
AIM OF THE STUDY: To compare the preferences of patients who survived resuscitation with those admitted as emergency cases about whether family members should be present during resuscitation. METHODS: We used a case control design and recruited, from four large hospitals, 21 survivors of resuscitation and 40 patients admitted as emergency cases without the experience of resuscitation (control group) who were matched by age and gender at a ratio of 1:2. Data collection involved face-to-face interviews using a standardised 22 item questionnaire. Data analysis sought to identify differences between the two groups. RESULTS: Both groups were broadly supportive of the practice, however resuscitated patients were more likely to favour witnessing the resuscitation of a family member (72% versus 58%), preferred to have a relative present in the event they required resuscitation (67% versus 50%) and believed that relatives benefited from such an experience (67% versus 48%). Additionally, both groups indicated that staff should seek patient preferences about family witnessed resuscitation following hospital admission, and stated that they were unconcerned about confidential matters being discussed with family members present during resuscitation (91% and 75%, respectively). However none of these differences between the two groups achieved statistical significance. CONCLUSION: Hospitalised patients report a favourable disposition towards family witnessed resuscitation, and this view appears to be strengthened by successfully surviving a resuscitation episode. Practitioners should strive to facilitate family witnessed resuscitation by establishing, documenting and enacting patient preferences. Research exploring the perceptions of the wider public would help further inform this debate. Level III-2 case-control study.


Background: The presence of physicians is believed to facilitate optimal management of out-of-hospital cardiac arrest, but has not been sufficiently documented. Methods: Adult non-traumatic cardiac arrests treated by Oslo EMS between May 2003 and April 2008 were prospectively registered. Patients were categorized according to being treated by the physician-manned ambulance (PMA) or by regular paramedic-manned ambulances (non-PMA). Patient records and continuous electrocardiograms (ECGs) with impedance signals were reviewed. Quality of cardiopulmonary resuscitation (CPR) and clinical outcomes were compared. Results: Resuscitation was attempted in 1128 cardiac arrests, of which 151 treated by non-PMA
and PMA together were excluded from comparative analysis. Of the remaining 977 patients, 232 (24%) and 741 (76%) were
treated by PMA and non-PMA, respectively. The PMA group was more likely to have bystander witnessed arrests and initial
VF/VT, and received better CPR quality with shorter hands-off intervals and pre-shock pauses, and having a greater
proportion of patients being intubated. Despite uneven distribution of positive prognostic factors and better CPR quality,
short-term and long-term survival were not different for patients treated by the PMA vs. non-PMA, with 34% vs. 33% (p =
0.74) achieving return of spontaneous circulation (ROSC), 28% vs. 25% (p = 0.50) being admitted to ICU and 13% vs. 11% (p =
0.28) being discharged from hospital, respectively. Conclusions: Survival after out-of-hospital cardiac arrest was not different
for patients treated by the PMA and non-PMA in our EMS system.

Level III – 2 prospective cohort study, non-randomised.

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Study objective: Assisted ventilation may adversely affect out-of-hospital cardiac arrest outcomes. Passive ventilation offers
an alternate method of oxygen delivery for these patients. We compare the adjusted neurologically intact survival of out-of-
hospital cardiac arrest patients receiving initial passive ventilation with those receiving initial bag-valve-mask ventilation.

Methods: The authors performed a retrospective analysis of statewide out-of-hospital cardiac arrests between January 1,
resuscitation with minimally interrupted cardiopulmonary resuscitation (CPR) consisting of uninterrupted preshock and
postshock chest compressions, initial noninvasive airway maneuvers, and early epinephrine. Paramedics selected the method
of initial noninvasive ventilation, consisting of either passive ventilation (oropharyngeal airway insertion and high-flow
oxygen by nonrebreather facemask, without assisted ventilation) or bag-valve-mask ventilation (by paramedics at 8
breaths/min). The authors determined adjusted neurologically intact survival from hospital and public records and by
telephone interview and mail questionnaire. The authors compared adjusted neurologically intact survival between
ventilation techniques by using generalized estimating equations. Results: Among the 1,019 adult out-of-hospital cardiac
arrest patients in the analysis, 459 received passive ventilation and 560 received bag-valve-mask ventilation. Adjusted
neurologically intact survival after witnessed ventricular fibrillation/ventricular tachycardia out-of-hospital cardiac arrest was
higher for passive ventilation (39/102; 38.2%) than bag-valve-mask ventilation (31/120; 25.8%) (adjusted odds ratio [OR] 2.5;
95% confidence interval [CI] 1.3 to 4.6). Survival between passive ventilation and bag-valve-mask ventilation was similar after
unwitnessed ventricular fibrillation/ventricular tachycardia (7.3% versus 13.8%; adjusted OR 0.5; 95% CI 0.2 to 1.6) and non-
shockable rhythms (1.3% versus 3.7%; adjusted OR 0.3; 95% CI 0.1 to 1.0). Conclusion: Among adult, witnessed, ventricular
fibrillation/ventricular tachycardia, out-of-hospital cardiac arrest resuscitated with minimally interrupted cardiac resuscitation, adjusted neurologically intact survival to hospital discharge was higher for individuals receiving initial passive ventilation than those receiving initial bag-valve-mask ventilation. 

*Level III-2 cohort study.*

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**BACKGROUND:** Advanced life support of patients contaminated with chemical, biological, radiological or nuclear (CBRN) substances requires adequate respiratory protection for medical first responders. Conventional and powered air-purifying respirators may exert a different impact during resuscitation and therefore require evaluation. This will help to improve major incident planning and measures for protecting medical staff. **METHODS:** A randomised crossover study was undertaken to investigate the influence of conventional negative pressure and powered air-purifying respirators on the simulated resuscitation of casualties contaminated with hazardous substances. Fourteen UK paramedics carried out a standardised resuscitation algorithm inside an ambulance vehicle, either unprotected or wearing a conventional or a powered respirator. Treatment times, wearer mobility, ease of communication and ease of breathing were determined and compared. **RESULTS:** In the questionnaire, volunteers stated that communication and mobility were similar in both respirator groups while breathing resistance was significantly lower in the powered respirator group. There was no difference in mean (SD) treatment times between the groups wearing respiratory protection and the controls (245 (19) s for controls, 247 (17) s for conventional respirators and 250 (12) s for powered respirators). **CONCLUSIONS:** Powered air-purifying respirators improve the ease of breathing and do not appear to reduce mobility or delay treatment during a simulated resuscitation scenario inside an ambulance vehicle with a single CBRN casualty. 

*Level III – 2 cohort study.*

5/ 

Despite being a standard procedure during induction of anaesthesia, facemask ventilation can be a major challenge especially for inexperienced anaesthetists. We manufactured a Jaw-Thrust-Device designed to keep the patient's jaws in an optimised position, and thus to maintain the airway in a permanently patent state. Using a cross over design, we compared the
influence of using the Esmarch manoeuvre (bimanual jaw-thrust), a nasopharyngeal airway, an oropharyngeal airway, or the Jaw-Thrust-Device on airway physiology in 50 healthy adults with body mass index < 35 kg/m², undergoing standard facemask ventilation for routine induction of anaesthesia. The main study endpoints were expiratory tidal volumes, airway resistances, and gas flow rates. The Jaw-Thrust-Device was more effective in increasing expiratory tidal volumes and peak inspiratory flow than a standard Esmarch manoeuvre, and was more effective than both nasopharyngeal and oropharyngeal airways in decreasing airway resistance. 

Level III-2 comparative study, non-randomised, non-blinded, fasted, healthy surgical patients.

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Objective: Survival following out-of-hospital cardiac arrest (OHCA) continues to be disappointingly low world-wide, despite advances in technology and international guidelines for resuscitation. Few cities or emergency medical service (EMS) agencies report patient outcomes after OHCA. Among those who do, survival from witnessed VF ranges from 7.7% to 39.9%, with only a few cities reporting rates higher than this. We report outcomes and incidence of VF OHCA over 18 years in a medium-sized city incorporating an aggressive approach to OHCA. Methods: The city, which increased in population over the study period from 70,000 to 100,000 persons, utilizes an emergency response system which dispatches defibrillator-equipped police, fire-rescue and ambulance personnel simultaneously. Police and fire-rescue personnel are equipped with automated external defibrillators (AEDs). Advanced life-support is provided as needed by paramedics. Results: There were 454 arrests during the study period attributed to a cardiac cause. Of 271 bystander-witnessed arrests, 203 (74.9%) were in VF and 94 (46.3%) were discharged. Average time from 9-1-1 call to shock was relatively short: mean 6.5 min (S.D. 2.5 min). In a multivariable model, the interval from call to shock was strongly associated with neurologically intact survival (OR 0.72, 95% CI: 0.61-0.84 for each additional minute). The age- and sex-adjusted incidence of EMS-treated VF OHCA significantly (p < 0.001) declined over the study period: 1991-1999: 37.9/100,000 (95% CI: 31.8-44.0), 2000-2008: 17.8/100,000 (95% CI: 14.4-21.2). Conclusions: High survival from witnessed VF OHCA (46.3%) was achieved during the study period. Rapid response, and therefore rapid defibrillation, was the major contributor to survival.

Level IV observational study

Purpose: To investigate cardiovascular nurses' experiences of and attitudes towards the presence of family members during resuscitation of adult patients. Methods: A 36-item questionnaire exploring the experiences of and attitudes towards family members being present in the resuscitation room was distributed to a convenience sample of nurses attending three national and one international cardiovascular nursing conferences held in Europe during 2007. Results: Of 820 questionnaires distributed, 411 (50%) completed ones were returned. Of these 411 respondents, 178 (44%) had experienced at least one situation of families being present. Positive (23%) and negative (21%) experiences of family presence were equally distributed. Only 28 (7%) respondents stated that their unit had a protocol covering family presence. Nurses in Ireland (n = 30; 59%) and the UK (n = 18; 55%) were most likely to have experienced family presence and protocols relating to this were most commonly found in the UK (n = 4; 14%). Conclusion: Less than half of the included European cardiovascular nurses had experienced a situation of families being present during resuscitation and protocols pertaining to this were rare. There was no clear attitude towards family presence, though experience in nursing made nurses more favourable towards it.

Level IV study.


OBJECTIVE: In patients who remain in a coma after cardiopulmonary resuscitation (CPR), the bilateral absence of cortical N20 responses of median nerve somatosensory evoked potentials (SSEP) 24 hours after admission invariably correlates with a poor neurologic outcome. Nowadays, CPR patients are treated with mild hypothermia, with simultaneously administered sedative drugs, hampering clinical neurologic assessment. We investigated whether SSEP performed during hypothermia can reliably predict a poor neurologic outcome. METHODS: Between July 2006 and April 2008, this multicenter prospective cohort study included adult comatose patients admitted after CPR and treated with induced mild hypothermia (32-34 degrees C). SSEP was performed during hypothermia, and in patients who remained comatose after rewarming, a second SSEP was performed. Neurologic outcome was assessed 30 days after admission with the Glasgow Outcome Scale. RESULTS: Seventy-seven consecutive patients were included in 2 hospitals. In 13 patients (17%), the cortical N20 response during hypothermia was bilaterally absent. In 9 of these 13 patients in whom SSEP could be repeated during normothermia, the N20
response was also absent, yielding a positive predictive value of 1.00 (95% confidence interval [CI] 0.70-1.00). All 13 patients with absent SSEP during hypothermia had a poor neurologic outcome, yielding a positive predictive value of 1.00 (95% CI 0.77-1.00). CONCLUSIONS: The results of this pilot study show that bilaterally absent cortical N20 responses of median nerve somatosensory evoked potentials performed during mild hypothermia after resuscitation can predict a poor neurologic outcome. We started a larger multicenter prospective cohort study to confirm these results.

Level III – 2 prospective cohort study

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BACKGROUND: Although clinicians are expected to help patients make decisions about end-of-life care, there is insufficient data to help guide patient preferences. The objective of this study was to determine the frequency of patients who undergo 'limited code' and compare survival to discharge with those who undergo maximum resuscitative efforts ('full code').

METHODS: We performed a retrospective analysis of all adult in-hospital cardiac arrests (IHCA) at a tertiary care teaching hospital from January 1999 to December 2003 to compare survival in patients with limited code to survival in patients with a full code. We collected data on demographic and clinical variables known to influence survival in IHCA. Logistic regression was used to assess the association of code status with subsequent survival through the code and to hospital discharge after adjusting for potential confounding factors. RESULTS: Of the 309 patients having IHCA, there were 17 (5.5%) patients with limited code status and 292 (94.5%) with full code status. Among full code patients, 171 (58.6%) survived the code compared to five patients (29.4%) who had a limited code (p=0.023). After adjusting for demographic variables and pre-arrest co-morbidities, patients with full code status compared to limited code status had an odds ratio for return of spontaneous circulation of 3.69 (95% CI: 1.13-14.34). CONCLUSIONS: Patients who opt for limited code have a significantly lower probability of survival compared to patients who choose full code. Patients who choose limited code should be informed of the likely negative outcome as compared to full resuscitation.

Level III – 2 retrospective cohort study.

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Spontaneous changes in body temperature after return of circulation (ROSC) from cardiac arrest are common, but the
association of these changes with outcomes in hospitalized patients who survive to 24h post-ROSC is not known. We tested the hypothesis that adults who experience temperature lability in the first 24h have worse outcomes compared with those who maintain normothermia. A prospective observational study from a multicenter registry of cardiac arrests (National Registry of Cardiopulmonary Resuscitation) from 355 US and Canadian hospitals. 14,729 adults with return of circulation from a pulseless cardiac arrest. We excluded those who died or were discharged before 24h post-event, those made Do-Not-Resuscitate (DNR) within 24h of event, those that had a preceding trauma, and those with multiple cardiac arrests. Finally, we included only subjects that had both a lowest (Tmin) and highest (Tmax) body temperature value recorded during the first 24-h after ROSC, resulting in a study sample of 3426 patients. After adjustment for potential covariates, there was a lower odds of survival in those having an episode of hypothermia (adjusted odds ratio [OR], 0.62; 95% confidence interval [CI], 0.48 - 0.80), those having an episode of hyperthermia (OR, 0.67; 95% CI, 0.48 - 0.80), and those having an episode of both (OR, 0.59; 95% CI, 0.39 - 0.91). Among those who survived to discharge, there was also a lower odds of favorable neurologic performance in those who had an episode of hyperthermia (OR, 0.71; 95% CI, 0.51 - 0.98). Episodes of temperature lability following in-hospital resuscitation from cardiac arrest are associated with lower odds of surviving to discharge. Hyperthermia is also associated with fewer patients leaving the hospital with favorable neurologic performance. Further studies should identify whether therapeutic control over changes in body temperature after in-hospital cardiac arrest improves outcomes.

Level III – 2 prospective observational cohort study, non-randomised.

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Setting: Sudden Cardiac Death accounts for approximately 5000 deaths in Ireland each year. Nationally, out-of-hospital cardiac arrest has a very low resuscitation rate, reported at less than 5%. Ireland has a well developed general practice network which routinely manages emergencies arising in the community setting. However, little is known about its potential impact on Sudden Cardiac Death. This study reports on the incidence and management of cardiac arrest in Irish general practice. Method: A national training/equipment project in defibrillation in general practice (MERIT) has established a network to prospectively report all cardiac arrests with a resuscitation attempt in general practice. Three monthly surveys of the network record events; structured debriefing uses a modified Utstein template to detail events and their outcomes. Results: 426 practices reported data during a 36-month period (85-97% response rate to surveys), reporting 144 events, of which data are available on 136 events. 88.4% of events were witnessed, 31.6% by general practice staff. 58.2% of events occurred in the general practice or in the patient's home. The general practitioner (GP) was on scene before the ambulance
in 72.6% of cases and 52.3% of the patients involved were patients of the GP attending. 52.3% of patients were defibrillated, 32.6% had return of spontaneous circulation at some point and 26 patients (19.5%) were discharged from hospital.

Conclusions: Cardiac arrest in general practice is compatible with structured, effective interventions and significant rates of successful resuscitation. All general practices should be capable of providing this care.

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INTRODUCTION: Several prognostic scores exist for critically ill patients, including APACHE II, Revised Trauma Score (RTS), Rapid Emergency Medicine Score (REMS) and Modified Early Warning Score (MEWS). However, there is no widely used score specifically designed to predict the likelihood of early intensive care unit (ICU) admission or death in undifferentiated emergency department (ED) resuscitation room patients. We aimed to derive such a score and compare it with other similar scores. METHODS: This was a single centre study of consecutive adult resuscitation room patients over one month. Physiological and blood test variables were compared according to the composite primary outcome: admission to ICU or death within 7 days of attendance. Multivariate logistic regression was used to derive a prediction score which was compared with other scores using ROC (receiver operating characteristic) analysis. RESULTS: 330 patients were included in the study, of whom 77 were admitted to ICU or died within 7 days. A prediction score was derived using the following parameters: systolic blood pressure; Glasgow coma score; blood glucose; bicarbonate; white cell count; and a history of metastases. This score significantly out-performed APACHE II, RTS, REMS and MEWS with an area under the ROC curve of 0.909 (95% CI 0.872-0.938). CONCLUSION: The Prince of Wales Emergency Department Score (PEDS) is a new prognostic score to predict the likelihood of early ICU admission or death in undifferentiated resuscitation room patients. Further studies are needed to validate and refine this potentially useful tool.

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To collect data regarding prehospital paediatric tracheal intubation by emergency physicians skilled in advanced airway management. A prospective 8-year observational study of a single emergency physician-staffed emergency medical service. Self-reporting by emergency physicians of all children aged 0 - 14 years who had prehospital tracheal intubation and were attended by either anaesthesia-trained emergency physicians (group 1) or by a mixture of anaesthesia and non-anaesthesia-
trained emergency physicians (group 2). Eighty-two out of 2040 children (4.0%) had prehospital tracheal intubation (58 in group 1). The most common diagnoses were trauma (50%; in school children, 73.0%), convulsions (13.4%) and SIDS (12.2%; in infants, 58.8%). The overall tracheal intubation success rate was 57 out of 58 attempts (98.3%). Compared to older children, infants had a higher number of Cormack-Lehane scores of 3 or 4, ‘difficult to intubate’ status (both 3 out of 13; 23.1%) and a lower first attempt success rate for tracheal intubation (p=0.04). Among all 82 children 71 (86.6%) survived to hospital admission and 63 (76.8%) to discharge. Of the 63 survivors, 54 (85.7%) demonstrated a favourable or unchanged neurological outcome (PCPC 1 - 3). The survival and neurological outcomes of infants were inferior compared to older children (p<0.001). On average an emergency physician performed one prehospital tracheal intubation in 3 years in a child and one in 13 years in an infant. Anaesthesia-trained emergency physicians working in our system report high success rates for prehospital tracheal intubation in children. Survival and neurological outcomes were considerably better than reported in previous studies.  

*Level IV prospective observational study*


**OBJECTIVE:** The objective of this study was to assess whether pediatric inpatients who receive cardiopulmonary resuscitation (CPR) for bradycardia with poor perfusion are more likely to survive to hospital discharge than pediatric inpatients who receive CPR for pulseless arrest (asystole/pulseless electrical activity [PEA]), after controlling for confounding characteristics.

**METHODS:** A prospective cohort from the National Registry of Cardiopulmonary Resuscitation was enrolled between January 4, 2000, and February 23, 2008. Patients who were younger than 18 years and had an in-hospital event that required chest compressions for >2 minutes were eligible. Patients were divided into 2 groups on the basis of initial rhythm and pulse state: bradycardia/poor perfusion and asystole/PEA. Patient characteristics, event characteristics, and clinical characteristics were analyzed as possible confounders. Univariate analysis between bradycardia and asystole/PEA patient groups was performed. Multivariable logistic regression was used to determine whether an initial state of bradycardia/poor perfusion was independently associated with survival to discharge. **RESULTS:** A total of 6288 patients who were younger than 18 years were reported; 3342 met all inclusion criteria. A total of 1853 (55%) patients received chest compressions for bradycardia/poor perfusion compared with 1489 (45%) for asystole/PEA. Overall, 755 (40.7%) of 1353 patients with bradycardia survived to hospital discharge, compared with 365 (24.5%) of 1489 patients with asystole/PEA. After controlling for known confounders, CPR for bradycardia with poor perfusion was associated with increased survival to hospital discharge. **CONCLUSIONS:** Pediatric inpatients with chest compressions initiated for bradycardia and poor perfusion before onset of pulselessness were
more likely to survive to discharge than pediatric inpatients with chest compressions initiated for asystole or PEA.

Level III-2 cohort study


BACKGROUND: Biphasic waveform defibrillation results in higher rates of termination of fibrillation than monophasic waveform defibrillation but has not been shown to improve survival outcomes. OBJECTIVE: To compare the effectiveness of a biphasic automated external defibrillator (AED) with a monophasic AED for witnessed out-of-hospital cardiac arrest (OHCA) due to ventricular fibrillation (VF). METHODS: In a prospective population-based cohort study, adults with witnessed VF OHCA were treated with either monophasic or biphasic waveform AED shocks. The primary outcome measure was neurologically favourable 1-month survival, defined as a Cerebral Performance Categories score of 1 or 2. RESULTS: Of 366 adults with witnessed OHCA of presumed cardiac aetiology, 74 (20%) had VF. Termination of VF with the first shock tended to occur more frequently after biphasic AED shocks (36/44 (82%) vs 20/30 (67%), p = 0.14). Return of spontaneous circulation (ROSC) occurred more frequently after biphasic AED shocks (29/44 (66%) vs 8/30 (27%), p = 0.001). Neurologically favourable 1-month survival was also more frequent in the biphasic group (10/44 (23%) vs 1/30 (3%), p = 0.04). The median time interval from the first shock to the second shock was 67 s in the monophasic group and 24 s in the biphasic group (p = 0.001). CONCLUSIONS: Treatment with biphasic AED shocks improved the likelihood of ROSC and neurologically favourable 1-month survival after witnessed VF compared with monophasic AED shocks. In addition to waveform differences, a shorter time interval from the first shock to the second shock could account for the better outcomes with biphasic AED.

Level III-2 cohort study (not randomised, not blinded)


Paramedic tracheal intubation has been reported to carry a high failure rate and morbidity. A comparison between doctor and paramedic-led intubation at out-of-hospital cardiac arrests (OHCA) was conducted to assess whether this finding was observed in our clinical practice. Retrospective review of all medical OHCA attended by the Warwickshire and Northamptonshire Air Ambulance (WNAA) over a 64-month period. Cases were identified and divided into doctor-led or
paramedic-led groups. Self-reported intubation failure rate, morbidity and clinical outcome were observed and compared. Paramedic exposure to tracheal intubation was assessed. 286 cases of medical OHCA were identified, 199 (69.6%) were doctor-led and 87 (30.4%) paramedic-led. Paramedic and doctor-led crews intubated an equivalent proportion of cases (Para-led 60.7% [37] vs. Dr-led 62.8% [98]; p=0.89) and no significant difference in failure rate was observed (Para-led 2.7% [1 case, 95% CI 0.0 - 7.9%] vs. Dr-led 3.1% [3 cases, 95% CI 0.0 - 6.5%]; p=1). No morbidity from failure-to-intubate was recorded, and equal rates of return of spontaneous circulation (ROSC) were observed (Para-led 20.7% [18] vs. Dr-led 20.6% [41]; p=0.89). Paramedics operating with the WNAA were found to have a higher exposure to tracheal intubation (WNAA 0.03 TT/shift vs. unselected paramedics 0.004 TT/shift). Experienced paramedics regularly operating with physicians have a low tracheal intubation failure rate at OHCA, whether practicing independently or as part of a doctor-led team. This is likely due to increased and regular clinical exposure.

Level III-2 retrospective cohort.

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Objective: We investigated whether emergency thoracotomy (ET) performed in pre-hospital settings contributed to saving the lives of blunt trauma patients with impending or recent cardiac arrest. Methods: Eighty-one consecutive cardiac arrest patients with blunt trauma were performed ET before or after arrival at the emergency department (ED). These were reviewed retrospectively and were classified into the following three groups: (1) an emergency field thoracotomy was performed (EFT group, n = 34); (2) a doctor dispatched to the scene, but the thoracotomy was performed in the ED (EDT-a group, n = 10); and (3) no doctor dispatched to the scene, and the thoracotomy was performed in the ED (EDT-b group, n = 37). The patients in the EFT and EDT-a groups were managed within the Japanese helicopter emergency medical service system with a doctor dispatched to the scene. Result: The time between the arrival of the EMT at the scene and the start of the thoracotomy was significantly shorter in the EFT group than in the EDT-b group (19.2 ± 7.9 min vs. 30.7 ± 6.8 min, p < 0.001). In the EFT group, the ICU admission" rate was significantly higher among the patients who experienced cardiac arrest after the EMT arrival than among the patients who experienced cardiac arrest before the EMT arrival (70% vs. 8%, p = 0.001). Unfortunately, however, there were no survivors in this series. Conclusion: These findings indicate that "early access" to a doctor's expertise and the performance of an "emergency field thoracotomy" might be two important factors for improving the possibility of saving the lives of blunt trauma patients with impending or recent cardiac arrest.

Level III-2 retrospective cohort

AIMS: Out-of-hospital cardiac arrest (OHCA) is a major public health problem. The objective of this study is to explore the effects of a dual dispatch early defibrillation programme. METHODS AND RESULTS: In this pilot study, automated external defibrillators (AEDs) were provided to all 43 fire stations in Stockholm during 2005. Fire-fighters were dispatched in parallel with traditional emergency medical responders (EMS) to all suspected cases of OHCA. Additionally, 65 larger public venues were equipped with AEDs. All 863 OHCA from December 2005 to December 2006 were included during the intervention, whereas all 657 OHCA from 2004 served as historical controls. Among dual dispatches, fire-fighters assisted with cardiopulmonary resuscitation (CPR) in 94% of the cases and arrived first on scene in 36%. The median time from call to arrival of first responder decreased from 7.5 min during the control period to 7.1 min during the intervention (P = 0.004). The proportion of patients in shockable rhythm remained unchanged. The proportion of patients alive 1 month after OHCA rose from 4.4 to 6.8% [adjusted odds ratio (OR): 1.6; 95% confidence interval (CI): 0.9-2.9]. One-month survival in witnessed cases rose from 5.7 to 9.7% (adjusted OR: 2.0; 95% CI: 1.1-3.7). Survival after OHCA in the rest of Sweden (Stockholm excluded) declined from 8.3 to 6.6% during the corresponding time period (unadjusted OR: 0.8; 95% CI: 0.6-1.0). Only three OHCA occurred at public venues equipped with AEDs. CONCLUSION: An introduction of a dual dispatch early defibrillation programme in Stockholm has shortened response times and is likely to have improved survival in patients with OHCA, especially in the group of witnessed cardiac arrests. The increase in survival is believed to be associated with improved CPR and shortened time intervals.

Level III-3 cohort, with historical control.


To investigate the incidence of iatrogenic dyscarbia in survivors of out-of-hospital cardiac arrest treated with induced mild hypothermia. We performed a retrospective cohort study of the ventilatory management based on blood gas analyses of patients resuscitated from prehospital cardiac arrest. In the pilot phase, we assessed the ventilatory management in the patients treated in one university hospital during a 4-year study period. Subsequently, a more recent (1-year) retrospective cohort of resuscitated patients from all five Finnish university hospitals concerning the first 48h after hospital admission was analyzed. Core temperatures and temperature corrected (or non-corrected) blood gas analysis results with focus on carbon
dioxide tension were analyzed. In addition, a survey was performed to investigate the ventilatory strategies in all Finnish hospitals providing mild hypothermia for cardiac arrest victims. The pilot cohort suggested a high incidence of hypo- or hyper-carbia during hypothermia treatment. In the multicenter patient population of 122 patients contributing a total of 1627 measurements, the PaCO(2) distribution was as follows: less than 4 kPa in 148 samples out of 1627 (9%), 4-4.6 kPa in 404 (25%), 4.7-6 kPa in 887 (55%) and more than 6 kPa in 188 samples (12%). There was a significant difference in the incidence of hypercarbia between the hospitals (p<0.05). We conclude that normocarbia was achieved/maintained only in approximately 55% of the samples. The incidence of hypo- or hyper-carbia (dyscarbia) was high (45%). This may predispose for serious derangements in the cerebral perfusion of the resuscitated patient. These results call for vigilance in adjustment of the ventilatory management to meet the needs of the patients treated with mild hypothermia.

Level IV observational study

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The aim of this study was to design a severity score specific to mobile emergency and resuscitation services (MERS). A prospective, multicentre cohort study including 17 868 patients was performed. The severity reference criterion was determined by multiple correspondence analysis. A multiple linear regression was used for the construction of the severity score. The score performances were analysed in terms of area under the receiver operating characteristics curves (AUC). Twelve variables were identified for the construction of the severity score. The multiple regression (r² = 0.947; p<0.001) provided a severity score that took on values from 8 to 68. The score performs well in distinguishing the various patient outcomes in terms of AUC. This study develops the first adaptable and specific severity score of MERS activities.

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Headache is one of the most common manifestations of non-traumatic intracranial hemorrhage, which is an uncommon, but not rare, cause of cardiac arrest in adults. History of a sudden headache preceding collapse may be a helpful clue to estimate the cause of out-of-hospital cardiac arrest (OHCA). Medical records of witnessed OHCA patients were reviewed to identify those who complained of a sudden headache preceding collapse, and the incidence of intracranial hemorrhage among them as well as their clinical characteristics was investigated retrospectively. During the 12-month period, 124 patients who
sustained a witnessed OHCA were treated. Among them, 74 (60%) collapsed without any pain complaint, and only 6 (5%) complained of a sudden headache preceding collapse. All of the six patients were resuscitated: four had a severe subarachnoid hemorrhage (SAH), while the other two had a massive cerebellar hemorrhage. By contrast, 39 of the 74 patients who collapsed without any pain were resuscitated. Among them, another six patients were found to harbor an SAH. Thus, a total of 12 among the 124 witnessed OHCA (10%) sustained a fatal intracranial hemorrhage. While OHCA patients who collapse complaining of a sudden headache are uncommonly seen in the emergency room, they have a high likelihood of harboring a severe intracranial hemorrhage. It should also be reminded that approximately half of patients whose cardiac arrest is due to an intracranial hemorrhage may collapse without complaining of a headache. The prognosis of those with cerebral origin of OHCA is invariably poor, although they may relatively easily be resuscitated temporarily. Focus needs to be directed to avoid sudden death from a potentially treatable cerebral lesion.

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AIM: Aneurysmal subarachnoid haemorrhage (SAH) is a relatively common cause of out-of-hospital cardiac arrest (OHCA). Early identification of SAH-induced OHCA with the use of brain computed tomography (CT) scan obtained immediately after resuscitation may help emergency physicians make therapeutic decision as quickly as they can. METHODS: During the 4-year observation period, brain CT scan was obtained prospectively in 142 witnessed non-traumatic OHCA survivors who remained haemodynamically stable after resuscitation. Demographics and clinical characteristics of SAH-induced OHCA survivors were compared with those with "negative" CT finding. RESULTS: Brain CT scan was feasible with an average door-to-CT time of 40.0 min. SAH was found in 16.2% of the 142 OHCA survivors. Compared with 116 survivors who were negative for SAH, SAH-induced OHCA survivors were significantly more likely to be female, to have experienced a sudden headache, and trended to have achieved return of spontaneous circulation (ROSC) prior to arrival in the emergency department less frequently. Ventricular fibrillation (VF) was significantly less likely to be seen in SAH-induced than SAH-negative OHCA (OR, 0.06; 95% CI, 0.01-0.46). Similarly, Cardiac Trop-T assay was significantly less likely to be positive in SAH-induced OHCA (OR, 0.08; 95% CI, 0.01-0.61). CONCLUSION: Aneurysmal SAH causes OHCA more frequently than had been believed. Immediate brain CT scan may particularly be useful in excluding SAH-induced OHCA from thrombolytic trial enrollment, for whom the use of thrombolitics is contraindicated. The low VF incidence suggests that VF by itself may not be a common cause of SAH-induced OHCA.

Level III-2 cohort study
Patients with heart failure (HF) have abnormal cellular anatomy and myocardial mechanics that may impact the initial rhythm and subsequent outcomes in cardiac arrest (CA). Patients with pre-existing HF are less likely to have ventricular fibrillation/pulseless ventricular tachycardia (VF/pVT) as the first documented rhythm in CA and have poorer survival than patients without pre-existing HF. Identify the first documented cardiac arrest rhythm (FDR) in hospitalized patients with and without a pre-existing heart failure history.

We evaluated 60,389 consecutive, adult, index, pulseless CA events with documented initial rhythm in the National Registry of Cardiopulmonary Resuscitation. The primary endpoint was the FDR in patients with and without a history of pre-existing HF. Secondary endpoints were return of spontaneous circulation (ROSC), survival to discharge, and neurological outcome. Thirty-three percent of patients had a pre-existing diagnosis of HF. HF patients were more likely to have VF/pVT (25.9 vs. 23.2%) and less likely to have asystole (34.4 vs. 35.3%, p=<.0001) than non-HF. There was no difference in survival to discharge (18.3 vs. 18.2%, p=.66), or good neurological outcomes (82.2 vs. 83.2%, p=.23) between the groups. Women were less likely to have VF/pVT as the first documented rhythm in both HF and non-HF groups.

Hospitalized patients with HF are more likely than those without HF to have VF/pVT as the FDR in CA, however the clinical magnitude of this difference is small. Overall survival and neurological outcomes are no different than hospitalized arrest patients without HF.

Level III-2 retrospective cohort

International guidelines for cardiopulmonary resuscitation recommend mild hypothermia (32-34 °C) for 12-24 h in comatose survivors of cardiac arrest. To induce therapeutic hypothermia a variety of external and intravascular cooling devices are available. A cheap and effective method for inducing hypothermia is the infusion of large volume, ice-cold intravenous fluid. There are concerns regarding the effects of rapid infusion of large volumes of fluid on respiratory function in cardiac arrest survivors. We have retrospectively studied the effects of high volume cold fluid infusion on respiratory function in 52 resuscitated cardiac arrest patients. The target temperature of 32-34°C was achieved after 4.1 ± 0.5 h (cooling rate 0.48°C/h). During this period 3427 ± 210 mL ice-cold fluid was infused. Despite significantly reduced LV-function (EF 35.8 ± 2.2%) the respiratory status of these patients did not deteriorate significantly. On intensive care unit admission the mean PaO2 was 231.4 ± 20.6 mmHg at a FiO2 of 0.82 ± 0.03 (PaO2/FiO2 = 290.0 ± 24.1) and a PEEP level of 7.14 ± 0.31 mbar. Until reaching
the target temperature of 34 °C the FiO2 could be significantly reduced to 0.63 ± 0.03 with unchanged PEEP level (7.23 ± 0.36 mbar). Under these conditions the PaO2/FiO2 ratio slightly decreased to 247.5 ± 18.5 (P = 0.0893). Continuing the saline infusion to achieve a body temperature of 33 °C, the FiO2 could be further reduced with unchanged PEEP. The infusion of large volume, ice-cold fluid is an effective and inexpensive method for inducing therapeutic hypothermia. Resuscitation from cardiac arrest is associated with deterioration in respiratory function. The infusion of large volumes of cold fluid does not cause a statistically significant further deterioration in respiratory function. A larger, randomized and prospective study is required to assess the efficacy and safety of ice-cold fluid infusion for the induction of therapeutic hypothermia.

Level IV case series

25/

The success rate of cardiopulmonary resuscitation (CPR) for cancer patients following in-hospital cardiac arrest has remained poor over the last 3 decades, but little is known about determinants of undergoing CPR for these patients at the end of life. To determine the prevalence of CPR for Taiwanese cancer patients in the last month of life and the association between their undergoing CPR and patient demographics, disease characteristics, physician specialty, hospital characteristics, and availability of healthcare resources at the hospital and regional levels. This retrospective cohort study examined administrative data for a cohort of 204,850 cancer decedents in 2001 - 2006. Rates of CPR decreased substantially over the study period, from 13.18% to 8.63%, and the adjusted odds ratio of undergoing CPR decreased significantly by a factor of 0.93 for each successive year. Taiwanese cancer patients were predisposed to undergo CPR in their last month of life if they were male, young, and unmarried (except for widowhood); had high comorbidity; had certain cancers (hematological malignancies, head and neck, esophageal, and prostate cancers); had a localized or newly diagnosed (within 1 - 2 months of death) cancer; had a non-oncologist as their primary physician; and received care at a non-teaching hospital. One-tenth of Taiwanese cancer patients underwent CPR in the last month of life, and the rates of CPR decreased substantially from 2001 to 2006. The propensity for CPR was influenced by patient demographics, disease characteristics, physician specialty, and teaching status of the patient's primary hospital.

26/
In December 2005, updated resuscitation Guidelines (G) were introduced worldwide and will be revised again in 2010. This study sought to elucidate how long it takes to implement new guidelines. This was a prospective observational study. From July 2005 to January 2008, we included all patients with an out-of-hospital cardiac arrest of suspected cardiac cause. We analyzed Emergency Medical System (EMS) Guideline usage via defibrillator recordings of the continuous ECG and impedance signals. We excluded patients with missing or otherwise unusable ECGs. All shocks and CPR cycles were individually classified. The same Guideline needed to be applied for at least 75% of all shocks and CPR cycles. If no shocks had been given, continuous ECGs were classified by its CPR status only. Continuous ECGs were classified as G1992, G2000 or G2005. If at least 75% of the shocks were given according to G2000 and at least 75% of the CPR was according to G2005, the Guideline protocol was classified as intermediate. All analyses that did not fulfill any Guideline criteria were classified as indeterminate. Of 1672 analyzable resuscitations, 31 (2%) used G1992, 826 (49%) G2000, 608 (36%) G2005, and 125 (7%) intermediate Guidelines. The Guideline protocol could not be identified for the remaining 81 (5%) patients. It took 17 months (from publication) until EMS personnel applied GL2005 in over 80% of cases. Our experience shows it took one-and-a-half years to effectively implement new resuscitation Guidelines. We believe improvements in implementation can shorten this to six months.

27/

BACKGROUND AND OBJECTIVE: Code status discussions may fail to address patients' treatment-related goals and their knowledge of cardiopulmonary resuscitation (CPR). This study aimed to investigate patients' resuscitation preferences, knowledge of CPR and goals of care. Design, setting, patients and measurements: 135 adults were interviewed within 48 h of admission to a general medical service in an academic medical centre, querying code status preferences, knowledge about CPR and its outcome probabilities and goals of care. Medical records were reviewed for clinical information and code status documentation. RESULTS: 41 (30.4%) patients had discussed CPR with their doctor, 116 (85.9%) patients preferred full code status and 11 (8.1%) patients expressed code status preferences different from the code status documented in their medical record. When queried about seven possible goals of care, patients affirmed an average of 4.9 goals; their single most important goals were broadly distributed, ranging from being cured (n = 36; 26.7%) to being comfortable (n = 8; 5.9%). Patients' mean estimate of survival to discharge after CPR was 60.4%. Most patients believed it was helpful to discuss goals of care (n = 95; 70.4%) and the chances of surviving in hospital CPR (n = 112; 83.0%). Some patients expressed a desire to change their code status after receiving information about survival following in hospital CPR (n = 11; 8.1%) or after discussing
goals of care (n = 2; 1.5%). CONCLUSIONS: Doctors need to address patients' knowledge about CPR and take steps to avoid discrepancies between treatment orders and patients' preferences. Addressing CPR outcome probabilities and goals of care during code status discussions may improve patients' knowledge and influence their preferences.

Level IV study

28/

Aims: Therapeutic hypothermia (TH) is used in neuroprotection following cardiac arrest due to ventricular tachycardia (VT) and ventricular fibrillation (VF). Accidental hypothermia is itself known to cause prolongation of the corrected QT interval (QTc). QTc prolongation can cause polymorphic VT and VF. If this also occurs in TH, it may induce refibrillation. We investigated the effect of TH on the QTc interval. Methods and results: Prospective case series of all patients undergoing TH following cardiac arrest following VT/VF at our hospital between July 2008 and January 2009. We studied the effect of temperature on QTc. All electrocardiograms (ECGs) undertaken during TH were studied and compared with the ECG prior to this. Four patients underwent TH. A total of 10 ECGs were undertaken during TH. The QTc was normal prior to TH. It became prolonged (>460 ms) in all cases during TH and normalized after cessation of TH, apart from Patient 4 who did not have an ECG post-TH since she died from cardiogenic shock. There was a negative correlation between temperature and QTc (Pearson's correlation coefficient, r= -0.71). Conclusion: Our series illustrates QTc prolongation during TH. This carries potential for refibrillation. Guidelines on ECG monitoring during TH are needed, especially since hypothermic myocardium is intrinsically prone to arrhythmias and commonly used antiarrythmic drugs such as amiodarone can prolong the QTc.

Level IV case series

29/

Aim: To study haemodynamic effects and changes in intravascular volume during hypothermia treatment, induced by ice-cold fluids and maintained by ice-packs followed by rewarming in patients after resuscitation from cardiac arrest. Materials and methods: In 24 patients following successful restoration of spontaneous circulation (ROSC), hypothermia was induced with infusion of 4 °C normal saline and maintained with ice-packs for 26 h after ROSC. This was followed by passive...
rewarming. Transthoracic echocardiography was performed at 12, 24 and 48 h after ROSC to evaluate ejection fraction and intravascular volume status. Central venous pressure (CVP), central venous oxygen saturation (ScvO2) and serum lactate were measured. Fluid balance was calculated. Results: Twelve hours after ROSC, two separate raters independently estimated that 10 and 13 out of 23 patients had a decreased intravascular volume using transthoracic echocardiography. After 24 and 48 h this number had increased further to 14 and 13 out of 19 patients and 13 and 12 out of 21 patients. Calculated fluid balance was positive (4000 ml the day 1 and 2500 ml day 2). There was no difference in ejection fraction between the recording time points. Serum lactate and ScvO2 were in the normal range when echocardiography exams were performed. CVP did not alter over time. Conclusions: Our results support the hypothesis that inducing hypothermia following cardiac arrest, using cold intravenous fluid infusion does not cause serious haemodynamic side effects. Serial transthoracic echocardiographic estimation of intravascular volume suggests that many patients are hypovolaemic during therapeutic hypothermia and rewarming in spite of a positive fluid balance.

**Level IV case series**

30/


The optimal intravenous catheterisation site for emergencies is unknown. The external jugular vein might be preferable route compared to cubital veins in emergencies due to more rapid circulation time to heart and faster cardiac responses. However, the feasibility of the different venous catheterisation sites has not been compared in relation to catheterisation time and success rate. We examined the time differences and success rates of external jugular compared to antecubital vein catheterisations. 32 paramedics and 28 emergency department residents performed external jugular and antecubital venous catheterisations on anesthetized patients scheduled for elective cardiac surgery. The primary outcome was catheterisation time and the secondary outcomes the failure rate and catheterisation times needed to succeed. Antecubital venous catheterisation was faster (113±89s) compared to external jugular vein catheterisation (156±112s), p=0.008 and the success rate was higher (93% compared to 68%, respectively, p=0.001). Less attempts were needed for antecubital vein catheterisations compared to external jugular vein catheterisations (p=0.002). For the antecubital vein, subjects needed two attempts in 6 patients and three attempts in 6 patients. For the external jugular vein, subjects needed two attempts in 13 patients and three attempts in 20 patients. Two (6%) paramedics and two (7%) residents failed to catheterise the antecubital vein. Nine (28%) paramedics and 10 (36%) residents failed to catheterise the external jugular vein. Antecubital vein catheterisation was faster and had a superior success rate compared to external jugular vein catheterisation.

**Level IV case series**

BACKGROUND: Rescuer fatigue during cardiopulmonary resuscitation (CPR) is a likely contributor to variable CPR quality during clinical resuscitation efforts, yet investigations into fatigue and CPR quality degradation have only been performed in simulated environments, with widely conflicting results. OBJECTIVE: We sought to characterize CPR quality decay during actual in-hospital cardiac arrest, with regard to both chest compression (CC) rate and depth during the delivery of CCs by individual rescuers over time. METHODS: Using CPR recording technology to objectively quantify CCs and provide audiovisual feedback, we prospectively collected CPR performance data from arrest events in two hospitals. We identified continuous CPR "blocks" from individual rescuers, assessing CC rate and depth over time. RESULTS: 135 blocks of continuous CPR were identified from 42 cardiac arrests at the two institutions. Median duration of continuous CPR blocks was 112s (IQR 101-122). CC rate did not change significantly over single rescuer performance, with an initial mean rate of 105+/-11/min, and a mean rate after 3 min of 106+/-9/min (p=NS). However, CC depth decayed significantly between 90s and 2 min, falling from a mean of 48.3+/-9.6mm to 46.0+/-9.0mm (p=0.0006) and to 43.7+/-7.4mm by 3 min (p=0.002). CONCLUSIONS: During actual in-hospital CPR with audiovisual feedback, CC depth decay became evident after 90s of CPR, but CC rate did not change. These data provide clinical evidence for rescuer fatigue during actual resuscitations and support current guideline recommendations to rotate rescuers during CC delivery.


Aim: To quantitatively describe pauses in chest compression (CC) delivery during resuscitation from in-hospital pediatric and adolescent cardiac arrest. We hypothesized that CPR error will be more likely after a chest compression provider change compared to other causes for pauses. Methods: CPR recording/feedback defibrillators were used to evaluate CPR quality for victims >8 years who received CPR in the PICU/ED. Audiovisual feedback was supplied in accordance with AHA targets. Etiology of CC pauses identified by post-event debriefing/reviews of stored CPR quality data. Results: Analysis yielded 205 pauses during 304.8 min of CPR from 20 consecutive cardiac arrests. Etiologies were: 57.1% for provider switch; 23.9% for pulse/rhythm analysis; 4.4% for defibrillation; and 14.6% "other." Provider switch accounted for 41.2% of no-flow duration. Compared to other causes, CPR epochs following pauses due to provider switch were more likely to have measurable...
residual leaning (OR: 5.52; CI95: 2.94, 10.32; p < 0.001) and were shallower (43 ± 8 vs. 46 ± 7 mm; mean difference: -2.42 mm; CI 95: -4.71, -0.13; p = 0.04). Individuals performing continuous CPR >120 s as compared to those switching earlier performed deeper chest compressions (42 ± 6 vs. 38 ± 7 mm; mean difference: 4.44 mm; CI95: 2.39, 6.49; p < 0.001) and were more compliant with guideline depth recommendations (OR: 5.11; CI95: 1.67, 15.66; p = 0.004). Conclusions: Provider switches account for a significant portion of no-flow time. Measurable residual leaning is more likely after provider switch. Feedback systems may allow some providers to continue high quality CPR past the recommended switch time of 2 min during in-hospital resuscitation attempts.

33/
Aim: Cardiopulmonary resuscitation (CPR) artefact removal methods provide satisfactory results when the rhythm is shockable but fail on non-shockable rhythms. We investigated the influence of the corruption level on the performance of four different two-channel methods for CPR artefact removal. Materials and methods: 395 artefact-free ECGs and 13 pure CPR artefacts with corresponding blood pressure readings as a reference channel were selected. Using a simplified additive data model we generated CPR-corrupted signals at different signal-to-noise ratio (SNR) levels from -10 to +10 dB. The algorithms were optimized on learning data with respect to SNR improvement and then applied to testing data. Sensitivity and specificity were derived from the shock/no-shock advice of an automated external defibrillator before CPR corruption and after artefact removal. Results: Sensitivity for the filtered data (>95%) was significantly superior to that for the unfiltered data (76%), p < 0.001. However, specificity was similar for the filtered and unfiltered data (<90% vs 89.3%). For large artefacts (-10 dB) specificity decreased below 70%. No important difference in the performance of the four algorithms was found. Conclusion: Using a simplified data model we showed that, when the ECG rhythm is non-shockable, two-channel methods could not reduce CPR artefacts without affecting the rhythm analysis for shock recommendation. The reason could be poor reconstruction when the artefacts are large. However, poor reconstruction was not a hindrance to re-identifying shockable rhythms. Future investigations should both include the refinement of filter methods and also focus on reducing motion artefacts already at the recording stage.

34/
Clinical emergency response systems such as medical emergency teams (MET) have been implemented in many hospitals worldwide, but the effect that these systems have on injuries to hospital staff is unknown. The objective of this study was to determine the rate and nature of injuries occurring in hospital staff attending MET calls. This study was a prospective, observational study, using a structured interview, of 1265 MET call participants, in a 650 bed urban, teaching hospital. Data was collected on the number and the nature of injuries occurring in hospital staff attending MET calls. Over 131 days, 248 MET calls were made. An average of 8.1 staff participated in each MET call. The overall injury rate was 13 (95% confidence interval (CI) 7 - 20) per 1000 MET participant attendances, and 70 (95% CI 38 - 102) per 1000 MET calls. One injured participant required time off-work, an injury requiring time off-work rate of 1 (95% CI 0 - 4) per 1000 MET participant attendances, or 4 (95% CI 0 - 27) per 1000 MET calls. The relative risk of sustaining an injury if the MET participant performed chest compressions, contacted patient body fluids on clothing or protective equipment, without direct contact to skin or mucosa, or lifted the patient or a patient body part was 11.0 (95% CI 4.2 - 28.6), 8.7 (95% CI 3.4 - 22.0) and 5.5 (95% CI 2.1 - 14.2), respectively. The rate of injuries occurring to hospital staff attending MET calls is relatively low, and many injuries could be considered relatively minor. 

Level IV prospective observational study.

35/

The study aims to evaluate the optimal chest compression site in two-rescuer infant cardiopulmonary resuscitation (CPR). Charts and multidirectional computed tomography images of infants who presented to one of four hospitals from March 2004 to March 2009 were reviewed retrospectively. The length of the sternum (Stotal), the length and width (L, W) of adult thumbs after two thumbs were placed side-by-side were measured. The study included the structures located underneath the lower third of Stotal (Stotal/3), the lower half of Stotal (Stotal/2), the sternum at the inter-nipple line (Sn), the point of maximal anterior - posterior heart diameter (Sm), the lower margin of L and the lateral margin of W from Stotal/3, Stotal/2, Sn and Sm. Of the 75 infants enrolled, the ratio of the length from the xiphoid process to Sm from Stotal was 0.24 ±0.19. In the population studied, 43.1% had aortic roots in Stotal/2, 44.0% had left ventricular outflow tracts in Stotal/3, 46.7% had left ventricular outflow tracts at Sn and 100.0% had left ventricles at Sm. All the infants had livers in the lower margin of L from Sm and all of them had hearts in the left lateral margin of half of W from Sm. A total of 42.7% had lungs in the right lateral margin of half of W from Sm. The left ventricle was located in the lower quarter of the sternum, lower than Stotal/3. However, more studies are needed to validate the efficiency and safety of compressing the lower quarter of the sternum in
two-rescuer infant CPR.

*Level IV observational study*

## CASE STUDIES

### 36/

Short QT syndrome (SQTS) is a recently described genetic syndrome characterized by abnormally brisk ventricular repolarization. Similar to long QT syndrome, SQTS might result in ventricular arrhythmias, syncope, and sudden death. The clinical diagnosis of SQTS is supported by the finding of an abnormally short QT interval on the resting electrocardiogram in combination with a suggestive clinical or family history. To date, few pediatric cases have been reported and the ideal therapy is unknown. We report a teenage boy who suffered a witnessed ventricular fibrillation arrest and was subsequently diagnosed with SQTS. Additional data from nine other pediatric patients diagnosed with SQTS are presented.

### 37/
*Resuscitation* 80(9): 973-4.

## STUDY DESIGN / STATISTICS

### 38/
*Resuscitation* 80(12): 1382-1387.

To determine public attitudes towards emergency research, exception from informed consent (EFIC) and a specific proposed clinical trial using EFIC. As part of a planned community consultation activity, a survey was conducted at a popular public venue. Participants answered demographic questions and then were asked their opinions on specifically described consent circumstances in emergency research, including the proposed EFIC trial. Multiple logistic and linear regression were used to determine respondent characteristics associated with specific attitudes. 1901 surveys were completed. The majority of respondents supported emergency research (88%) and the concept of surrogate consent by a legally authorized representative (78%). The concept of EFIC was less well supported (35%) but the application of EFIC was more accepted,
especially when EFIC was applied to the respondent themselves (51%). The community believed the proposed EFIC study was acceptable (82%); a minority had concerns but most were related to patient safety and not to EFIC. Respondents with less education and lower incomes were less likely to express opinions about the consent and research concepts described. Emergency research and the proposed EFIC trial is supported in this community. The concept of EFIC is less well supported but is more acceptable when a specific trial is described or when respondents consider EFIC for themselves. Specific respondent characteristics are associated with attitudes about research; this can assist in development of meaningful community consultation activities.

39/
BACKGROUND: United States regulations allow a narrow exception from informed consent for a subset of resuscitation research. Such an exception is also allowed under the Declaration of Helsinki. In 2001, a European Union (EU) Directive was passed, which, if enforced literally, could prohibit resuscitation research. The purpose of this study is to assess the knowledge and attitudes of healthcare workers, specifically emergency physicians, with regard to the EU Directive as it applies to resuscitation research and informed consent. METHODS: A closed-response survey was distributed in six languages at the Third Mediterranean Emergency Medicine Congress in Nice, France, and to a sample of emergency physicians using a directed approach. Descriptive and bivariate statistics, with a weighting adjustment to account for a disproportionately large number of responses from one country, are reported. RESULTS: Two hundred and thirty-two surveys (111 using a weighted analysis) were returned from 26 countries. Sixty-seven percent of EU respondents and 70% of non-EU respondents stated that their country adhered to the Declaration of Helsinki, but only 44% of EU and 43% of non-EU respondents, were aware the Declaration allowed a waiver for resuscitation research. Among EU respondents, 49% were unaware of the EU Directive and another 15%, although aware of the Directive, were unaware of its implications for resuscitation research. CONCLUSION: The international regulatory status of consent in resuscitation research is in flux; yet, most emergency physicians are unaware of the potential implications of the EU Directive or the provisions in the Declaration of Helsinki allowing an exemption from informed consent for resuscitation research.
ANIMAL MODELS / SIMULATIONS / MANIKIN STUDIES

40/
Factors that affect resuscitation to a perfusing rhythm (ROSC) following ventricular fibrillation (VF) include untreated VF duration, acute myocardial infarction (AMI), and possibly factors reflected in the VF waveform. We hypothesized that resuscitation of VF to ROSC within 3min is predicted by the VF waveform, independent of untreated VF duration or presence of acute MI. AMI was induced by the occlusion of the left anterior descending coronary artery. VF was induced in normal (N=30) and AMI swine (N=30). Animals were resuscitated after untreated VF of brief (2min) or prolonged (8min) duration. VF waveform was analyzed before the first shock to compute the amplitude-spectral area (AMSA) and slope. Unadjusted predictors of ROSC within 3min included untreated VF duration (8min vs 2min; OR 0.11, 95%CI 0.02 - 0.54), AMI (AMI vs normal; OR 0.11, 95%CI 0.02 - 0.54), AMSA (highest to lowest tertile; OR 15.5, 95%CI 1.7 - 140), and slope (highest to lowest tertile; OR 12.7, 95%CI 1.4 - 114). On multivariate regression, untreated VF duration (P=0.011) and AMI (P=0.003) predicted ROSC within 3min. Among secondary outcome variables, favorable neurological status at 24h was only predicted by VF duration (OR 0.22, 95% CI 0.05 - 0.92). In this swine model of VF, untreated VF duration and AMI were independent predictors of ROSC following VF cardiac arrest. AMSA and slope predicted ROSC when VF duration or the presence of AMI were unknown. Importantly, the initial treatment of choice for short duration VF is defibrillation regardless of VF waveform.

41/
Introduction: Quality of external chest compression (ECC) is a key component of Basic Life Support. Different approaches to improve rescuers' performance have been evaluated, but few attempts have been made to invent simple devices to improve performance. This study evaluates a new visual feedback system for ECC for healthcare professionals. Methods: Ninety-three healthcare professionals volunteered (14 emergency medical technicians, 45 paramedics, 34 physicians; age 32 ± 7.2 (range 21-61); 72% male) in this randomized cross-over study. All subjects were tested on a manikin (Skillreporter ResusciAnne®, Laerdal, Stavanger, Norway) in identical mock cardiac arrest scenario and asked to perform 2 min of continuous ECC (secured airway): Group A (n = 46): ECC with device first, followed by ECC without device a minimum of 45 min later; group B (n = 47): vice versa. Primary endpoints: mean compression rate 90-120 min-1; mean compression depth 38-51 mm. Data were
analyzed using repeated measure logistic regression model for binary categorized endpoints and repeated measure ANOVA test for continuous endpoints. Results: Correct compression depth was achieved by 45.2% of subjects (95%-CI: 30.5-64.9 mm) without vs. 73.1% (95%-CI: 40.3-57.4 mm) with device (p < 0.001); correct compression rate was achieved by 62.4% (95%-CI: 78-147.8 min-1) without vs. 94.6% (95%-CI: 87.3-126.6 min-1) with device (p < 0.001). Overall, 85% of the subjects thought the feedback system was helpful and 80.6% would use it if available. Conclusions: The new visual feedback device significantly improved ECC performance (compression rate and depth) by healthcare professionals in simulated cardiac arrest. Most participants found the device easy to use.

42/

Direct laryngoscopy using the Macintosh laryngoscope is a difficult skill to acquire. Videolaryngoscopy is a widely accepted airway management technique that may be easier for novices to learn. We compared the McGrath videolaryngoscope and Macintosh laryngoscope by studying the performance of 25 medical students with no previous experience of performing tracheal intubation using an easy intubation scenario in a manikin. The order of device use was randomised for each student. After brief instruction each participant performed eight tracheal intubations with one device and then eight tracheal intubations with the other laryngoscope. Novices achieved a higher overall rate of successful tracheal intubation, avoided oesophageal intubation and produced less dental trauma when using the McGrath. The view at laryngoscopy was significantly better with the McGrath. Intubation times were similar for both laryngoscopes and became shorter with practice. There was no difference in participants' rating of overall ease of use for each laryngoscope.

43/

INTRODUCTION: Administration of medications via the intraosseous (IO) route has proven to be a lifesaving procedure in critically ill or injured children. Two mechanical IO infusion devices have been approved for use in children, the spring-loaded IO infusion device (Bone Injection Gun, BIG) and the battery-powered IO infusion drill (EZ-IO). The objective of this pilot study was to compare the success rates for insertion and the ease-of-use of the two devices. PATIENTS AND METHODS: A randomized crossover study was conducted in a local paramedic training course with 29 paramedic students participating. Participants watched two videos describing the use of the two devices, followed by a demonstration on how to use each
device on a turkey bone model. Then subjects were divided into two study groups: BIG-first or EZ-IO-first. Each participant performed one insertion attempt with each device independently. All attempts were filmed by a video camera. Successful placement was defined as the visualization of fluid flow from the marrow cavity. Following the study procedure, participants completed a two-item questionnaire recording their ranking of the ease-of-use of each device and their "first choice device".

RESULTS: Participants had a significantly higher one-attempt success rate with the EZ-IO than with the BIG (28/29 vs 19/29, $p=0.016$), and selected the EZ-IO as their first choice (20/29). Participants of the EZ-IO-first group assessed the EZ-IO as easier to use than the BIG ($p=0.0039$). The subjects of the BIG-first group found no difference in the ease-of-use between the two devices ($p=0.32$). CONCLUSIONS: As tested by paramedic students on a turkey bone model, the EZ-IO demonstrated higher success rates than the BIG and was the preferred device. Future studies are planned to determine which of the two devices is more appropriate for obtaining IO access in the setting of paediatric emergencies.


BACKGROUND: During cardiac arrest the paramount goal of basic life support (BLS) is the oxygenation of vital organs. Current recommendations are to combine chest compressions with ventilation in a fixed ratio of 30:2; however the optimum compression/ventilation ratio is still debatable. In our study we compared four different compression/ventilation ratios and documented their effects on the return of spontaneous circulation (ROSC), gas exchange, cerebral tissue oxygenation and haemodynamics in a pig model. METHODS: Study was performed on 32 pigs under general anaesthesia with endotracheal intubation. Arterial and central venous lines were inserted. For continuous cerebral tissue oxygenation a Licox PtiO(2) probe was implanted. After 3 min of cardiac arrest (ventricular fibrillation) animals were randomized to a compression/ventilation-ratio 30:2, 100:5, 100:2 or compressions-only. Subsequently 10 min BLS, Advanced Life Support (ALS) was performed (100%O(2), 3 defibrillations, 1mg adrenaline i.v.). Data were analyzed with 2-factorial ANOVA. RESULTS: ROSC was achieved in 4/8 (30:2), 5/8 (100:5), 2/8 (100:2) and 0/8 (compr-only) pigs. During BLS, PaCO(2) increased to 55 mm Hg (30:2), 68 mm Hg (100:5; p=0.0001), 66 mm Hg (100:2; p=0.002) and 72 mm Hg (compr-only; p<0.0001). PaO(2) decreased to 58 mmg (30:2), 40 mm Hg (100:5; p=0.15), 43 mm Hg (100:2; p=0.04) and 26 mm Hg (compr-only; p<0.0001). PtiO(2) baseline values were 12.7, 12.0, 11.1 and 10.0 mm Hg and decreased to 8.1 mm Hg (30:2), 4.1 mm Hg (100:5; p=0.08), 4.3 mm Hg (100:2; p=0.04), and 4.5 mm Hg (compr-only; p=0.69). CONCLUSIONS: During BLS, a compression/ventilation-ratio of 100:5 seems to be equivalent to 30:2, while ratios of 100:2 or compressions-only detoriate peripheral arterial oxygenation and reduce the chance for ROSC.

Aim of study: Impedance compensation methods differ markedly among manufacturers and can play an important role in defibrillation success. In this study we compared the efficacy of two different commercial defibrillators based on defibrillation success in a high impedance porcine model of cardiac arrest. The first defibrillator (A) compensates high impedance by controlling current with fixed shock duration, while the second defibrillator (B) by prolonging the shock duration. Methods: In 10 domestic male pigs weighing between 17 and 28 kg, ventricular fibrillation was electrically induced and untreated for 15 s. Animals were randomized to receive defibrillations with either defibrillator A or defibrillator B, at maximum energy settings of which were 200 J for the defibrillator A and 360 J for the defibrillator B. A grouped up-down defibrillation threshold testing protocol was used to compare the success rate between the two defibrillators. A variable resistance, ranging from 80 to 200 ohm was placed in series with the defibrillation pads. After a recovery interval of 5 min, the sequence was repeated for a total of 60 test shocks for each animal. Results: The measured total pathway impedance was in a range of 108-278 ohm. The combined success rate was 49.5% for the two defibrillators in a total of 600 testing shocks. The success rate was significantly higher when the defibrillator A was employed in comparison with defibrillator B (63% vs. 36%, p = 0.0001). Conclusion: For transthoracic impedances greater than average, the current-based compensation technique was more effective than the duration-based compensation technique.


OBJECTIVES: The aim of the study was to investigate the effect on calcium cycling protein and electrical restitution of beta(1)-adrenergic receptor antagonist esmolol administered during cardiopulmonary resuscitation in the porcine ventricular fibrillation model. METHODS: Ventricular fibrillation untreated for four minutes was induced by dynamic steady state pacing protocol in 40 healthy male pigs, in which local unipolar electrograms were recorded using one 10-electrode catheter that was sutured to the left ventricular epicardium. During CPR, animals were randomized into two groups to receive saline as placebo or esmolol after two standard doses of epinephrine. At post-resuscitation 2-h, six pigs were randomly selected from each group and the second VF induction was performed. Local activation-recovery intervals (ARI) restitutions and the VF inducibility between control group and esmolol group were compared. Western blotting was performed to determine expression of Ca(2+)/calmodulin-dependent protein kinase IIdelta(CaMKIIdelta) and cardiac ryanodine receptor (RyR2)
protein, and their phosphorylation status. RESULTS: Injection of esmolol combined with epinephrine during CPR significantly decreased recurrent rate of ventricular fibrillation during 2-h post-resuscitation, meanwhile it has no adverse affect on the restore of spontaneous circulation. Esmolol significantly flattened ARI restitution slope, lessened regional difference of ARI restitution, decreased the VF inducibility, and alleviated CaMKII delta hyper-activation and RyR2 hyper-phosphorylation. CONCLUSIONS: Esmolol given during CPR has significant effects on modulating electrical restitution property and intracellular calcium handling, which contributes the most important reasons why beta(1)-blockade significantly reduced the onset and maintenance of VF.

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As the duration of untreated cardiac arrest increases, the effectiveness of standard therapies declines, and may be more harmful than helpful. We investigated the hemodynamic, metabolic and anti-inflammatory effects of Ringer's ethyl pyruvate solution (REPS) versus Ringer's solution (RS) in the acute model of prolonged porcine arrest. Seventeen mixed-breed swine were induced into ventricular fibrillation (VF) and left untreated for 8min. CPR was begun using a mechanical chest compression device at a rate of 100 per minute. At the onset of CPR, animals were randomly assigned to treatment with either 25mL/kg of RS or 25mL/kg of REPS containing 40mg/kg of ethyl pyruvate, infused over 5min in blinded fashion. CPR continued with administration of a drug cocktail at 2min and the first rescue shock was delivered at minute 13 of VF. Animals having ROSC were supported with standardized care for 2h. Both groups had 100% ROSC and 100% 2-h survival. The REPS group exhibited higher median CPP (27.3mmHg) than the control group (16.5mmHg) by 3min of CPR, which continued throughout the duration of CPR (p=0.02). The median time to hypotension following ROSC was 9.64min in the REPS group and 7.25min in controls (p=0.04) and there was a non-significant trend of decreased use of vasopressors for the duration of resuscitation. There was no difference in systemic or cerebral metabolism between groups. There were no significant trends of decreased IL-6, increased IL-10 and decreased mesenteric bacterial colony growth in those treated with REPS when compared to RS. The administration of REPS with CPR significantly improved intra- and post-resuscitation hemodynamics in this swine model of prolonged cardiac arrest, but did not definitely change the metabolic or inflammatory profile during the acute resuscitation period.

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This study determines the systemic and microvascular hemodynamic consequences of administering a low dose sodium nitrite after fluid resuscitation from hemorrhagic shock. Hemodynamic responses to hemorrhagic shock and resuscitation were studied in the hamster window chamber model. Moderated hemorrhage was induced by arterial controlled bleeding of 50% of the blood volume (BV) and the hypovolemic state was maintained for 1h. Volume restitution was performed by infusion of 25% of BV using Hextend® (6% Hetastarch 670kDa in lactated electrolyte solution) 10min after fluid resuscitation. 100μl of specific concentrations of sodium nitrite were infused. The experimental groups were named based on the nitrite concentration used, namely: 0μM, 10μM and 50μM. Systemic parameters, microvascular hemodynamics and capillary perfusion (functional capillary density, FCD) were followed during entire protocol. Exogenous 10μM nitrite maintained systemic and microhemodynamic conditions post fluid resuscitation from hemorrhagic shock, compared to 50μM or no nitrite. A moderated increase in plasma nitrite during the early phase of resuscitation reversed arteriolar vasoconstriction and increased capillary perfusion and venous return, improving central cardiac function. Nitrite effects on resistance vessels, directly influenced intravascular pressure redistribution, sustained blood flow, and prevented tissue ischemia. In conclusion, increasing nitrite plasma bioavailability after fluid resuscitation from hemorrhagic shock can be a potential therapy to enhance microvascular perfusion and to improve overall outcome.


We sought to compare the effects of conservative hypotensive and aggressive normotensive resuscitation strategies on blood loss, fluid requirements, blood lactate and survival rate in a clinically relevant model of uncontrolled hemorrhagic shock in pregnancy. 60 anesthetized New Zealand white rabbits at late gestation underwent uncontrolled hemorrhagic shock by transecting a small artery in the mesometrium, followed by blood withdrawal via the carotid artery, to a mean arterial pressure (MAP) of 40 - 45mmHg. They were randomly divided into six groups (n=10 per group): sham shock (group SS); shock without resuscitation (group SH); hypotensive resuscitation in the simulated prehospital phase with Ringer's solution to MAP of 50, 60, or 70mmHg, respectively (groups RE50, RE60, RE70); and aggressive resuscitation in the prehospital phase with Ringer's solution to MAP of 80mmHg (group RE80). Finally, in the simulated hospital phase, animals in the resuscitated groups underwent surgical control of bleeding and were fully resuscitated with half of the heparinized shed blood and Ringer's solution to MAP of 80mmHg. Hypotensive resuscitation significantly decreased blood loss and subsequent volume infusion, leading to higher haematocrit, lower lactate concentration, and shorter prothrombin time and activated partial
thromboplastin time. Median survival time in group RE60 (4.3 ±0.6 days) was significantly longer than that in groups RE50 (2.7 ±0.4 days), RE70 (2.3 ±0.3 days), and RE80 (1.7 ±0.3 days) (P<0.05). We conclude that in this rabbit model of uncontrolled hemorrhage in pregnancy, hypotensive resuscitation to MAP of 60mmHg may be an optimal target MAP before hemorrhage can be controlled by surgical intervention.

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Computational models of integrative physiology may serve as a framework for understanding the complex adaptive responses essential for homeostasis in critical illness and resuscitation and may provide insights for design of diagnostics and therapeutics. In this study a computer model of human physiology was compared to results obtained from experiments using Lower Body Negative Pressure (LBNP) analog model of human hemorrhage. LBNP has been demonstrated to produce physiologic changes in humans consistent with hemorrhage. The computer model contains over 4000 parameters that describe the detailed integration of physiology based upon basic physical principles and established biologic interactions. The LBNP protocol consisted of a 5min rest period (0mmHg) followed by 5min of chamber decompression of the lower body to −15, −30, −45, and −60mmHg and additional increments of 10mmHg every 5min until the onset of hemodynamic decompensation (n=20). Physiologic parameters recorded include mean arterial pressure (MAP), cardiac output (CO), and venous oxygen saturation (SVO2; from peripheral venous blood), during the last 30s at each LBNP level. The computer model analytic procedure recreates the investigational protocol for a virtual individual in an In Silico environment. After baseline normalization, the model predicted measurements for MAP, CO, and SVO2 were compared to those observed through the entire range of LBNP. Differences were evaluated using standard statistical performance error measurements (median performance error (PE) <5%). The simulation results closely tracked the average changes observed during LBNP. The predicted MAP fell outside the standard error measurement for the experimental data at only LBNP −30mmHg while CO was more variable. The predicted SVO2 fell outside the standard error measurement for the experimental data only during the post-LBNP recovery point. However, the statistical median PE measurement was found to be within the 5% objective error measure (1.3% for MAP, 3.5% for CO, and 3.95% for SVO2). The computer model was found to accurately predict the experimental results observed using LBNP. The model should be explored as a platform for studying concepts and physiologic mechanisms of hemorrhage including its diagnosis and treatment.

AIMS: Basic Life Support Guidelines 2005 emphasise the importance of reducing interruptions in chest compressions (no-flow duration) yet at the same time stopped recommending Dual Operator CPR. Dual Operator CPR (where one rescuer does ventilations and one chest compressions) could potentially minimize no-flow duration compared to Single Operator CPR. This study aims to determine if Dual Operator CPR reduces no-flow duration compared to Single Operator CPR. METHODOLOGY: This was a prospective randomised controlled crossover trial. Medical students were randomised into 'Dual Operator' or 'Single Operator' CPR groups. Both groups performed 4 min of CPR according to their group allocation on a resuscitation manikin before crossing over to perform the other technique one week later. RESULTS: Fifty participants were recruited. Dual Operator CPR achieved slightly lower no-flow durations than the Single Operator CPR (28.5% (S.D.=3.7) versus 31.6% (S.D.=3.6), P<or=0.001). Dual Operator CPR was associated with slightly more rescue breaths per minute (4.9 (S.D.=0.5) versus 4.5 (S.D.=0.5), P=0.009. There was no difference in compression depth, compression rate, duty cycle, rescue breath flow rate or rescue breath volume. CONCLUSIONS: Dual Operator CPR with a compression to ventilation rate of 30:2 provides marginal improvement in no-flow duration but CPR quality is otherwise equivalent to Single Operator CPR. There seems little advantage to adding teaching on Dual Operator CPR to lay/trained first responder CPR programs.


Studies have shown that the quality of chest compressions for cardiac arrest decreases markedly after only a brief time. This is thought to be an important contributor to an adverse outcome of resuscitation, which has led to recommendations to alternate chest compression providers. This study compared alternating rescuers every 1 min versus every 2 min in a manikin simulation. Forty pairs of rescuers were randomly assigned to either scenario. The main outcome measure was the number of effective compressions. The results were analysed using one-way analysis of variance. Over the full 8 min, no significant difference was found in the number of effective chest compressions (p=0.707). Furthermore, no significant difference was found when comparing each 2 min block. An explanation for this may be that the compressions lost due to fatigue in the 2 min scenario are approximately offset by compressions lost due to the practicalities of changing over. Power calculations with these results show that an unfeasibly large number of scenarios would be needed to definitively demonstrate the superiority of one of the scenarios. It seems reasonable to alternate chest compression providers every 2 min, to prevent the...
loss of effective compressions due to fatigue and to minimise interruptions of chest compressions. The ideal time to do this would be during the rhythm and pulse check as dictated by current guidelines.

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BACKGROUND: In general, in-hospital resuscitation is performed in a bed and out-of-hospital resuscitation on the floor. The surface under the patient may affect the cardiopulmonary resuscitation (CPR) quality; therefore, we evaluated CPR quality (the percentage of chest compressions of correct depth) and rescuer's fatigue (the mean compression depth minute by minute) when CPR is performed on a manikin on the floor or in the bed. METHODS: Forty-four simulated cardiac arrest scenarios of 10 min were treated by intensive care unit (ICU) nurses in pairs using a 30 : 2 chest compression-to-ventilation ratio. The rescuer who performed the compressions was changed every 2 min. CPR was randomly performed either on the floor or in the bed without a backboard; in both settings, participants kneeled beside the manikin. RESULTS: A total number of 1060 chest compressions, 44% with correct depth, were performed on the floor; 1068 chest compressions were performed in the bed, and 58% of these were the correct depth. These differences were not significant between groups. The mean compression depth during the scenario was 44.9+/-6.2 mm (mean+/-SD) on the floor and 43.0+/-5.9 mm in the bed (P=0.3). The mean chest compression depth decreased over time on both surfaces (P<0.001), indicating rescuer fatigue, but this change was not different between the groups (P=0.305). CONCLUSIONS: ICU nurses perform chest compression as effectively on the floor as in the bed. The mean chest compression depth decreases over time, but the surface had no significant effect.

REVIEWS

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Head injury outcome is influenced by the initial insult and the various pathophysiological changes that take place in the posttraumatic phase, some of which may be amenable to intervention. Appropriate measures taken during initial emergency department management and subsequently in the intensive therapy unit can significantly improve outcome. The primary
goal is to limit secondary brain injury. Early imaging, rather than admission and observation for neurological deterioration, reduces the time to the detection of life-threatening complications. This paper discusses the current management of severe head injury, some prognostic indicators and methods used to rule out an associated spinal injury.

55/
Recent reports consistently point to a substantial decline in the incidence of ventricular fibrillation (VF) as the initial rhythm observed by Emergency Medical Service (EMS) responders and a complementary increase in pulseless electrical activity (PEA) and asystole. Historically, efforts at improving survival have focused primarily on patients found in VF. Consequently, the approach for other patients has included frequent pauses in cardiopulmonary resuscitation (CPR) to check for VF followed by shock when VF is observed. However, the "yield" of survivors comes largely from the non-shocked patients. Therefore, it is critical that we start evaluating treatments specifically for the PEA and asystole groups. [References: 7]

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OBJECTIVE: The goal of this concise review is to provide an overview of some of the most important resuscitation and monitoring issues and approaches that are unique to burn patients compared with the general intensive care unit population. STUDY SELECTION: Consensus conference findings, clinical trials, and expert medical opinion regarding care of the critically burned patient were gathered and reviewed. Studies focusing on burn shock, resuscitation goals, monitoring tools, and current recommendations for initial burn care were examined. CONCLUSIONS: The critically burned patient differs from other critically ill patients in many ways, the most important being the necessity of a team approach to patient care. The burn patient is best cared for in a dedicated burn center where resuscitation and monitoring concentrate on the pathophysiology of burns, inhalation injury, and edema formation. Early operative intervention and wound closure, metabolic interventions, early enteral nutrition, and intensive glucose control have led to continued improvements in outcome. Prevention of complications such as hypothermia and compartment syndromes is part of burn critical care. The myriad areas where standards and guidelines are currently determined only by expert opinion will become driven by level 1 data only by continued research into the critical care of the burn patient. [References: 91]
The use of oxygen in the treatment of neonates with respiratory distress has been reported for more than a century. Oxygen therapy is generally titrated to one or more measures of blood oxygenation and administered to reverse or prevent hypoxia. Individual responses to oxygen therapy vary greatly, depending on the particular cause of hypoxia and the degree of impairment. Despite this focused purpose, oxygen administration in this patient population has become complex. The longer we deliver this drug, the more we discover its beneficial and detrimental effects. New and innovative ways to deliver and monitor this therapy have improved outcomes. Despite this vast experience there still remain some unanswered questions regarding the use of oxygen in the neonatal environment. Nonetheless, oxygen is a major staple in our treatment arsenal for neonates.

BACKGROUND: At present, terlipressin is predominantly used for the management of bleeding gastric and esophageal varices, as well as hepato-renal syndrome secondary to liver cirrhosis. Owing to its high and relatively selective affinity to vascular V1 receptors, terlipressin is also increasingly used as an adjunct vasopressor agent in the management of vasodilatory hyperdynamic septic shock. OBJECTIVE: This review article aims to summarize the available knowledge related to hemodynamic support with terlipressin in septic shock. METHODS: For literature search, PubMed and specific keywords from the MeSH Database were used. RESULTS/CONCLUSIONS: Terlipressin represents an effective pressor agent in patients with catecholamine-unresponsive septic shock. However, caution should be exercised, as terlipressin may contribute dose-dependently to vasoconstriction and a reflexatory decrease in cardiac output. Additional studies are needed to clarify: i) the optimal time of therapy institution; ii) the efficacy and the dosages of continuous infusion versus bolus administration; and iii) the safety and efficacy of this compound in comparison with other nonspecific vasopressinergic drugs, such as arginine vasopressin. Whether or not terlipressin may improve the outcome of septic shock patients compared with standard therapy with catecholamines remains to be determined. [References: 54]
59/
Iserbyt, P., J. Elen, et al. "Peer evaluation in reciprocal learning with task cards for acquiring Basic Life Support (BLS)."

Resuscitation.

Background: Research emphasises the need for instructional methods and tools which can improve Basic Life Support (BLS) performance or reduce instructional time. Aim: To investigate the effect of peer evaluation to improve reciprocal learning with task cards as instructional tools for acquiring BLS. Methods: A total of 78 kinesiology students from a Belgian university were paired and randomised across two groups to learn BLS in 20 min with task cards. In the control group, students worked together in a defined doer-helper relationship and switched roles every 5 min. In the peer evaluation group, students followed the same co-operation procedure as in the control group. In addition, 1 min before every switching of roles, the helper evaluated the doer's performance. All BLS skills were individually assessed on a Laerdal AED Resusci Anne mannequin (Laerdal Medical, Vilvoorde, Belgium) using the Laerdal PC-Skill reporting system. A total BLS score was calculated and performance was measured before training (baseline), immediately after training (intervention) and 2 weeks later (retention). Results: Significantly more students from the evaluation group remembered and consequently performed all BLS skills at intervention (P = 0.03). No significant differences were found between groups for main cardiopulmonary resuscitation (CPR) variables and total BLS scores at baseline, intervention and retention. Both groups achieved more than 70% of the maximum BLS score at intervention and retention. Conclusions: This study demonstrated that 20 min reciprocal-learning setting with task cards is an effective method to learn BLS. The implementation of peer evaluation in this setting has an immediate, however small, positive impact on BLS skill learning.

60/
Napier, F., R. P. Davies, et al. (2009). "Validation for a scoring system of the ALS cardiac arrest simulation test (CASTest)."

Resuscitation 80(9): 1034-8.

AIM: The cardiac arrest simulation test (CASTest) assesses resuscitation knowledge and skills during a simulated cardiac arrest. The aim of this study is to validate an alternative scoring system for measuring individual candidate performance during research involving the CASTest. METHODS: The performance of 537 participants was measured using the new scoring system. Evidence of internal structure was sought by comparing the score with global rating of performance and pass/fail decision; identification of participants with instructor potential, skill tests and MCQ scores. Relationships between CASTest score, profession and seniority were also examined. RESULTS: Global assessment of performance identified 413 passes
CASTest score was significantly higher in those that passed than in those that failed (median 77 vs 62.5, P<0.0001). There were no differences between professions. Senior staff performed slightly better than junior staff (median 74 and 72 respectively, P=0.01). Excellent participants (identified as having instructor potential) scored significantly higher than the other participants (median 94 and 72 respectively, P<0.0001). A strong correlation was demonstrated between domains in the CASTest (rho 0.72-0.82, P<0.01). Other assessment outcomes for the ALS course correlated poorly with CASTest scores (rho 0.27-0.37, P<0.01). CONCLUSION: This new simple scoring system can be used to better characterise performance on the ALS course CASTest than the current binary pass-fail outcome.


Introduction: Patients' preferences for cardiopulmonary resuscitation (CPR) relate to their perception about the likelihood of success of the procedure. There is evidence that the lay public largely base their perceptions about CPR on their experience of the portrayal of CPR in the media. The medical profession has generally been critical of the portrayal of CPR on medical drama programmes although there is no recent evidence to support such views. Objective: To compare the patient characteristics, cause and success rates of cardiopulmonary resuscitation (CPR) on medical television drama with published resuscitation statistics. Design: Observational study. Method: 88 episodes of television medical drama were reviewed (26 episodes of Casualty, Casualty, 25 episodes of Holby City, 23 episodes of Grey's Anatomy and 14 episodes of ER) screened between July 2008 and April 2009. The patient's age and sex, medical history, presumed cause of arrest, use of CPR and immediate and long term survival rate were recorded. Main outcome measures: Immediate survival and survival to discharge following CPR. Results: There were a total of 76 cardio-respiratory arrests and 70 resuscitation attempts in the episodes reviewed. The immediate success rate (46%) did not differ significantly from published real life figures (p = 0.48). The resuscitation process appeared to follow current guidelines. Survival (or not) to discharge was rarely shown. The average age of patients was 36 years and contrary to reality there was not an age related difference in likely success of CPR in patients less than 65 compared with those 65 and over (p = 0.72). The most common cause of cardiac arrest was trauma with only a minor proportion of arrests due to cardio-respiratory causes such as myocardial infarction. Conclusions: Whilst the immediate success rate of CPR in medical television drama does not significantly differ from reality the lack of depiction of poorer medium to long term outcomes may give a falsely high expectation to the lay public. Equally the lay public may perceive that the incidence and likely success of CPR is equal across all age groups.

The aim of this study was to evaluate the effect of multi-professional full-scale simulation-based education of staff on the mortality and staff awareness of patients at risk on general wards. A prospective before-and-after study conducted on four general wards at Herlev Hospital, Denmark. In the pre-intervention period (June - July 2006) and post-intervention period (November - December 2007), all patients on the wards had vital signs measured in the evening by study personnel, who also asked nursing staff questions about patients with abnormal vital signs. The mortality of patients with abnormal vital signs was registered from the hospital database. Simplified medical emergency team calling criteria were used to define abnormal vital signs. In the intervention period (February - June 2007), 50% of medical and 70% of nursing staff on the wards (app. 220 members of staff) were trained in a 1-day multi-professional full-scale simulation-based course. In the pre- and post-intervention periods, 690 and 873 patients were included and of these 129 and 155, respectively, had abnormal vital signs. No significant differences were observed between the pre- and post-intervention periods concerning the incidence of patients with abnormal vital signs (p=0.64), staff awareness of patients at risk (p=0.80), 30-day mortality (p=1.00), 180-day mortality (p=1.00) or length of hospital stay (p=0.11) among patients at risk. This multi-professional education of staff did not affect the rate of mortality or staff awareness of patients at risk on the wards.


AIM: The aim of this survey was to establish prevalence of cardiopulmonary resuscitation (CPR) training within the last 5 years and reasons preventing training and initiation of CPR in Ireland as well as awareness of the emergency numbers. METHODS: An in-home omnibus survey was undertaken in 2008 with quota sampling reflecting the age, gender, social class and geography of Ireland. RESULTS: Of the 974 respondents, 23.5% had undergone CPR training in the previous 5 years with lower social class and age 65 years and older significantly less likely to be trained. The workplace was both a major source of awareness as well as training for those trained. In the untrained group lack of awareness of the need for CPR training was the most significant reason for non-training. Cost was not cited as a barrier. 88.9% of people gave a correct emergency number with geographical variation. Notably, the European emergency number 112 was not well known. CONCLUSION: Previous Irish and American population targets for CPR training have been surpassed in Ireland in 2008. New internationally agreed targets are now required. Meanwhile older people and those in lower socio-economic groups should be targeted for training.
Awareness of at least one emergency number is very high in Ireland. Some geographical variation was found and this should be studied further.

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Pediatric advanced life support (PALS) teaches skills unique to pediatric resuscitation. The purpose of this study was to assess the effect of PALS training among emergency medical service (EMS) providers in out-of-hospital trauma and medical resuscitations. A physician panel evaluated all EMS run sheets of pediatric traumas and medical resuscitations brought to a tertiary children's hospital/regional trauma center over a 3-year period. In 183 responses, EMS personnel were the sole providers of medical stabilization. Evaluation included the ability to secure an airway, establish vascular access, shock recognition, and appropriate cardiac rhythm assessment and resuscitation. The panel was blinded to the PALS training status of the responding EMS squad until completion of the review. Pediatric advanced life support-trained EMS personnel responded to 36% of the resuscitations reviewed. A significant difference in successful intubations was noted in PALS-trained squads compared with squads with no PALS training (85% vs 48%; P < 0.001). A significant difference was also noted in the ability to obtain vascular access in shock/arrest cases (100% vs 70%; P < 0.001). Similarly, PALS-trained squads were more successful in intraosseous line placement than non-PALS-trained squads (100% vs 55%; P < 0.01). However, despite better procedural skills, there was no difference in mortality rates between the groups (37% PALS vs 32% non-PALS). We conclude that PALS training improves procedural skills among EMS personnel and should be strongly considered as part of EMS training.

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OBJECTIVES: Bystanders cardiopulmonary resuscitation (CPR) increases survival in out-of-hospital cardiac arrest (OHCA). Emergency medical dispatchers (EMDs) can provide even totally inexperienced bystanders with instructions by telephone on how to resuscitate victims (T-CPR) until the emergency medical services (EMS) arrive. Agonal respiration makes it difficult for EMDs to identify cardiac arrests (CAs) which will prevent or delay initiation of T-CPR. The aim of this investigation was to study if tuition of EMDs can improve their ability to identify agonal respiration in OHCA to allow for more frequent offers of T-CPR. METHODS: An observational study was made in 2004 and subsequently, a repeat study was made in 2006. All OHCA
n=315 in 2004, n=255 in 2006) in the Stockholm region reported to the Swedish Cardiac Arrest Register were included and all corresponding EMS reports were reviewed. Emergency calls were recorded during the event. Witnessed cases of OHCA (n=76 in both 2004 and 2006) were analyzed using a structured data collection tool. RESULTS: The frequency of offered T-CPR to all bystanders of OHCA in 2004 was 47%. After special tuition on agonal respiration in OHCA it rose to 68% in 2006 (p=0.01). An even more marked rise was observed in OHCA cases with agonal respiration. In 2004 T-CPR was offered in 23% of these situations whereas the corresponding figures in 2006 had risen to 56% (p=0.006). CONCLUSIONS: Teaching EMDs to understand and recognize bystander descriptions of agonal respiration in patients with OHCA has resulted in a significant increase in offers of T-CPR in these situations.

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National resuscitation guidelines were published in Finland in 2002 and updated in 2006. The purpose of this study was to analyse the effect of cardiopulmonary resuscitation (CPR) education on attitudes towards defibrillation during arrests (CPR-D) and the guidelines. In 2003 (before CPR-D education) and in 2007 (after the education), 48-item questionnaires (using a 7-point Likert scale: 1=totally disagree, 7=totally agree) were sent to nurses in a secondary hospital. Factor loadings were applied using maximum likelihood factor analyses with a varimax rotation. Five scales were built from the items of the questionnaire: attitudes towards CPR-D, positive attitudes, negative attitudes towards guidelines, implementation and nurses’ role. A total of 297 and 199 responded in 2003 and 2007, respectively. Education increased positive attitudes towards CPR-D (scale mean: 4.40 vs. 3.61, 95% confidence interval (CI): 3.9 - 4.2, P<0.001). Nevertheless, 27% of nurses hesitated to perform defibrillation because of fear of injuring patient and 64% because of anxiety. After education, negative attitudes towards guidelines increased (scale mean 2.94 vs. 3.92, 95% CI: 3.2 - 3.6, P<0.001) and nurses were more unsure about their role than before education (scale mean: 4.84 vs. 3.42, CI: 4.1 - 4.4, P<0.001). Intensive education increased self-confidence regarding CPR-D skills but did not reduce anxiety. CPR-D education should include a focus on reducing anxiety, and negative attitudes within organisations need to be explored.
66/  
Peter, I., E. Jan, et al. (2009). "Peer evaluation in reciprocal learning with task cards for acquiring Basic Life Support (BLS)."  
Resuscitation 80(12): 1394-1398.

Research emphasises the need for instructional methods and tools which can improve Basic Life Support (BLS) performance or reduce instructional time. To investigate the effect of peer evaluation to improve reciprocal learning with task cards as instructional tools for acquiring BLS. A total of 78 kinesiology students from a Belgian university were paired and randomised across two groups to learn BLS in 20min with task cards. In the control group, students worked together in a defined doer - helper relationship and switched roles every 5min. In the peer evaluation group, students followed the same co-operation procedure as in the control group. In addition, 1min before every switching of roles, the helper evaluated the doer's performance. All BLS skills were individually assessed on a Laerdal AED Resusci-Anne mannequin (Laerdal Medical, Vilvoorde, Belgium) using the Laerdal PC-Skill reporting system. A total BLS score was calculated and performance was measured before training (baseline), immediately after training (intervention) and 2 weeks later (retention). Significantly more students from the evaluation group remembered and consequently performed all BLS skills at intervention (P=0.03). No significant differences were found between groups for main cardiopulmonary resuscitation (CPR) variables and total BLS scores at baseline, intervention and retention. Both groups achieved more than 70% of the maximum BLS score at intervention and retention. This study demonstrated that 20min reciprocal-learning setting with task cards is an effective method to learn BLS. The implementation of peer evaluation in this setting has an immediate, however small, positive impact on BLS skill learning.

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Objective: Our study evaluates the impact of features of automated external defibrillators (AEDs) on the performance and speed of untrained laypersons to deliver a shock and initiate CPR after a shock. Methods: This was a randomized trial of volunteer laypersons without AED or advanced medical training. Subjects were assigned to use one of six different models of AEDs on a manikin in simulated cardiac arrest. No instructions on AED operation were provided. Primary endpoints were shock delivery and elapsed time from start to shock. Secondary endpoints included time to power-on, initiation of CPR, adequacy of pad placement and subjects' ratings of ease of use (1 = very easy, 5 = very difficult). Results: Most subjects (109/120; 91%) were able to deliver a shock. Median time from start of scenario to shock delivery was 79 s (IQR: 67-99). Of the 11 participants who did not deliver shock, eight never powered on the device. Time to power-on was shorter in devices with open lid (median 12 s, IQR 8-27 s) and pull handle (17 s, IQR 9-20 s) mechanisms than with a push button (37 s, IQR 18-
69 s; p = 0.000). Pad position on the manikin was judged adequate for 86 (77%) of the 111 subjects who placed pads. Devices which gave more detailed voice instruction for pad placement had higher rates of adequate pad position [38/39 (97%) versus 50/73 (68%), p = 0.001]. With AEDs that provided step-by-step CPR instruction, 49/58 (84%) subjects began CPR compared to 26/51 (51%) with AEDs that only prompted to start CPR (p = 0.01). Participants rated all the models easy to use (overall mean 1.48; individual device means 1.28-1.71). Conclusions: Most untrained laypersons were successful in delivering a shock. Device features had the most impact on these functions: ability and time to power-on device, adequacy of pad position and initiation of CPR.

**COMMENTS / EDITORIALS / LETTERS**

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In a recent article Wolff et al. (2009) [1] present highly interesting results bearing on how timing of therapeutic hypothermia might affect outcome. However, some of their analyses are unadjusted for heterogeneities in the patient population, while others indicate a statistical model break-down. Moreover, the time from cardiac arrest to return of spontaneous circulation is recorded but not included as a potential covariate in the multivariate logistic regression, which is unfortunate considering that many studies have found it to be an important predictor of outcome. It is well-known that in observational studies it is important to adjust for all important covariates, not only statistically significant ones. Hence, we caution against drawing firm conclusions from this study.

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