (OHCA) to the emergency department, however, have rarely been reported. Methods: Data on adults (>=20 years) presenting with OHCA after witnessed food asphyxiation were retrieved from an institutional database. Clinical variables were evaluated to identify their demographic characteristics. Their outcomes, represented by return of spontaneous circulation (ROSC) and survival rate, were also investigated. Results: Sixty-nine food asphyxiation victims presenting with OHCA were identified during the 4-year period. Food asphyxiation occurred most frequently in the age group of 71-80 years, followed by that of 81-90 years. The majority of victims had medical conditions that adversely affected mastication/swallowing, such as dementia. Bystander cardiopulmonary resuscitation (CPR) was performed only in 26%, although bystanders often attempted to clear the airway without performing CPR. Despite the high ROSC rate of 78%, only 7% survived to discharge. Asphyxiation-ROSC interval might play a crucial role in determining the outcomes: the interval was <=10 min in all survivors, while it was longer than 10 min in all non-survivors. Conclusion: Because of their advanced age and debilitating general condition, it may be difficult to substantially improve the outcomes of food asphyxiation victims. Effort should be directed to prevent food asphyxiation, and public education to perform standard CPR for food asphyxiation victims including the Heimlich manoeuvre is warranted.

Guideline 4: Airway, Guideline 7: Cardiopulmonary resuscitation


We determine whether droperidol, midazolam, or the combination is more effective for intramuscular sedation in violent and acute behavioral disturbance in the emergency department (ED). Methods: We conducted a blinded randomized controlled trial of intramuscular sedation for violent and acute behavioral disturbance, comparing droperidol (10 mg), midazolam (10 mg), and droperidol (5 mg)/midazolam (5 mg). Inclusion criteria were patients requiring physical restraint and parenteral sedation. The primary outcome was the duration of the violent and acute behavioral disturbance, defined as the time security staff were required. Secondary outcomes
included time until additional sedation was administered, staff and patient injuries, further episodes of violent and acute behavioral disturbance, and drug-related adverse effects. Results: From 223 ED patients with violent and acute behavioral disturbance, 91 patients were included; 33 received droperidol, 29 received midazolam, and 29 received the combination. There was no difference in the median duration of the violent and acute behavioral disturbance: 20 minutes (interquartile range [IQR] 11 to 37 min) for droperidol, 24 minutes (IQR 13 to 35 minutes) for midazolam, and 25 minutes (IQR 15 to 38 minutes) for the combination. Additional sedation was required in 11 (33%; 95% confidence interval [CI] 19% to 52%) droperidol patients, 18 (62%; 95% CI 42% to 79%) midazolam patients, and 12 (41%; 95% CI 24% to 61%) in the combination group. The hazard ratio for additional sedation in the midazolam versus droperidol group was 2.31 (95% credible interval 1.01 to 4.71); for the combination versus droperidol, 1.18 (95% credible interval 0.46 to 2.50). Patient and staff injuries and number of further episodes of violent and acute behavioral disturbance did not differ between groups. There were two adverse effects for droperidol (6%; 95% CI 1% to 22%), 8 for midazolam (28%; 95% CI 13% to 47%), and 2 for the combination (7%; 95% CI 1% to 24%). An abnormal QT occurred in 2 of 31 (6%; 95% CI 1% to 23%) droperidol patients, which was not different from the other groups. Conclusion: Intramuscular droperidol and midazolam resulted in a similar duration of violent and acute behavioral disturbance, but more additional sedation was required with midazolam. Midazolam caused more adverse effects because of oversedation, and there was no evidence of QT prolongation associated with droperidol compared with midazolam.


BACKGROUND: Survival of children with in-hospital cardiac arrest that does not respond to conventional cardiopulmonary resuscitation (CPR) is poor. We report on survival and early neurological outcomes of children with heart disease supported with rapid-response extracorporeal membrane oxygenation (ECMO) to aid cardiopulmonary resuscitation (ECPR). METHODS AND RESULTS: Children with heart disease supported with ECPR were identified from our ECMO database. Demographic, CPR, and ECMO details associated with mortality were evaluated using multivariable logistic regression. Pediatric overall performance category and pediatric cerebral performance category scores were assigned to ECPR survivors to assess neurological outcomes. There were 180 ECPR runs in 172 patients. Eighty-eight patients (51%) survived to discharge. Survival in patients who underwent ECPR after cardiac surgery (54%) did not differ from nonsurgical patients (46%). Survival did not vary by cardiac diagnosis and CPR duration did not differ between survivors and nonsurvivors. Factors associated with mortality included noncardiac structural or chromosomal abnormalities (OR, 3.2; 95% CI, 1.3-7.9), use of blood-primed ECMO circuit (OR, 7.1; 95% CI, 1.4-36), and arterial pH <7.00 after ECMO deployment (OR, 6.0; 95% CI, 2.1-17.4). Development of end-organ injury on ECMO and longer ECMO duration were associated with increased mortality. Of pediatric overall performance category/pediatric cerebral performance category scores assigned to survivors, 75% had scores >2, indicating no to mild neurological injury. CONCLUSIONS: ECPR may promote survival in children with cardiac disease experiencing cardiac arrest unresponsive to conventional CPR with favorable early neurological outcomes. CPR duration was not associated with mortality, whereas patients with metabolic acidosis and noncardiac structural or chromosomal anomalies had higher mortality.

Background: Many patients with intracranial bleeding (ICB) are being evaluated in hospitals with no neurosurgical service. Some of the patients may be safely managed in the primary hospital without transferring them to a designated neurosurgical center. In Israel, there are three approaches to alert patients with ICB: mandatory transfer, remote telemedicine neurosurgical consultation, and clinical-radiologic guidelines. We evaluated the outcome of alert patients with low-risk intracranial bleeding (ICB) who were managed in centers without neurosurgical service. Methods: A retrospective cohort comparative study. Patients with ICB and a Glasgow Coma Score >12 were included. Low-risk ICB was defined as solitary brain contusion of <1 cm in diameter, limited small subarachnoid hemorrhage, or subdural hematoma of <5 mm in maximal width and length. The decision to transfer the patients to a neurosurgical center was based on one of the three models. Hospital A: mandatory transfer. Hospital B: telemedicine-based consultation with a remote neurosurgeon. Hospital C: clinical-radiologic algorithm-based guidelines. Primary endpoint was the neurologic outcome of patients at discharge. Results: There were 152 patients in group A, 98 patients in group B, and 73 patients in group C. All patients of group A were transferred to a neurosurgical center. Fifty-eight percent of patients from hospital B and 26% of patients from hospital C were hospitalized in the primary center despite a proven ICB. These patients were discharged without any neurologic sequel of their injury. Two patients from group B and one patient from group C needed a delayed transfer to a neurosurgical center. None of the patient needed delayed neurosurgical intervention. Conclusions: Despite the small sample size of this study, the presented data suggest that some patients with ICB can be safely and definitively managed in centers with no on-site neurosurgical service. The need for transfer may be based on telemedicine consultation or clinical-radiologic guidelines. Further larger scale studies are warranted.

Guideline 8.11: Head injury


Objective: While the use of therapeutic hypothermia (TH) has improved outcomes after resuscitation from cardiac arrest, prognostication of survival and neurologic function remains difficult during the post-arrest time period. Bispectral index (BIS) monitoring, a non-invasive measurement of simplified electroencephalographic data, is increasingly being considered for post-arrest neurologic assessment and outcomes prediction, although data supporting the technique are limited. We hypothesized that BIS values within 24 h after resuscitation would correlate with neurologic outcomes at discharge. Methods: We prospectively collected BIS data in consecutive patients initially resuscitated from cardiac arrest and treated with TH in one academic medical center. We assessed BIS values in context of cerebral performance category (CPC) assessment on the day of discharge. Results: Data were collected in 62 post-arrest patients, of whom 26/62 (42%) survived to hospital discharge. Mean BIS values at 24 h post-resuscitation were significantly different in the survivors with CPC 1-2 (“good” outcome) vs those with CPC 3-5 (“poor” outcome) or death during hospitalization (49 ± 13 vs 30 ± 20; p < 0.001). Receiver operator characteristic analysis suggested that 24 h BIS was most predictive of CPC 1-2 outcome compared to the other timepoints; a BIS cutpoint of 45 exhibited a sensitivity of 63% and a specificity of 86%, with a positive likelihood ratio of 4.67. Sixteen patients exhibited a BIS of zero during at least one timepoint; all of these patients died during hospitalization. Conclusions: BIS monitoring values at 24 h post-
resuscitation are correlated with neurologic outcomes in patients undergoing TH treatment. In 16/62 patients, a BIS of zero at any timepoint was observed, which was uniformly correlated with poor outcome after resuscitation from cardiac arrest; however, a non-zero BIS is insufficient as a sole predictor of good neurologic survival.

*Guideline 11.8 & 11.9: Post resuscitation therapy and therapeutic hypothermia*

Although gestational age (GA) is often used as the primary basis for counseling and decision-making for extremely premature infants, a study of tertiary care centers showed that additional factors could improve prediction of outcomes. Our objective was to determine how such a model could improve predictions for a population-based cohort. METHODS: From 2005 to 2008, data were collected prospectively for the California Perinatal Quality Care Collaborative, which encompasses 90% of NICUs in California. For infants born at GAs of 22 to 25 weeks, we assessed the ability of the Eunice Kennedy Shriver National Institute of Child Health and Human Development 5-factor model to predict survival rates, compared with a model using GA alone. RESULTS: In the study cohort of 4527 infants, 3647 received intensive care. Survival rates were 53% for the whole cohort and 66% for infants who received intensive care. In multivariate analyses of data for infants who received intensive care, prenatal steroid exposure, female sex, singleton birth, and higher birth weight (per 100-g increment) were each associated with a reduction in the risk of death before discharge similar to that for a 1-week increase in GA. The multivariate model increased the ability to group infants in the highest and lowest risk categories (mortality rates of >80% and <20%, respectively). CONCLUSIONS: In a population-based cohort, the addition of prenatal steroid exposure, sex, singleton or multiple birth, and birth weight to GA allowed for improved prediction of rates of survival to discharge for extremely premature infants.

BACKGROUND: For healthcare providers in the prehospital setting, bag-valve mask (BVM) ventilation could be as efficacious and safe as endotracheal intubation. To facilitate the evaluation of efficacious ventilation, capnographs have been further developed into small and convenient devices able to provide end-tidal carbon dioxide (ETCO₂). The aim of this study was to investigate whether a new portable device (EMMATM) attached to a ventilation mask would provide ETCO₂ values accurate enough to confirm proper BVM ventilation. METHODS: A prospective observational trial was conducted in a single level-2 centre. Twenty-two patients under general anaesthesia were manually ventilated. ETCO₂ was measured every five minutes with the study device and venous PCO₂ (PvCO₂) was simultaneously measured for comparison. Bland-Altman plots were used to compare ETCO₂, and PvCO₂. RESULTS: The patients were all haemodynamically and respiratory stable during anaesthesia. End-tidal carbon dioxide values were corresponding to venous gases during BVM ventilation under optimal conditions. The bias, the mean of the differences between the two methods (device versus venous blood gases), for time points 1-4 ranges from -1.37 to -1.62. CONCLUSION: The portable device, EMMATM is suitable for determining carbon dioxide in expired air (kPa) as compared to simultaneous samples of PvCO₂. It could therefore, be a supportive tool to assess the BVM ventilation in the demanding prehospital and emergency setting.
Guideline 11.7: Equipment and techniques in adult ALS


Out-of-hospital cardiac arrest (OHCA) is a leading cause of mortality and severe neurological disability. Recent literature suggests that mild therapeutic hypothermia (MTH) can improve survival and neurological outcome in some groups of comatose patients after cardiac arrest but uncertainty exists over the best way to implement this treatment. This review examines the evidence for the efficacy and mode of implementation of MTH after OHCA, particularly in the Emergency Department setting. A literature search was performed and all systematic reviews; human and animal randomised and non-randomised trials were screened for inclusion. Specific emphasis was placed on MTH being commenced in the prehospital and Emergency Department setting. Outcome measures were: time to reach target temperature, in-hospital mortality, neurological outcome at hospital discharge and complications of therapeutic hypothermia. Two systematic reviews found that MTH improved outcome after OHCA. Five human randomised controlled trials were identified. Two trials commenced cooling prehospital. One showed a favourable outcome but the other failed to show survival benefit. The other three trials only commenced cooling after the patient arrived in hospital and all showed improved survival for patients treated with MTH after OHCA. Evidence from animal and non-randomised studies suggests cooling should be commenced as early as possible after return of spontaneous circulation. Cold intravenous fluid was reported as a safe, effective means of cooling in the emergency setting. MTH improves patient outcome after OHCA. There is some evidence to suggest cooling should be commenced early. Cold intravenous crystalloid infusion may be the preferred cooling method in the Emergency Department.

Guideline 9.1.1: Hypothermia after cardiac arrest


Occasionally, individuals accused of inflicting fatal injuries on infants and young children will claim some variant of the "CPR defense," that is, they attribute the cause of injuries found at autopsy to their "untrained" resuscitative efforts. A 10-year (1994-2003) historical fixed cohort study of all pediatric forensic autopsies at the Miami-Dade County Medical Examiner Department was undertaken. To be eligible for inclusion in the study, children had to have died of atraumatic causes, with or without resuscitative efforts (N atraumatic = 546). Of these, 382 had a history of cardiopulmonary resuscitation (CPR; average age of 4.17 years); 248 had CPR provided by trained individuals only; 133 had CPR provided by both trained and untrained individuals; 1 had CPR provided by untrained individuals only. There was no overlap between these 3 distinct groups. Twenty-two findings potentially attributable to CPR were identified in 19:15 cases of orofacial injuries compatible with attempted endotracheal intubation; 4 cases with focal pulmonary parenchymal hemorrhage; 1 case with prominent anterior mediastinal emphysema; and 2 cases with anterior chest abrasions. There were no significant hollow or solid thoracoabdominal organ injuries. There were no rib fractures. The estimated relative risk of injury subsequent to resuscitation was not statistically different between the subset of decedents whose resuscitative attempts were made by trained individuals only, and the subset who received CPR from both trained and untrained individuals. In the single case of CPR application by an untrained individual
only, no injuries resulted. The remaining 164 children dying from nontraumatic causes and who did not undergo resuscitative efforts served as a control group; no injuries were identified. This study indicates that in the pediatric population, injuries secondary to resuscitative efforts are infrequent or rare, pathophysiologically inconsequential, and predominantly orofacial in location. In our population, CPR did not result in any rib fractures or significant visceral injuries. Participation of nonmedical or untrained individuals in resuscitation did not increase the likelihood of injury.


BACKGROUND: Current 2005 guidelines for advanced cardiac life support strongly recommend immediate defibrillation for out-of-hospital cardiac arrest. However, findings from experimental and clinical studies have indicated a potential advantage of pretreatment with chest compression-only cardiopulmonary resuscitation (CPR) prior to defibrillation in improving outcomes. The aim of this meta-analysis is to evaluate the beneficial effect of chest compression-first versus defibrillation-first on survival in patients with out-of-hospital cardiac arrest. METHODS: Main outcome measures were survival to hospital discharge (primary endpoint), return of spontaneous circulation (ROSC), neurologic outcome and long-term survival. Randomized, controlled clinical trials that were published between January 1, 1950, and June 19, 2010, were identified by a computerized search using SCOPUS, MEDLINE, BIOS, EMBASE, the Cochrane Central Register of Controlled Trials, International Pharmaceutical Abstracts database, and Web of Science and supplemented by conference proceedings. Random effects models were used to calculate pooled odds ratios (ORs). A subgroup analysis was conducted to explore the effects of response interval greater than 5 min on outcomes. RESULTS: A total of four trials enrolling 1503 subjects were integrated into this analysis. No difference was found between chest compression-first versus defibrillation-first in the rate of return of spontaneous circulation (OR 1.01 [0.82-1.26]; P = 0.979), survival to hospital discharge (OR 1.10 [0.70-1.70]; P = 0.686) or favorable neurologic outcomes (OR 1.02 [0.31-3.38]; P = 0.979). For 1-year survival, however, the OR point estimates favored chest compression first (OR 1.38 [0.95-2.02]; P = 0.092) but the 95% CI crossed 1.0, suggesting insufficient estimate precision. Similarly, for cases with prolonged response times (> 5 min) point estimates pointed toward superiority of chest compression first (OR 1.45 [0.66-3.20]; P = 0.353), but the 95% CI again crossed 1.0. CONCLUSIONS: Current evidence does not support the notion that chest compression first prior to defibrillation improves the outcome of patients in out-of-hospital cardiac arrest. It appears that both treatments are equivalent. However, subgroup analyses indicate that chest compression first may be beneficial for cardiac arrests with a prolonged response time.

Guideline 11.5: Electrical therapy for adult ALS


Objective: To compare the effectiveness of intravenous (IV) morphine, intranasal (IN) fentanyl, and inhaled methoxyflurane when administered by paramedics to patients with moderate to severe pain. Methods: We conducted a retrospective comparative study of adult patients with moderate to severe pain treated by paramedics from the Ambulance Service of New South Wales who received IV morphine, IN fentanyl, or inhaled methoxyflurane either alone or in combination between January 1, 2004, and November 30, 2006. We used
multivariate logistic regression to analyze data extracted from a clinical database containing routinely entered information from patient health care records. The primary outcome measure was effective analgesia, defined as a reduction in pain severity of ≥30% of initial pain score using an 11-point verbal numeric rating scale (VNRS-11). Results: The study population comprised 52,046 patients aged between 16 and 100 years with VNRS-11 scores of ≥5. All analgesic agents were effective in the majority of patients (81.8%, 80.0%, and 59.1% for morphine, fentanyl, and methoxyflurane, respectively). There was very strong evidence that methoxyflurane was inferior to both morphine and fentanyl (p < 0.0001). There was strong evidence that morphine was more effective than fentanyl (p = 0.002). There was no evidence that combination analgesia was better than either fentanyl or morphine alone. Conclusion: Inhaled methoxyflurane, IN fentanyl, and IV morphine are all effective analgesic agents in the out-of-hospital setting. Morphine and fentanyl are significantly more effective analgesic agents than methoxyflurane. Morphine appears to be more effective than IN fentanyl; however, the benefit of IV morphine may be offset to some degree by the ability to administer IN fentanyl without the need for IV access.


Background: Mild to moderate therapeutic hypothermia (TH) has been shown to improve survival and neurological outcome in patients resuscitated from out-of-hospital cardiac arrest (OHCA) with ventricular fibrillation (VF) as the presenting rhythm. This approach entails the management of physiological variables which fall outside the realm of conventional critical cardiac care. Management of serum potassium fluxes remains pivotal in the avoidance of lethal ventricular arrhythmia. Methods: We retrospectively analyzed potassium variability with TH and performed correlative analysis of QT intervals and the incidence of ventricular arrhythmia. Results: We enrolled 94 sequential patients with OHCA, and serum potassium was followed intensively. The average initial potassium value was 3.9 ± 0.7 mmol/L and decreased to a nadir of 3.2 ± 0.7 mmol/L at 10 h after initiation of cooling (p < 0.001). Eleven patients developed sustained polymorphic ventricular tachycardia (PVT) with eight of these occurring during the cooling phase. The corrected QT interval prolonged in relation to the development of hypothermia (p < 0.001). Hypokalemia was significantly associated with the development of PVT (p = 0.002), with this arrhythmia being most likely to develop in patients with serum potassium values of less than 2.5 mmol l-1 (p = 0.002). Rebound hyperkalemia did not reach concerning levels (maximum 4.26 ± 0.8 mmol/L at 40 h) and was not associated with the occurrence of ventricular arrhythmia. Furthermore, repletion of serum potassium did not correlate with the development of ventricular arrhythmia. Conclusions: Therapeutic hypothermia is associated with a significant decline in serum potassium during cooling. Hypothermic core temperatures do not appear to protect against ventricular arrhythmia in the context of severe hypokalemia and cautious supplementation to maintain potassium at 3.0 mmol l-1 appears to be both safe and effective. Guideline 11.8 & 11.9: Post resuscitation therapy and therapeutic hypothermia


To provide a critical review of research on clinical handover between the ambulance service and emergency department (ED) in hospitals. Data base and hand searches were conducted using the keywords ambulance, handover, handoff, emergency department, emergency
room, ER, communication, and clinical handover. Data were extracted, summarised and critically assessed to provide evidence of current clinical handover processes. From 252 documents, eight studies fitted the inclusion criteria of clinical handover and the ambulance to ED patient transfer. Three themes were identified in the review: (1) important information may be missed during clinical handover; (2) structured handovers that include both written and verbal components may improve information exchange; (3) multidisciplinary education about the clinical handover process may encourage teamwork, a shared common language and a framework for minimum patient information to be transferred from the ambulance service to the hospital ED. Knowledge gaps exist concerning handover information, consequences of poor handover, transfer of responsibility, staff perception of handovers, staff training and evaluation of recommended strategies to improve clinical handover. Evidence of strategies being implemented and further research is required to examine the ongoing effects of implementing the strategies.


This study aimed to determine if a deployment strategy based on geospatial–time analysis is able to reduce ambulance response times for out-of-hospital cardiac arrests (OOHCA) in an urban emergency medical services (EMS) system. Methods: An observational prospective study examining geographic locations of all OOHCA in Singapore was conducted. Locations of cardiac arrests were spot-mapped using a geographic information system (GIS). A progressive strategy of satellite ambulance deployment was implemented, increasing ambulance bases from 17 to 32 locations. Variation in ambulance deployment according to demand, based on time of day, was also implemented. The total number of ambulances and crews remained constant over the study period. The main outcome measure was ambulance response times. Results: From October 1, 2001, to October 14, 2004, a total of 2,428 OOHCA patients were enrolled into the study. Mean ± SD age for arrests was 60.6 ± 19.3 years with 68.0% male. The overall return of spontaneous circulation (ROSC) rate was 17.2% and survival to discharge rate was 1.6%. Response time decreased significantly as the number of fire stations/fire posts increased (Pearson χ² = 108.70, df = 48, p < 0.001). Response times for OOHCA decreased from a monthly median of 10.1 minutes at the beginning to 7.1 minutes at the end of the study. Similarly, the proportion of cases with response times < 8 minutes increased from 22.3% to 47.3% and < 11 minutes from 57.6% to 77.5% at the end of the study. Conclusions: A simple, relatively low-cost ambulance deployment strategy was associated with significantly reduced response times for OOHCA. Geospatial–time analysis can be a useful tool for EMS providers.


Background: The sudden influx of patients during mass casualty events (MCEs) may compromise the quality of care provided and possibly impact on the medical outcomes of these patients. To test this assumption, a comparison must be made between injuries sustained in MCE and non-MCE events caused by the same mechanism. The mechanism of injury selected for this study was gunshot wounds, which occur in both types of event. Methods: A retrospective study was carried out using the Israel’s National Trauma Registry data on patients hospitalized between November 1, 2000, and December 31, 2005, as a result of high-energy gunshot trauma. Descriptive statistics and bivariate analysis were used to characterize injury patterns, and multivariate analysis was used to determine factors influencing inpatient
mortality. Results: Of 462 patients with gunshot wounds, 120 cases (26.38%) were defined as MCE and 342 (73.62%) as non-MCE. Both populations had ~30% of severely injured patients (Injury Severity Score 16+). MCE patients had undergone significantly fewer operational procedures. No differences between MCE and non-MCE were found in intensive care units utilization. The likelihood of death as a result of MCE was 2.75 (CI 1.09-7.02) times higher than non-MCE. Factors influencing this difference are the number of injured regions and injuries to the brain, chest, and abdomen. Conclusions: MCE patients have a significantly higher mortality than non-MCE patients, not manifesting substantial differences in the severity of injuries. The absence of difference in intensive care units utilization may be related to the effectiveness of existing protocols for dealing with MCEs.


Background: Neurologic prognostication after cardiac arrest relies on clinical examination findings derived before the advent of therapeutic hypothermia (TH). We measured the association between clinical examination findings at hospital arrival, 24, and 72 h after cardiac arrest in a modern intensive care unit setting. Methods: Between 1/1/2005 and 3/31/2009, hospital charts were reviewed in 272 subjects for neurologic examination findings (Glasgow Coma Score - motor examination, pupil response, corneal response) at hospital arrival, 24, and 72 following cardiac arrest. Primary outcome was survival to hospital discharge. Secondary outcome was "good outcome," defined as discharge to home or acute rehabilitation facility. Results: Mean age was 61 years; 155 (57%) were male. Most were treated with TH (N = 161; 59%) and 100 subjects (37%) were in ventricular fibrillation/ventricular tachycardia. Out-of-hospital cardiac arrest was common (N = 169; 62%). Ninety-one (33%) survived, with 54 (20%) experiencing a good outcome. In subjects with a GCS Motor score <=3 at 24 and 72 h survival was 17% (13/76; 95% CI 7.9-26.2%) and 20% (6/27; 95% CI 6.3-33.6%), respectively. Subjects with a GCS Motor score <=2 at 24 and 72 h survived in 14% (9/66; 95% CI 4.6-22.6%) and 18% (6/33; 95% CI 3.5-32.8%), respectively. Absent pupil reactivity on arrival did not exclude survival (7/65; 11%; 95% CI 2.4-19%). A lack of pupil reactivity or corneal response at 72 h was associated with death (pupil: 0/17; 95% CI 0, 2.9%; corneal: 0/21; 95% CI 0, 2.4%). Conclusions: GCS Motor score <=3 or <=2 at 24 or 72 h following cardiac arrest does not exclude survival or good outcome. However, absent pupil or corneal response at 72 h appears to exclude survival and good outcome.


Patients with moderate to severe head injury and abnormal coagulation studies have a significantly higher risk of brain injury. The objective of this study was to determine the association of clinical suspicion of coagulopathy and intracranial injury (ICI) among patients sustaining blunt head trauma, including minor injuries. As part of the NEXUS II blunt head injury study, enrolled patients were prospectively evaluated for ICI and suspicion of coagulopathy. We examined the relationship between suspicion of coagulopathy and the presence of any clinically significant or 'therapeutically inconsequential' ICI based on head computed tomography (CT) scan results. The NEXUS II study enrolled 13,728 patients, including 493 with suspicion of coagulopathy. Significant ICI was present in 46 (9.3%; 95% confidence interval [CI] 6.9 - 12.2) patients with suspected coagulopathy, and in 460 of 9863 (4.7%; 95% CI 4.3 - 5.1) patients without
such suspicion. 'Therapeutically inconsequential' findings were found on head CT scan in 74 patients, and 7 of these had suspected coagulopathy. Interventions including intubation, intracranial pressure monitoring, or craniotomy were performed in 5 of these 7 (71%; 95% CI 29 - 96) individuals, compared with only 3 of 67 (4%; 95% CI 1 - 12) patients without suspicion of coagulopathy. Initial clinical suspicion of coagulopathy, independent of laboratory confirmation, is associated with a greater prevalence of significant ICI injury after blunt head trauma; it also substantially increases the risk of morbidity despite the presence of an apparent 'therapeutically inconsequential' injury. CT scanning of the head should be performed initially based on clinical suspicion of coagulopathy.

Guideline 8.11: Head injury


Background: Return of spontaneous circulation (ROSC) occurs in 35.0 to 61.0% of emergency medical services (EMS)-treated out-of-hospital cardiac arrests (OHCA); however, not all patients achieving ROSC survive to hospital arrival or discharge. Previous studies have estimated the incidence of some types of rearrest (RA) at 61.0 to 79.0%, and the electrocardiogram (ECG) waveform characteristics of prehospital RA rhythms have not been previously described. Objectives: We sought to determine the incidence of rearrest (RA) in OHCA, to classify RA events by type, and to measure the time from ROSC to RA. We also conducted a preliminary analysis of the relationship between first EMS-detected rhythms and RA, as well as the effect of RA on survival. Methods: The Pittsburgh Regional Clinical Center of the National Heart, Lung, and Blood Institute (NHLBI)-sponsored Resuscitation Outcomes Consortium (ROC) provided cases from a population-based cardiac arrest surveillance program, ROC Epistry. Only OHCA cases of nontraumatic etiology with available and adequate ECG files were included. We analyzed defibrillator–monitor ECG tracings (Philips MRX), patient care reports (PCRs), and defibrillator audio recordings from EMS-treated cases of OHCA spanning the period from October 2006 to December 2008. We identified ROSC and RA through interpretation of ECG tracings and audio recordings. Rearrest events were categorized as ventricular fibrillation (VF), pulseless ventricular tachycardia (VT), asystole, and pulseless electrical activity (PEA) based on ECG waveform characteristics. Proportions of RA rhythms were stratified by first EMS rhythm and compared using Pearson's chi-square test. Logistic regression was used to test the predictive relationship between RA and survival to hospital discharge. Results. Return of spontaneous circulation occurred in 329 of 1,199 patients (27.4% [95.0% confidence interval (CI): 25.0–30.0%]) treated for cardiac arrest. Of these, 113 had ECG tracings that were available and adequate for analysis. Rearrest occurred in 41 patients (36.0% [95.0% CI: 26.0–46.0%]), with a total of 69 RA events. Survival to hospital discharge in RA cases was 23.1% (95.0% CI: 11.1–39.3%), compared with 27.8% (95.0% CI: 17.9–39.6%) in cases without RA. Counts of RA events by type were as follows: 17 VF (24.6% [95% CI: 15.2–36.5%]), 20 pulseless VT (29.0% [95.0% CI: 18.7–41.2%]), 26 PEA (37.0% [95.0% CI: 26.3–50.2%]), and six asystole (8.8% [95.0% CI: 3.3–18.0%]). Rearrest was not predictive of survival to hospital discharge; however, initial EMS rhythm was predictive of RA shockability. The overall median (interquartile range) time from ROSC to RA among all events was 3.1 (1.6–6.3) minutes. Conclusion: In this sample, the incidence of RA was 38.0%. The most common type of RA was PEA. Shockability of first EMS rhythm was found to predict subsequent RA rhythm shockability.

Background: Decision making in chest pain of uncertain origin is challenging. Objectives: To evaluate the predictive value of simple characteristics of pain presentation in patients coming to the emergency department with chest pain and without electrocardiogram ischaemia or raised troponin. Methods: 789 patients were studied. The following categorical pain characteristics were collected: effort related pain, pressing character, radiation, associated symptoms, and ≥2 episodes in 24h. Additionally, a predefined semi-quantitative pain score including seven items (Geleijnse score) was completed. Risk factors and co-morbidities were also recorded. The primary and secondary endpoints were cardiac events at 30days and at 1year.

Results After adjusting for risk factors and co-morbidities, the pain characteristics associated with the primary and secondary endpoints were effort related pain (HR=2.1, 95% CI 1.5 to 3.0, p=0.0001; HR=1.8, 95% CI 1.3 to 2.5, p=0.0003) and ≥2 episodes in 24h (HR=2.4, 95% CI 1.7 to 3.5, p=0.0001; HR=2.3, 95% CI 1.7 to 3.2, p=0.0001). Both variables retained their predictive value in women, diabetics and elderly (>70years) patients. The discriminatory capacity of the predictive models including these two pain characteristics for the primary and secondary endpoints (C-statistic 0.76 and 0.76) was better than using the complex semi-quantitative pain score (C-statistic 0.69 and 0.71). Conclusion: In patients presenting to the emergency department with chest pain and without electrocardiogram ischaemia or raised troponin, effort related pain and ≥2 episodes in 24h are the main characteristics to be considered for decision making.

Guideline 8.2: Heart attack


Purpose: Few studies specify the methods used to measure ST-segment elevation (STE). We therefore assessed differences in electrocardiography results depending on STE measurement methods for patients with inferior acute myocardial infarction (MI) and right ventricular infarction. Methods: This study was a retrospective analysis. The STE group consisted of 88 patients consecutively admitted to the emergency department with inferior ST elevation MI associated with occlusion of right coronary artery or left circumflex coronary artery who underwent primary percutaneous coronary intervention. The control group consisted of 109 patients with non-ST elevation MI who had occlusion of right coronary artery or left circumflex coronary artery and underwent percutaneous coronary intervention. Measurements were performed at the J point and 60 milliseconds later for limb lead and right precordial V4 lead (V4R). The criterion of at least 1-mm STE in 2 consecutive leads was applied, and the diagnostic accuracy of V4R was calculated. Results: In the STE group, the measurements 60 milliseconds after the J point were significantly higher than measurements at the J point at the II, III, aVF, and V4R leads. In the control group, only the measurements at lead I differed significantly. There was a 5% difference in diagnostic sensitivity depending on the measuring points in the STE group, a 1% to 3% difference in the control group, and a 10% to 11% difference at the V4R lead. Conclusion: In patients with inferior MI, STE depends on the method of measurement, indicating a need for the standardization of measurements.


We assess the methodological quality and prognostic accuracy of clinical decision rules in emergency department (ED) syncope patients. Methods: We searched 6 electronic databases, reviewed reference lists of included studies, and contacted content experts to identify articles for review. Studies that derived or validated clinical decision rules in ED syncope patients were included. Two reviewers independently screened records for relevance, selected studies for inclusion, assessed study quality, and abstracted data. Random-effects meta-analysis was used to pool diagnostic performance estimates across studies that derived or validated the same clinical decision rule. Between-study heterogeneity was assessed with the I² statistic, and subgroup hypotheses were tested with a test of interaction. Results: We identified 18 eligible studies. Deficiencies in outcome (blinding) and interrater reliability assessment were the most common methodological weaknesses. Meta-analysis of the San Francisco Syncope Rule (sensitivity 86% [95% confidence interval {CI} 83% to 89%]; specificity 49% [95% CI 48% to 51%]) and the Osservatorio Epidemiologico sulla Sincope nel Lazio risk score (sensitivity 95% [95% CI 88% to 98%]; specificity 31% [95% CI 29% to 34%]). Subgroup analysis identified study design (prospective, diagnostic odds ratio 8.82 [95% CI 3.5 to 22] versus retrospective, diagnostic odds ratio 2.45 [95% CI 0.96 to 6.21]) and ECG determination (by evaluating physician, diagnostic odds ratio 25.5 [95% CI 4.41 to 148] versus researcher or cardiologist, diagnostic odds ratio 4 [95% CI 2.15 to 7.55]) as potential explanations for the variability in San Francisco Syncope Rule performance. Conclusion: The methodological quality and prognostic accuracy of clinical decision rules for syncope are limited. Differences in study design and ECG interpretation may account for the variable prognostic performance of the San Francisco Syncope Rule when validated in different practice settings.

Guideline 8.21: Syncope


Background: Among individuals experiencing an ST segment-elevation myocardial infarction, current guidelines recommend that the interval from first medical contact to percutaneous coronary intervention be less than 90 minutes. The objective of this study was to determine whether prehospital time intervals were associated with ST-elevation myocardial infarction system performance, defined as first medical contact to percutaneous coronary intervention. Methods and Results: Study patients presented with an acute ST-elevation myocardial infarction diagnosed by prehospital ECG between May 2007 and March 2009. Prehospital time intervals were as follows: 9-1-1 call receipt to ambulance on scene ≤10 minutes, ambulance on scene to 12-lead ECG acquisition ≤8 minutes, on-scene time ≤15 minutes, prehospital ECG acquisition to ST-elevation myocardial infarction team notification ≤10 minutes, and scene departure to patient on cardiac catheterization laboratory table ≤30 minutes. Time intervals were derived and analyzed with descriptive statistics and logistic regression. There were 181 prehospital patients who received percutaneous coronary intervention, with 165 (91.1) having complete data. Logistic regression indicated that table time, response time, and on-scene time were the benchmark time intervals with the greatest influence on the probability of achieving percutaneous coronary intervention in less than 90 minutes. Individuals with a time from scene departure to arrival on cardiac catheterization laboratory table of less than 30 minutes were 11.1 times (3.4 to 36.0) more likely to achieve percutaneous coronary intervention in less than 90 minutes than those with extended table times. Conclusions: In this patient population, prehospital timing benchmarks were associated with system performance. Although meeting all 5 benchmarks may be an
ideal goal, this model may be more useful for identifying areas for system improvement that will have the greatest clinical impact.


Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia, occurring in 1–2% of the general population. Over 6 million Europeans suffer from this arrhythmia, and its prevalence is estimated to at least double in the next 50 years as the population ages. It is now 4 years since the last AF guideline was published, and a new version is now needed. AF confers a 5-fold risk of stroke, and one in five of all strokes is attributed to this arrhythmia. Ischaemic strokes in association with AF are often fatal, and those patients who survive are left more disabled by their stroke and more likely to suffer a recurrence than patients with other causes of stroke. In consequence, the risk of death from AF-related stroke is doubled and the cost of care is increased 1.5-fold. There has been much research into stroke prevention, which has influenced this guideline.

**Guideline 11.11: Managing acute dysrhythmias**


Objective: To determine cardioversion doses of biphasic DC shock for paediatric atrial dysrhythmias. Design: Prospective recording of energy, pre-shock and post-shock rhythms. Setting: Paediatric hospital. Patients: Shockable atrial dysrhythmias. Main results: Forty episodes of atrial dysrhythmias among 25 children (mean age 6.8 ± 7.1 years, mean weight 28.2 ± 28.5 kg) were treated with external shock. The first shock converted the dysrhythmia to sinus rhythm in 25 episodes. Cardioversion occurred in 2 of 8 (25%) episodes with a dose of <0.5 J/kg, 14 of 16 (88%) with a dose of 0.5-1.0 J/kg and 9 of 16 (56%) with a dose of >1.0 J/kg (p = 0.01, Fisher’s exact test). Ten of 15 initially non-responsive episodes were cardioverted with additional shocks at 1.1 ± 0.6 J/kg (range 0.5-2.1 J/kg). Of the remaining 5 unresponsive episodes, 2 of ventricular fibrillation (induced by unsynchronized shock) were successfully defibrillated, and 3 were managed with cardiopulmonary bypass. Among 11 additional children (mean age 4.3 ± 6.8 years, mean weight 18.1 ± 22.0 kg), 18 episodes of atrial dysrhythmias were treated with internal shock which successfully cardioverted all episodes with one or more shocks at 0.4 ± 0.2 J/kg. Conclusions: In rounded doses, recommended initial external cardioversion doses are 0.5-1.0 J/kg and subsequently up to 2 J/kg, internal cardioversion doses are 0.5 J/kg.

*Pediatric ALS*

55. Topal AE, Celik Y and Eren MN, Predictors of Outcome in Penetrating Cardiac Injuries J Trauma 2010: 69(3); 574-8

Background: Cardiac injury is one of the most lethal injuries. The objective of this study was to determine the risk factors for penetrating cardiac injuries. Method: A retrospective review of 64 consecutive penetrating cardiac injuries treated in reference center of the biggest regional hospital from September 2002 to January 2009. Results: There were 58 men (90.6%) and 6 women (9.4%), with a mean age of 26.19 years +/- 11.68 years (range, 13-67 years). The mechanism of injury was stab wound for 57 patients and gunshot wound for the remainder. Mortality was 17.19% (11 of 64 patients). The forward stepwise multivariate logistic regression analysis of the results
revealed four risk variables-two were measures of patients, age and pH, and the others were scoring systems, Trauma Injury Severity Scores and Acute Physiology and Chronic Health Evaluation II. The odds ratios and confidence interval of four variables are followed as 6.665 (4.213-10.544), 3.435 (2.171-5.433), 2.715 (1.716-4.295), and 2.201 (1.391-3.481), respectively. Conclusion: Our data have shown the risk variables for mortality in penetrating cardiac injuries by using binary logistic model.

NON-SYSTEMATIC REVIEWS / OPINION

Management of battlefield casualties in Iraq and Afghanistan has seen considerable development in damage control resuscitation, which aims to address the risk of haemorrhage, initially due to mechanical damage; and thereafter due to the development of life-threatening coagulopathy. Damage control resuscitation combines a variety of techniques, such as the use of the combat application tourniquet and novel haemostatics, through to ground-breaking developments in transfusion protocols. These practical aspects of the doctrine are combined with an ethos which sees consultant-led care implemented from as close to the point of wounding as is possible. Meticulous trauma audit is included in this process and has allowed for rapid translation of knowledge into practice. The main elements of this doctrine are described.

57. Demain JG, Minaei AA and Tracy JM, Anaphylaxis and insect allergy. Current Opinion in Allergy and Clinical Immunology 2010: 10(4); 318-22
Anaphylaxis is an acute-onset and potentially life-threatening allergic reaction that can be caused by numerous allergic triggers including stinging insects. This review focuses on recent advances, natural history, risk factors and therapeutic considerations. Recent findings: Recent work suggests that concerns over insect allergy diagnosis continue to exist. This is especially true with individuals who have a convincing history of a serious life-threatening anaphylactic event, but lack the necessary diagnostic criteria of venom-specific IgE by skin test or in-vitro diagnostic methods to confirm the diagnosis. The role of occult mastocytosis or increased basophile reactivity may play a role in this subset population. Additionally, epinephrine continues to be underutilized as the primary acute intervention for an anaphylactic reaction in the emergent setting. Summary: The incidence of anaphylaxis continues to rise across all demographic groups, especially those less than 20 years of age. Fortunately, the fatalities related to anaphylaxis appear to have decreased over the past decades. Our understanding of various triggers, associated risk factors, as well as an improved understanding and utilization of biological markers such as serum tryptase have improved. Our ability to treat insect anaphylaxis by venom immunotherapy is highly effective. Unfortunately, anaphylaxis continues to be underappreciated and undertreated especially in regard to insect sting anaphylaxis. This includes the appropriate use of injectable epinephrine as the primary acute management tool. These findings suggest that continued education of the general population, primary care healthcare providers and emergency departments is required.

Guideline 8.23: Anaphylaxis
Asphyxiation by an inhaled foreign body is a leading cause of accidental death among children younger than 4 years. We analyzed the recent epidemiology of foreign body aspiration and reviewed the current trends in diagnosis and management. In this article, we discuss anesthetic management of bronchoscopy to remove objects. The reviewed articles total 12,979 pediatric bronchoscopies. Most aspirated foreign bodies are organic materials (81%, confidence interval [CI] = 77%–86%), nuts and seeds being the most common. The majority of foreign bodies (88%, CI = 85%–91%) lodge in the bronchial tree, with the remainder catching in the larynx or trachea. The incidence of right-sided foreign bodies (52%, CI = 48%–55%) is higher than that of left-sided foreign bodies (33%, CI = 30%–37%). A small number of objects fragment and lodge in different parts of the airways. Only 11% (CI = 8%–16%) of the foreign bodies were radio-opaque on radiograph, with chest radiographs being normal in 17% of children (CI = 13%–22%). Although rigid bronchoscopy is the traditional diagnostic “gold standard,” the use of computerized tomography, virtual bronchoscopy, and flexible bronchoscopy is increasing. Reported mortality during bronchoscopy is 0.42%. Although asphyxia at presentation or initial emergency bronchoscopy causes some deaths, hypoxic cardiac arrest during retrieval of the object, bronchial rupture, and unspecified intraoperative complications in previously stable patients constitute the majority of in-hospital fatalities. Major complications include severe laryngeal edema or bronchospasm requiring tracheotomy or reintubation, pneumothorax, pneumomediastinum, cardiac arrest, tracheal or bronchial laceration, and hypoxic brain damage (0.96%). Aspiration of gastric contents is not reported. Preoperative assessment should determine where the aspirated foreign body has lodged, what was aspirated, and when the aspiration occurred (“what, where, when”). The choices of inhaled or IV induction, spontaneous or controlled ventilation, and inhaled or IV maintenance may be individualized to the circumstances. Although several anesthetic techniques are effective for managing children with foreign body aspiration, there is no consensus from the literature as to which technique is optimal. An induction that maintains spontaneous ventilation is commonly practiced to minimize the risk of converting a partial proximal obstruction to a complete obstruction. Controlled ventilation combined with IV drugs and paralysis allows for suitable rigid bronchoscopy conditions and a consistent level of anesthesia. Close communication between the anesthesiologist, bronchoscopist, and assistants is essential.

Pediatric syncope is a common presentation in the emergency department. Most causes are benign, but an evaluation must exclude rare life-threatening disorders. The lack of objective findings can pose a challenge. This case-based review emphasizes the importance of a detailed history and physical examination with electrocardiogram in determining high-risk patients.
Guideline 8.21: Syncope

60. Halstead ME and Walter KD, Sport-Related Concussion in Children and Adolescents. Pediatrics 2010: 126(3); 597-615
Sport-related concussion is a “hot topic” in the media and in medicine. It is a common injury that is likely underreported by pediatric and adolescent athletes. Football has the highest incidence of concussion, but girls have higher concussion rates than boys do in similar sports.
A clear understanding of the definition, signs, and symptoms of concussion is necessary to recognize it and rule out more severe intracranial injury. Concussion can cause symptoms that interfere with school, social and family relationships, and participation in sports. Recognition and education are paramount, because although proper equipment, sport technique, and adherence to rules of the sport may decrease the incidence or severity of concussions, nothing has been shown to prevent them. Appropriate management is essential for reducing the risk of long-term symptoms and complications. Cognitive and physical rest is the mainstay of management after diagnosis, and neuropsychological testing is a helpful tool in the management of concussion. Return to sport should be accomplished by using a progressive exercise program while evaluating for any return of signs or symptoms. This report serves as a basis for understanding the diagnosis and management of concussion in children and adolescent athletes.

*Guideline 8.11: Head injury*

61. Ho AMH, Dion PW, Yeung JHH, Ng CSH, Karmakar MK, Critchley LAH, et al., Fresh-frozen plasma transfusion strategy in trauma with massive and ongoing bleeding. *Common (sense) and sensibility. Resuscitation* 2010; 81(9); 1079-81

During trauma resuscitation involving massive transfusion, the best fresh-frozen plasma to packed red blood cells ratio is unknown. No randomised controlled trial (RCT) is available on this subject, although there are plenty of observational studies suggesting that the ratio should be about 1:1. This ratio also makes more physiological sense, and we suggest that in patients with massive and ongoing bleeding, it is a sensible strategy with which to start resuscitation.


This Journal feature begins with a case vignette that includes a therapeutic recommendation. A discussion of the clinical problem and the mechanism of benefit of this form of therapy follows. Major clinical studies, the clinical use of this therapy, and potential adverse effects are reviewed. Relevant formal guidelines, if they exist, are presented. The article ends with the author's clinical recommendations. A 62-year-old man collapses on the street, and emergency medical personnel who are called to the scene find that he is not breathing and that he has no pulse. The first recorded cardiac rhythm is ventricular fibrillation. Advanced cardiac life-support measures, including intubation, a total dose of 2 mg of epinephrine, and six defibrillation attempts, restore spontaneous circulation 22 minutes after the onset of the event. On admission to the emergency department, his condition is haemodynamically stable and he has adequate oxygenation and ventilation, but he is still comatose. A neurologic examination reveals reactive pupils and a positive cough . . .

*Guideline 11.9: Therapeutic hypothermia after cardiac arrest*


Hemorrhagic shock in the pediatric trauma patient is an uncommon but fundamental problem for the treating clinician. Current management of hemorrhagic shock involves initial resuscitation with crystalloid fluids followed by infusion of blood components as necessary. In management of the adult trauma patient, many institutions have implemented massive transfusion protocols to guide
transfusion in situations requiring or anticipating the use of greater than 10 U of packed red blood cells. In the pediatric population, guidelines for massive transfusion are vague or nonexistent. Adult trauma transfusion protocols can be applied to children until a pediatric protocol is validated. Here, we attempt to identify certain principles of transfusion therapy specific to pediatric trauma and outline a sample pediatric massive transfusion protocol that may be used to guide resuscitation. Also, adjuncts to transfusion, such as colloid fluids, other plasma expanders or hemoglobin substitutes, and recombinant activated factor VII, are discussed.

In 1967, the modern era of prehospital emergency cardiac care began with Dr Frank Pantridge’s publication of "A mobile intensive-care unit in the management of myocardial infarction." Recognizing that myocardial infarction mortality could be reduced by interventions prior to hospital arrival, Dr Pantridge developed a specialized ambulance system in Belfast, Ireland to stabilize and transport patients with suspected acute myocardial infarction to the Royal Victoria Hospital. Within 3 years, Dr Pantridge’s system was being replicated in the United States, first in Haywood County, NC and subsequently in Pittsburgh, Pa, Seattle, Wash, Miami, Fla, and Los Angeles, Calif. Dr Pantridge recognized the importance of collecting performance data and setting time standards, including a goal of 15 minutes from dispatch to patient arrival. His initial publication documented an improvement in the percentage of calls meeting this goal from 20% to 78%....

Syncope is a sudden, transient loss of consciousness associated with inability to maintain postural tone followed by spontaneous recovery and return to baseline neurologic status. Global cerebral hypoperfusion is the final pathway common to all presentations of syncope, but this symptom presentation has a broad differential diagnosis. It is important to identify patients whose syncope is a symptom of a potentially life-threatening condition. This article reviews the current status of syncope from the emergency department perspective, focusing on the current evidence behind the various clinical decision rules derived during the past decade.

Guideline 8.21: Syncope

This article covers the general approach to patients who present to the emergency department with a complaint of dizziness or vertigo, and altered mentation. Patients’ histories and physical examination findings are discussed first, and then a pertinent differential diagnosis, ranging from neurological causes and poor perfusion states to toxicologic causes, is described along with the distinguishing features and potential diagnostic pitfalls of each problem. Case scenarios are presented and the treatment and disposition of patients from the emergency department are discussed.

The diagnosis and management of poisoned patients presenting with alterations in mental status can be challenging, as patients are often unable (or unwilling) to provide an adequate history. Several toxidromes exist. Recognition hinges upon vital signs and the physical examination. Understanding these “toxic syndromes” may guide early therapy and management, providing insight into the patient’s underlying medical problem. Despite toxidrome recognition guiding antidotal therapy, the fundamental aspect of managing these patients involves meticulous supportive care. The authors begin with a discussion of various toxidromes and then delve into the drugs responsible for each syndrome. They conclude with a discussion on drug-facilitated sexual assault (“date rape”), which is both an underrecognized problem in the emergency department (ED) and representative of the drug-related problems faced in a modern ED.

**Guideline 8.12: Emergency management of the victim who has been poisoned**

68. Slattery D and Pollack C, Seizures as a Cause of Altered Mental Status. Emerg Med Clin North Am 2010: 28(3); 517-34
The differential diagnosis and empiric management of altered mental status and seizures often overlap. Altered mental status may accompany seizures or simply be the manifestation of a postictal state. This article provides an overview of the numerous causes of altered mental status and seizures: metabolic, toxic, malignant, infectious, and endocrine causes. The article focuses on those agents that should prompt the emergency physician to initiate unique therapy to abate the seizure and correct the underlying cause.

**Guideline 8.10: Seizures**

69. Smith GB, In-hospital cardiac arrest: Is it time for an in-hospital 'chain of prevention'? Resuscitation 2010: 81(9); 1209-11
The ’chain of survival’ has been a useful tool for improving the understanding of, and the quality of the response to, cardiac arrest for many years. In the 2005 European Resuscitation Council Guidelines the importance of recognising critical illness and preventing cardiac arrest was highlighted by their inclusion as the first link in a new four-ring ’chain of survival’. However, recognising critical illness and preventing cardiac arrest are complex tasks, each requiring the presence of several essential steps to ensure clinical success. This article proposes the adoption of an additional chain for in-hospital settings - a ’chain of prevention’ - to assist hospitals in structuring their care processes to prevent and detect patient deterioration and cardiac arrest. The five rings of the chain represent ’staff education’, ’monitoring’, ’recognition’, the ’call for help’ and the ’response’. It is believed that a ’chain of prevention’ has the potential to be understood well by hospital clinical staff of all grades, disciplines and specialties, patients, and their families and friends. The chain provides a structure for research to identify the importance of each of the various components of rapid response systems.

**Guideline 7: Cardiopulmonary resuscitation**

70. Van ’t Hof AWJ, Early and aggressive treatment of patients with ST-segment elevation myocardial infarction: deciphering recent clinical trials and the timing of optimal platelet inhibition. Eur Heart J Supp 2010: 12:D24-D35
In patients with ST-segment elevation myocardial infarction (STEMI), early and effective revascularization is vital to an improved outcome. This not only involves enhancing blood flow through the infarct-related epicardial vessel, but also the restoring of perfusion to
the myocardial tissue as it has been strongly linked to clinical outcome. Platelets hold a pivotal position in the distal embolization in patients with STEMI, particularly those who are managed with primary percutaneous coronary intervention, and therefore provide robust rationale to include intense inhibition of their management. Recent clinical studies focusing on STEMI and subanalyses from larger ACS trials reflecting contemporary practice including newer and higher-dose oral agents along with GP IIb/IIIa inhibitors, have painted a mixed picture as to the optimal treatment regimen. Together with dosing, timing of administration could be critical in determining the proper strategy as earlier administration may facilitate more rapid perfusion and ultimately reduce adverse events.

71. Wolfe TR and Braude DA, Intranasal Medication Delivery for Children: A Brief Review and Update Pediatrics 2010: 126(3); 532-7

With the exception of oral medications, most traditional forms of drug delivery outside the operating suite require an injection with a needle; a process that is painful and anxiety-provoking, risks needle stick injury, and consumes valuable staff time. In addition, intravenous access in pediatrics may be difficult for inexperienced providers. Intranasal medication delivery offers an alternative method of drug delivery that is often as fast in onset as intravenous medication, usually painless, inexpensive, easy to deliver, and effective in a variety of acute pediatric medical conditions. This article briefly reviews the most common uses for intranasal medication delivery in pediatrics: pain control, anxiolysis, and seizure control.

ANIMAL / MANIKIN / CADAVER/ MODELS OF CARDIAC ARREST STUDIES


We sought to compare the ability of novice operators to provide artificial ventilation using a standard facemask and a new ergonomically designed facemask. Whether or not proper technique was used was also assessed. Methods: Thirty-two allied-health students used both masks in random crossover fashion to ventilate an airway trainer. Breaths were delivered by a mechanical ventilator and exhaled tidal volume was recorded for each of 12 breaths for each participant for each mask. The effect of each mask during ventilation over time was assessed using repeated-measures ANOVA. Assessment of mask technique among participants and association between mask type and hand repositioning were analyzed using the Wilcoxon-Rank Sum Test and McNemar’s paired proportions test, respectively. Results: The tidal volume achieved when participants used the ergonomic mask was higher than when participants used the standard mask by the fourth breath (361 ± 104 mL vs. 264 ± 163 mL; Bonferroni adjusted p-value = 0.040) and increased over time. The repeated-measures ANOVA showed that the ergonomic mask consistently resulted in higher tidal volumes than the standard mask regardless of rescuer's gender. Over time the standard mask resulted in a linear decrease in tidal volume of -10 mL/breath (estimated difference in decay of 10 mL/breath versus the ergonomic mask; p < 0.001). Conclusion: Novice airway operators were better able to provide facemask ventilation using an ergonomically designed mask than with a traditional facemask. We conclude that better hand position facilitating improved mask seal and less operator fatigue account for our findings.
**Guideline 11.7: Equipment and techniques in adult advanced life support**


**Purpose:** Previous data indicate that 100% O2 ventilation during early reperfusion after cardiac arrest (CA) and cardiopulmonary resuscitation (CPR) increases neuronal death. However, current guidelines encourage the use of 100% O2 during resuscitation and for an undefined period thereafter. We retrospectively analyzed data from a porcine CA model and hypothesized that prolonged hyperoxic reperfusion would be associated with increased neurohistopathological damage and impaired neurological recovery. Methods Fifteen male pigs underwent 8 min of CA and 5 min of CPR. After resuscitation animals were ventilated with either 100% oxygen for 60 min (hyperoxia; n = 8) or 10 min (normoxia; n = 7). Physiological variables were obtained at baseline and 10, 60 and 240 min after resuscitation. Daily functional performance was assessed using an established neurocognitive test in parallel to a neurological deficit score (NDS). On day 5, brains of the re-anaesthetized pigs were harvested for neurohistopathological analyses. Results: At baseline there were no differences in hemodynamics and neurological status between groups. Post-arrest only PaO2, as a result of the different inspired oxygen fractions, was significantly higher in the hyperoxia group. There was a numerical trend towards improved clinical recovery in both the NDS and the neurocognitive testing for animals exposed to 10 min of 100% oxygen. However, hyperoxic animals showed a significantly greater degree of necrotic neurons and perivascular inflammation in the striatum in comparison to normoxic animals. Conclusion: In this retrospective analysis prolonged hyperoxia after CA aggravated necrotic brain damage and perivascular inflammation in the striatum of pigs.

**Guideline 11.8: Post resuscitation therapy in adult advanced life support**


**Purpose:** To describe time delay during surf rescue and compare the quality of cardiopulmonary resuscitation (CPR) before and after exertion in surf lifeguards. Methods: A total of 40 surf lifeguards at the Tylösand Surf Lifesaving Club in Sweden (65% men; age, 19-43 years) performed single-rescuer CPR for 10 minutes on a Laerdal Resusci Anne manikin. The test was repeated with an initial simulated surf rescue on an unconscious 80-kg victim 100 m from the shore. The time to victim, to first ventilation, and to the start of CPR was documented. Results: The mean time in seconds to the start of ventilations in the water was 155 ± 31 (mean ± SD) and to the start of CPR, 258 ± 44. Men were significantly faster during rescue (mean difference, 43 seconds) than women (P = .002). The mean compression depth (millimeters) at rest decreased significantly from 0-2 minutes (42.6 ± 7.8) to 8-10 minutes (40.8 ± 9.3; P = .02). The mean compression depth after exertion decreased significantly (44.2 ± 8.7 at 0-2 minutes to 41.5 ± 9.1 at 8-10 minutes; P = .0008). The compression rate per minute decreased after rescue from 117.2 ±14.3 at 0 to 2 minutes to 114.1 ± 16.1 after 8 to 10 minutes (P = .002). The percentage of correct compressions at 8 to 10 minutes was identical before and after rescue (62%). Conclusion: In a simulated drowning, 100 m from shore, it took twice as long to bring the patient back to shore as to reach him; and men were significantly faster. Half the participants
delivered continuous chest compressions of more than 38 mm during 10 minutes of single-rescuer CPR. The quality was identical before and after surf rescue.

*Guideline 8.7: Resuscitation of the drowning victim*

75. Del Rossi G, Rechtine GR, Conrad BP and Horodyski M, Are scoop stretchers suitable for use on spine-injured patients? Am J Emerg Med 2010: 28(7); 751-6

In the prehospital setting, spine-injured patients must be transferred to a spine board to immobilize the spine. This can be accomplished using both manual techniques and mechanical devices. Objectives: The study aimed to evaluate the effectiveness of the scoop stretcher to limit cervical spine motion as compared to two commonly used manual transfer techniques. Methods: Three-dimensional angular motion generated across the C5-C6 spinal segment during execution of two manual transfer techniques and the application of a scoop stretcher was recorded first on cadavers with intact spines and then repeated after C5-C6 destabilization. A 3-dimensional electromagnetic tracking device was used to measure the maximum angular and linear motion produced during all test sessions. Results: Although not statistically significant, the execution of the log roll maneuver created more motion in all directions than either the lift-and-slide technique or with scoop stretcher application. The scoop stretcher and lift-and-slide techniques were able to restrict motion to a comparable degree. Conclusion: The effectiveness of the scoop stretcher to limit spinal motion in the destabilized spine is comparable or better than manual techniques currently being used by primary responders.

*Guideline 8.18: Management of a suspected spinal injury*


Aim: To compare hands-off time (HOT) in simulated advanced life support (ALS) following European Resuscitation Council (ERC) 2005 guidelines and ERC 2000 and to provide quantitative data on workflow. Subjects and Methods: Observations with 18 professional paramedics, performing 39 megacodes (mega-code training; MCT) were videotaped during ALS re-certification. Teams were randomly assigned to train according to ERC 2000 or ERC 2005. HOT, hands-off intervals (HOI) and other variables describing interventions and workflow were analysed. Results: In group ERC 2000 17±3 HOI appeared with a mean duration of 17.5±10.8s (mean ± SD). Overall HOT was 382±47s, equivalent to a mean hands-off fraction (HOF) of 0.45±0.05. 15±5 ventilation-free intervals (VFI) were observed, with a mean duration of 21±10s. In contrast after ERC 2005 variables resulted in 18±3 HOI with a mean duration of 10.0±4.0s (p<0.001 vs ERC 2000), overall HOT 196±33s (HOF 0.23±0.04; p<0.001), 24±12 VFI with a duration of 24±7s (p<0.05). The first HOI lasted for 60.4±33.1s in ERC 2000 and 17.6±4.3s in ERC 2005 (p<0.001). In ERC 2000 6.1±2.6 interruptions for two bag/mask ventilations (BMV) lasted for 5.4±0.8s, whereas in ERC 2005 9.6±3.1 interruptions for two BMV took 6.5±2.2s (p<0.001). In both groups HOI were used thoroughly for basic life support/ALS-based interventions. Conclusion: The application of ERC guidelines of 2005 markedly reduced the first HOI and mean duration of HOI at the cost of delayed secure airway management and ECG analysis in this mega-code training model.

*Guideline 7: Cardiopulmonary resuscitation*
77. Koyama J, Iwashita T and Okamoto K, Comparison of three types of laryngoscope for tracheal intubation during rhythmic chest compressions: A manikin study. Resuscitation 2010: 81(9); 1172-4

Background: If tracheal intubation can be performed during uninterrupted chest compressions, this will sustain circulation during the procedure of intubation and may lead to successful resuscitation. **We compared three types of laryngoscope on a manikin as to whether they enabled tracheal intubation while the manikin's chest was rhythmically compressed.** Methods: A total of 35 persons who had little or no experience in intubation served as examinees. The laryngoscopes employed were a conventional Macintosh laryngoscope (MAC), a new video laryngoscope, Pentax-AWS (AWS) and an optic laryngoscope Airtraq (ATQ). During chest compression on the manikin by an assistant, the examinee attempted to perform intubation. The success rate and the time for successful intubation were measured. Results: During rhythmic chest compressions, nine examinees failed in tracheal intubation with the MAC, seven failed with the ATQ, and no one failed with the AWS. The success rates with the AWS were significantly higher than those with the MAC (P < 0.01) or ATQ (P < 0.05). The time needed for intubation was significantly shorter with the Pentax-AWS than with the others. Conclusions: These results suggest that the use of the Pentax-AWS enables tracheal intubation while the patient’s chest is rhythmically compressed, and would more often lead to successful intubation, which in turn may lead to more successful resuscitation.

Guideline 11.7: Equipment and techniques in adult ALS


Background: Cardiocerebral resuscitation (CCR) is reportedly superior to cardiopulmonary resuscitation (CPR) for out-of-hospital cardiac arrest (OHCA) even though active ventilation is not initially provided. Understandably, concerns have been raised regarding the withholding of positive pressure ventilation (PPV) during CCR because of the longstanding belief that respiratory gas exchange is a critical action during resuscitation. **Objective: In this observational study, we sought to quantify the effect of prolonged untreated ventricular fibrillation (VF) on arterial pH, partial pressure of carbon dioxide (pCO2), and partial pressure of oxygen (pO2) values in a swine model of witnessed cardiac arrest to begin exploring the validity of these concerns.** Methods: Both included studies were approved by the institutional animal care and use committee (IACUC). Eighty-three animals (25–35 kg) were instrumented under general anesthesia. Baseline characteristics were recorded. An arterial blood gas (ABG) sample was drawn from each animal via femoral catheter just prior to electrical induction of VF. After 8 minutes of untreated VF in one study (study 1 [n = 30]) and 10 minutes of untreated VF in the other study (study 2 [n = 53]), a second ABG sample was drawn. All samples were processed immediately using an i-STAT portable whole blood analyzer. Baseline characteristics of animals in the two studies were assessed using descriptive statistics. For the second ABG sample in each study, the mean pH, pCO2, and pO2 values, with 95% confidence intervals (95% CIs), were determined. The paired ABG results for each animal were then compared and the average pH, pCO2, and pO2 proportions, with 95% CIs, for each study were calculated. Results: The baseline characteristics of the animals in the two studies were similar. After 8 and 10 minutes of untreated VF cardiac arrest, the pH values were 7.35 (95% CI = 7.32, 7.37) and 7.37 (95% CI = 7.36, 7.38), the pCO2 increased to 44.1 mmHg (95% CI = 41.1, 47.1) and 52.7 mmHg (95% CI = 51.0, 54.4), and the pO2 decreased to 44.8 mmHg (95% CI = 42.2, 47.4) and 45.5 mmHg (95% CI = 43.3, 47.6),
Conclusions: Using our swine model of witnessed cardiac arrest with prolonged untreated VF, the arterial pH remained essentially unchanged and the pCO2 increased to 1.42 times baseline after 10 minutes, while almost half of the initial O2 concentration in the blood at the beginning of resuscitation remained.

**Guideline 7: Cardiopulmonary resuscitation**


**Background:** In cardiopulmonary resuscitation (CPR) of a patient with an unsecured airway performed by two health care professionals, two methods are possible: 1) Standard CPR according to the guidelines, with one rescuer performing chest compressions from the side and the other rescuer performing ventilations from over the head of the patient. Additional tasks (like attaching the electrocardiogram and defibrillator) must be performed by the second rescuer during the time between ventilations. 2) Over-the-head CPR, with one rescuer performing chest compressions and ventilations from over the head and the other rescuer performing additional tasks. **Objectives:** The aim of this study was to compare the quality of CPR achieved by the two methods. **Methods:** After a standardized theoretical introduction and practical training, 106 medical students with limited knowledge and training in CPR participated in this randomized crossover study. Students performed a 2-min CPR test of standard CPR in both positions and over-the-head CPR alone on a manikin. Results: Standard CPR led to a significantly shorter hands-off-time over a 2-min interval than over-the-head CPR (median 25 s [interquartile range (IQR) 22-26 s] vs. 38 s [IQR 36-43 s], respectively, p < 0.001), and significantly more chest compressions (167 [IQR 158-176] vs. 142 [IQR 132-150], respectively, p < 0.001), more correct chest compressions (72 [IQR 11-136] vs. 45 [IQR 13-88], respectively, p = 0.004), inflations (10 [IQR 10-10] vs. 8 [IQR 8-8], respectively, p < 0.001), and correct inflations (5 [IQR 2-7] vs. 3 [IQR 1-4], respectively, p < 0.001). **Conclusions:** In the case of a two-professional-rescuer CPR scenario, standard CPR enables a quantitatively better resuscitation than over-the-head CPR.

**Guideline 7: Cardiopulmonary resuscitation**


**Objectives:** This study aimed to compare the time-dependent deterioration of chest compressions between chest compression-only cardiopulmonary resuscitation (CPR) and conventional CPR. **Methods:** This study involved 106 and 107 participants randomly assigned to chest compression-only CPR training and conventional CPR training, respectively. Immediately after training, participants were asked to perform CPR for 2 min and the quality of their CPR skills were evaluated. The number of chest compressions in total and those with appropriate depth were counted every 20-s CPR period from the start of CPR. The primary outcome was the CPR quality index calculated as the proportion of chest compressions with appropriate depth among total chest compressions. Results: The total number of chest compressions remained stable over time both in the chest compression-only and the conventional CPR groups. The CPR quality index, however, decreased from 86.6 ± 25.0 to 58.2 ± 36.9 in the chest compression-only CPR group from 0-20 s through 61-80 s. The reduction was greater than in the conventional CPR group (85.9 ± 25.5 to 74.3 ± 34.0). The difference in the CPR quality index reached statistical significance (p = 0.003) at 61-80 s period. **Conclusions:** Chest compressions with appropriate depth decreased more rapidly during chest
compression-only CPR than conventional CPR. We recommend that CPR providers change their roles every 1 min to maintain the quality of chest compressions during chest compression-only CPR.

Guideline 7: Cardiopulmonary resuscitation


Aim: Experimental studies have shown sex differences in haemodynamic response and outcome after trauma and haemorrhagic shock. We recently reported that female sex protects against cerebral injury after exsanguination cardiac arrest (CA), independent of sexual effects of hormones. The current study examines if female sex is also cardioprotective. Methods: In this study 21 sexually immature piglets (12 males and 9 females) were subjected to 5 min of haemorrhagic shock followed by 2 min of ventricular fibrillation and 8 min of cardiopulmonary resuscitation (CPR). Volume resuscitation was started during CPR with intravenous administration of 3 ml kg-1 hypertonic saline-dextran (HSD) solution for 20 min. Sexually immature animals were used to differentiate innate sex differences from the effects of sexual hormones. Sex differences in haemodynamics, myocardial injury (troponin I), and short-term survival (3-h) were evaluated. Results: After resuscitation female animals had a higher blood pressure, lower heart rate, lower troponin I concentrations, and higher survival rate (100% and 63% in 3 h) despite comparable sex hormone levels. Conclusions: After resuscitation from haemorrhage and circulatory arrest, haemodynamic parameters are better preserved and myocardial injury is smaller in female piglets. This difference in outcome is independent of sexual hormones.

Guideline 8.4: Shock


Background: Cardiopulmonary arrest is a serious disease that claims many lives every day; 30% of the patients suffer irreversible central nervous system injury after restoration of systemic circulation (ROSC). Objectives: Naloxone combined with epinephrine was tested in a cardiac arrest rat model in which asphyxia was induced to determine if this drug combination could increase the resuscitation rate (survival) and decrease the cerebral damage. Methods: Twenty-four male Wistar rats were randomly assigned to one of three groups: the group treated with 1 mL saline (SA group; n = 8), the group treated with only epinephrine 5 [mu]g/100 g (EP group; n = 8), or the group treated with epinephrine 5 [mu]g/100 g combined with naloxone 1 mg/kg (NA group; n = 8). Eight minutes after arrest, cardiopulmonary resuscitation was initiated and the different drugs were administered to the rats in their respective groups at the same time. Mean arterial pressure (MAP), heart rate (HR), and neurodeficit score (NDS) were measured. Results: The HR in the NA group (414 ± 45 beats/min) was faster than in the EP group (343 ± 29 beats/min) at the 5-min time point (P < 0.01). The HR in the NA group was 392 ± 44 beats/min and 416 ± 19 beats/min at the 60-min and 180-min time points, respectively. There were no statistically significant differences in MAP before or after ROSC. The rates of ROSC were 2 of 8, 6 of 8, and 7 of 8 animals in the SA group, EP group, and NA group, respectively. Three days later, the rates decreased to 1, 3, and 5 in the SA group, EP group, and NA group, respectively. The average resuscitation time in the NA group was significantly shorter than in the other two groups. The NDS in the NA group was 57 ± 13, higher than in the EP group (45 ± 13)
Conclusion: Naloxone combined with epinephrine significantly increased the resuscitation rate in a rat model. Furthermore, the combination of naloxone and epinephrine increased the NDS after cardiopulmonary resuscitation.

Guideline 11.6: Medications in adult cardiac arrest

CASE SERIES / CASE STUDIES/ LETTERS/EDITORIALS

In this issue of Emergency Medicine Journal, Steurer et al report a systematic review of clinical decision rules (CDRs) for suspected cardiac chest pain. These patients may account for up to 6% of Emergency Department (ED) workload, and the majority are hospitalised for investigation even though only a minority actually prove to have an acute coronary syndrome (ACS). It is therefore not surprising that there have been many attempts to develop a CDR to improve diagnosis in the ED for this important patient group. However, it is perhaps surprising to learn that only two CDRs have been validated in the troponin era and no CDRs have been validated using a contemporary gold standard. Notwithstanding this obvious drawback, Steurer et al ...

It has come to the attention of the Faculty of Pre-Hospital Care that methoxyflurane as an inhaler (Penthrox) is being used by doctors involved in various sports. We have particularly noted that it has been promulgated in the Premier League and also within Mountain ...

Hydroxocobalamin, a precursor of vitamin B12, has a history of use in the prehospital setting in France for cyanide poisoning, particularly that associated with smoke inhalation. Because cyanide poisoning by ingestion is less common than smoke inhalation-associated cyanide poisoning, less information is available on prehospital use of hydroxocobalamin to treat cyanide poisoning by ingestion. This report describes a case of prehospital use of hydroxocobalamin for poisoning by ingestion of cyanide. The case supports the efficacy of hydroxocobalamin for acute cyanide poisoning caused by ingestion of a cyanide salt. No adverse events attributed to hydroxocobalamin were observed.

Guideline 8.14: Cyanide poisoning

86. Gabbe BJ, Sutherland AM, Hart MJ and Cameron PA, Population-Based Capture of Long-Term Functional and Quality of Life Outcomes after Major Trauma: The Experiences of the Victorian State Trauma Registry. The Journal of Trauma 2010: 69(3); 532-6 (Editorial)
Improved survival rates for trauma patients has placed a greater emphasis on determining the morbidity associated with injury, including
the degree of functional loss, ongoing disability, and lost quality of life experienced by survivors. Improvements in trauma care in advanced trauma systems have the potential to influence morbidity rather than mortality; however, there is no systematic approach to measuring morbidity after injury and, therefore, no possibility of meaningfully benchmarking improvements. Anecdotally, a major impediment in measuring injury-related morbidity has been a belief that it is not feasible. Collection of long-term outcomes data is necessary to establish the impact of the injury problem, evaluate treatment approaches, inform injury prevention research, and improve public health program planning.

We read with great interest the article by Krarup et al. on the Lazarus phenomenon and termination of treatment following cardiac arrest in a prehospital setting. The authors describe precisely the problem of “spontaneous return of circulation”. The main thought is whether management improves recognition and prevention of this phenomenon and more importantly, criteria for stopping treatment in out-of-hospital cardiac arrest (OHCA). We reported that continuous end-tidal carbon dioxide (ETCO₂) monitoring can help in identifying potential situations when this may occur. The authors reported that advanced life support was performed without continuous capnography. Changes in ETCO₂ levels during cardiopulmonary resuscitation (CPR) maybe a useful, non-invasive predictor of successful resuscitation and survival from cardiac arrest, and could help in determining when to cease CPR efforts. In our study, we found that ETCO₂ values of 1.9kPa or less discriminated between the 402 patients with ROSC and 335 patients without....

Guideline 11.7: Equipment and techniques in adult advanced life support

EDUCATION / ETHICS

Objective: The study evaluated the effectiveness of an online first aid course by comparing it with the traditional instructor-led course. An effective online course increases course accessibility and mitigates the major deterrent to widespread layperson training. Design: A comparison group design evaluated performances among 25 laypersons self-selecting the traditional course and 46 self-selecting the online course. Setting: Online participants completed the course in a location and at a time convenient to them. Traditional participants completed the course at testing sites. All attended a testing site for skills testing. Method: Eight instructors participated in traditional course delivery, skills review and practice, and skills testing. They assessed participants’ performance using standard checklists. Resuscitation mannequins captured objective performance data. Results: Instructors assessed all participants as passing all skills tests. None passed using the objective data but online course participants outperformed traditional course participants. Conclusions: The online course is effective. Its accessibility permits broader dissemination and use.

Guideline 9.1.1: Cardiopulmonary resuscitation training

Background: The purpose of this study is to compare the cardiopulmonary resuscitation (CPR) team dynamics and performance between a conventional simulation training group and a script-based training group. Methods: This was a prospective randomised controlled trial of educational intervention for CPR team training. Fourteen teams, each consisting of five members, were recruited. The conventional group (C) received training using a didactic lecture and simulation with debriefing, while the script group (S) received training using a resuscitation script. The team activity was evaluated with checklists both before and after 1 week of training. The videotaped simulated resuscitation events were compared in terms of team dynamics and performance aspects. Results: Both groups showed significantly higher leadership scores after training (C: 58.2±9.2 vs 67.2±9.5, p=0.007; S: 57.9±8.1 vs 65.4±12.1, p=0.034). However, there were no significant improvements in performance scores in either group after training. There were no differences in the score improvement after training between the two groups in dynamics (C: 9.1±12.6 vs S: 7.4±13.7, p=0.715), performance (C: 5.5±11.4 vs S: 4.7±9.6, p=0.838) and total scores (C: 14.6±20.1 vs S: 12.2±19.5, p=0.726). Conclusion: Script-based CPR team training resulted in comparable improvements in team dynamics scores compared with conventional simulation training. Resuscitation scripts may be used as an adjunct for CPR team training.

Guideline 9.1.1: Cardiopulmonary resuscitation training


Do not attempt resuscitation (DNAR) orders have been shown to be subject to misinterpretation in the 1980s and 1990s. We investigated whether this was still the case, and examined what perceptions doctors and nurses had of what care patients with DNAR orders receive. Methods: Using an anonymous written questionnaire, we directly approached 50 doctors and 40 nurses from a range of medical specialities and grades in our teaching hospital. Results: All 50 physicians and 35/40 nurses took part. Using McNemar's test, there were highly significant differences (p < 0.0001) in what doctors believed 'should' take place and what they perceived 'in practice' occurred on patients with DNAR orders in all areas questioned (e.g., frequency of nursing observations and contacting medical staff in the event of a patient's deterioration). Using Fisher's exact test, there were significant differences between what nursing staff thought occurred and what doctors thought should occur, for example, frequency of nursing observations (p < 0.001), contacting the medical team (p = 0.01) and giving fluids (p < 0.005). Conclusions: Despite widespread use of DNAR orders, they are still misunderstood. This article highlights the frequency with which DNAR orders are interpreted to mean that other care should be withheld. In addition, it shows that although some doctors know that this should not be the case, they believe that DNAR orders affect the care that their patients receive. We propose that options for more detailed care plans should be embedded within the resuscitation decision and documentation to improve communication and understanding.

Guideline 11.10: Legal and ethical issues related to resuscitation
91. Nielsen AM, Henriksen MJV, Isbye DL, Lippert FK and Rasmussen LS, Acquisition and retention of basic life support skills in an untrained population using a personal resuscitation manikin and video self-instruction (VSI). Resuscitation 2010: 81(9); 1156-60

**Background:** Video-based self-instruction (VSI) with a 24-min DVD and a personal resuscitation manikin solves some of the barriers associated with traditional basic life support (BLS) courses. No accurate assessment of the actual improvement in skills after attending a VSI course has been determined, and in this study we assess the skill improvement in laypersons undergoing VSI. **Methods:** The BLS skills of 68 untrained laypersons (high school students, their teachers and persons excluded from mainstream society) were assessed using the Laerdal ResusciAnne and PC Skill Reporting System 2.0 in a 3 min test. A total score (12-48 points) was calculated and 12 different variables were recorded. The participants attended a 24-min VSI course (MiniAnne, Laerdal) and took home the DVD and manikin for optional subsequent self-training. We repeated the test 3½-4 months later. **Results:** There was a significant increase in the total score (p < 0.0001) from 26.5 to 34 points. The participants performed significantly better in checking responsiveness, opening the airway, checking for respiration and using the correct compression/ventilation ratio (all p-values < 0.001). The compression depth improved from 38 mm to 49.5 mm and the total number of compressions increased from 67 to 141. The ventilation volume and the total number of ventilations increased, and total "hands-off" time decreased from 120.5 s to 85 s. **Conclusions:** Untrained laypersons attending a 24 min DVD-based BLS course have a significantly improved BLS performance after 3½-4 months compared to pre-test skill performance. Especially the total number of compressions improved and the hands-off time decreased.

*Guideline 9.1.1: Cardiopulmonary resuscitation training*

92. Rady MY, Verheijde JL and McGregor JL, Scientific, legal, and ethical challenges of end-of-life organ procurement in emergency medicine Resuscitation 2010: 81(9); 1069-78

**Aim:** We review (1) scientific evidence questioning the validity of declaring death and procuring organs in heart-beating (i.e., neurological standard of death) and non-heart-beating (i.e., circulatory-respiratory standard of death) donation; (2) consequences of collaborative programs realigning hospital policies to maximize access of procurement coordinators to critically and terminally ill patients as potential donors on arrival in emergency departments; and (3) ethical and legal ramifications of current practices of organ procurement on patients and their families. **Data sources:** Relevant publications in peer-reviewed journals and government websites. **Results:** Scientific evidence undermines the biological criteria of death that underpin the definition of death in heart-beating (i.e., neurological standard) and non-heart-beating (i.e., circulatory-respiratory standard) donation. Philosophical reinterpretation of the neurological and circulatory-respiratory standards in the death statute, to avoid the appearance of organ procurement as an active life-ending intervention, lacks public and medical consensus. Collaborative programs bundle procurement coordinators together with hospital staff for a team-huddle and implement a quality improvement tool for a Rapid Assessment of Hospital Procurement Barriers in Donation. Procurement coordinators have access to critically ill patients during the course of medical treatment with no donation consent and with family or surrogates unaware of their roles. How these programs affect the medical care of these patients has not been studied. **Conclusions:** Policies enforcing end-of-life organ procurement can have unintended consequences: (1) erosion of care in the patient’s best interests, (2) lack of transparency, and (3) ethical and legal ramifications of flawed standards of declaring death.
Guideline 11.10: Legal and ethical issues related to resuscitation


In the case of an emergency, fast and structured patient management is crucial for a patient's outcome. Every physician and graduate medical student should possess basic knowledge of emergency care and the skills to manage common emergencies. This study determines the effect of a simulation-based curriculum in emergency medicine on students’ abilities to manage emergency situations. METHODS: A controlled, blinded educational trial of 44 final-year medical students was carried out at Frankfurt Medical School; 22 students completed the former curriculum as the control group and 22 the new curriculum as the intervention group. The intervention consists of simulation-based training with theoretical and simulation-based training sessions in realistic encounters based on the Basic Life Support (BLS), Advanced Cardiac Life Support (ACLS) and adapted Advanced Trauma Life Support (ATLS) training. Further common emergencies were integrated corresponding to the course objectives. All students faced a performance-based assessment in a 10 station Objective Structured Clinical Examination (OSCE) using checklist rating within a maximum of 4 months after completion of the intervention. RESULTS: The intervention group performed significantly better at all of the 10 OSCE stations in the checklist rating (p<0.0001 to p=0.016). CONCLUSIONS: The simulation-based intervention offers a positively evaluated possibility to enhance students’ skills in recognising and handling emergencies. Additional studies are required to measure the long-term retention of the acquired skills, as well as the effect of training in healthcare professionals.

Guideline 9.1.1: Cardiopulmonary resuscitation training

94. Shavit I, Peled S, Steiner IP, Harley DD, Ross S, Tal-Or E, et al., Comparison of Outcomes of Two Skills-teaching Methods on Lay-rescuers’ Acquisition of Infant Basic Life Support Skills Acad Emerg Med 2010: 17(9);979-86

The objective was to determine if lay-rescuers’ acquisition of infant basic life support (BLS) skills would be better when skills teaching consisted of videotaping practice and providing feedback on performances, compared to conventional skills-teaching and feedback methods. Methods: This pilot-exploratory, single-blind, prospective, controlled, randomized study was conducted on November 12, 2007, at the Rappaport Faculty of Medicine, Technion–Israel Institute of Technology, Haifa, Israel. The population under study consisted of all first-year medical students enrolled in the 2007–2008 year. BLS training is part of their mandatory introductory course in emergency medicine. Twenty-three students with previous BLS training were excluded. The remaining 71 were randomized into four and then two groups, with final allocation to an intervention and control group of 18 and 16 students, respectively. All the students participated in infant BLS classroom teaching. Those in the intervention group practiced skills acquisition independently, and four were videotaped while practicing. Tapes were reviewed by the group and feedback was provided. Controls practiced using conventional teaching and feedback methods. After 3 hours, all subjects were videotaped performing an unassisted, lone-rescuer, infant BLS resuscitation scenario. A skills assessment tool was developed. It consisted of 25 checklist items, grouped into four sections: 6 points for “categories” (with specific actions in six categories), 14 points for “scoring” (of accuracy of performance of each action), 4 points for “sequence” (of actions within a category), and 1 point for “order” of resuscitation (complete and well-sequenced categories). Two blinded expert raters were given a
workshop on the use of the scoring tool. They further refined it to increase scoring consistency. The main outcome of the study was defined as evidence of better skills acquisition in overall skills in the four sections and in the specific skill sets for actions in any individual category. Data analysis consisted of descriptive statistics. Results: Means and mean percentages were greater in the intervention group in all four sections compared to controls: categories (5.72 [95.33%] and 4.69 [92.66%]), scoring (10.57 [75.50%] and 7.41 [43.59%]), sequence (2.28 [57.00%] and 1.66 [41.50%]), and order of resuscitation (0.96 [96.00%] and 0.19 [19.00%]). The means and mean percentages of the actions (skill sets) in the intervention group were also larger than those of controls in five out of six categories: assessing responsiveness (1.69 [84.50%] and 1.13 [56.50%]), breathing technique (1.69 [93.00%] and 1.13 [47.20%]), chest compression technique (3.19 [77.50%] and 1.84 [46.00%]), activating emergency medical services (EMS) (3.00 [100.00%] and 2.81 [84.50%]), and resuming cardiopulmonary resuscitation (0.97 [97.00%] and 0.47 [47.00%]). These results demonstrate better performance in the intervention group. Conclusions: The use of videotaped practice and feedback for the acquisition of overall infant BLS skills and of specific skill sets is effective. Observation and participation in the feedback and assessment of non-experts attempting infant BLS skills appeared to improve the ability of this group of students to perform the task.

Guideline 9.1.1: Cardiopulmonary resuscitation training

95. Westli H, Johnsen B, Eid J, Rasten I and Brattebo G, Teamwork skills, shared mental models, and performance in simulated trauma teams: an independent group design. Scand J Trauma 2010: 18(1); 47

BACKGROUND: Non-technical skills are seen as an important contributor to reducing adverse events and improving medical management in healthcare teams. Previous research on the effectiveness of teams has suggested that shared mental models facilitate coordination and team performance. The purpose of the study was to investigate whether demonstrated teamwork skills and behaviour indicating shared mental models would be associated with observed improved medical management in trauma team simulations. METHODS: Revised versions of the 'Anesthetists' Non-Technical Skills Behavioural marker system' and 'Anti-Air Teamwork Observation Measure' were field tested in moment-to-moment observation of 27 trauma team simulations in Norwegian hospitals. Independent subject matter experts rated medical management in the teams. An independent group design was used to explore differences in teamwork skills between higher-performing and lower-performing teams. RESULTS: Specific teamwork skills and behavioural markers were associated with indicators of good team performance. Higher and lower-performing teams differed in information exchange, supporting behaviour and communication, with higher performing teams showing more effective information exchange and communication, and less supporting behaviours. Behavioural markers of shared mental models predicted effective medical management better than teamwork skills. CONCLUSIONS: The present study replicates and extends previous research by providing new empirical evidence of the significance of specific teamwork skills and a shared mental model for the effective medical management of trauma teams. In addition, the study underlines the generic nature of teamwork skills by demonstrating their transferability from different clinical simulations like the anaesthesia environment to trauma care, as well as the potential usefulness of behavioural frequency analysis in future research on non-technical skills.

Guideline 9.1.1: Cardiopulmonary resuscitation training

Background: Today, prehospital emergency medical teams (EMTs) are confronted with emergent situations of cardiac arrest in palliative care patients. However, little is known about the out-of-hospital approach in this situation and the long-term survival rate of this specific patient type. The aim of the present investigation was to provide information about the strategic and therapeutic approach employed by EMTs in outpatient palliative care patients in cardiac arrest. Methods: During a period of 2 years, we retroactively analysed emergency medical calls with regard to palliative care emergency situations dealing with cardiac arrest. We evaluated the numbers of patients who were resuscitated, the prevalence of an advance directive or other end-of-life protocol, the first responder on cardiac arrest, the return of spontaneous circulation (ROSC) and the survival rate. Results: Eighty-eight palliative care patients in cardiac arrest were analysed. In 19 patients (22%), no resuscitation was started. Paramedics and prehospital emergency physicians began resuscitation in 61 cases (69%) and in 8 cases (9%), respectively. A total of 10 patients (11%) showed a ROSC; none survived after 48 h. Advance directives were available in 43% of cases. The start of resuscitation was independent of the presence of an advance directive or other end-of-life protocol. Conclusions: Strategic and therapeutic approaches in outpatient palliative care patients with cardiac arrest differ depending on medical qualification. Although many of these patients do not wish to be resuscitated, resuscitation was started independent of the presence of advance directive. To reduce legal insecurity and to avoid resuscitation and a possible lengthening of the dying process, advance directives and/or do not attempt resuscitation orders should be more readily available and should be adhered to more closely.

Guideline 11.10: Legal and ethical issues related to resuscitation

AND....


Male movements serve as courtship signals in many animal species, and may honestly reflect the genotypic and/or phenotypic quality of the individual. Attractive human dance moves, particularly those of males, have been reported to show associations with measures of physical strength, prenatal androgenization and symmetry. Here we use advanced three-dimensional motion-capture technology to identify possible biomechanical differences between women’s perceptions of ‘good’ and ‘bad’ male dancers. Nineteen males were recorded using the ‘Vicon’ motion-capture system while dancing to a basic rhythm; controlled stimuli in the form of avatars were then created in the form of 15 s video clips, and rated by 39 females for dance quality. Initial analyses showed that 11 movement variables were significantly positively correlated with perceived dance quality. Linear regression subsequently revealed that three movement measures were key predictors of dance quality; these were variability and amplitude of movements of the neck and trunk, and speed of movements of the right knee. In summary, we have identified specific movements within men’s dance that influence women’s perceptions of dancing ability. We suggest that such movements may form honest signals of male quality in terms of health, vigour or strength, though this remains to be confirmed.
In the late sixties the Canadian psychologist Laurence J. Peter advanced an apparently paradoxical principle, named since then after him, which can be summarized as follows: 'Every new member in a hierarchical organization climbs the hierarchy until he/she reaches his/her level of maximum incompetence'. Despite its apparent unreasonableness, such a principle would realistically act in any organization where the mechanism of promotion rewards the best members and where the competence at their new level in the hierarchical structure does not depend on the competence they had at the previous level, usually because the tasks of the levels are very different to each other. Here we show, by means of agent based simulations, that if the latter two features actually hold in a given model of an organization with a hierarchical structure, then not only is the Peter principle unavoidable, but also it yields in turn a significant reduction of the global efficiency of the organization. Within a game theory-like approach, we explore different promotion strategies and we find, counter intuitively, that in order to avoid such an effect the best ways for improving the efficiency of a given organization are either to promote each time an agent at random or to promote randomly the best and the worst members in terms of competence.

Although a common pain response, whether swearing alters individuals’ experience of pain has not been investigated. This study investigated whether swearing affects cold-pressor pain tolerance (the ability to withstand immersing the hand in icy water), pain perception and heart rate. In a repeated measures design, pain outcomes were assessed in participants asked to repeat a swear word versus a neutral word. In addition, sex differences and the roles of pain catastrophising, fear of pain and trait anxiety were explored. Swearing increased pain tolerance increased heart rate and decreased perceived pain compared with not swearing. However, swearing did not increase pain tolerance in males with a tendency to catastrophise. The observed pain-lessening (hypoalgesic) effect may occur because swearing induces a fight-or-flight response and nullifies the link between fear of pain and pain perception.