RCP

Gains of Continuing Resuscitation in Refractory Out-of-hospital Cardiac Arrest: A Model-based Analysis to Identify Deaths Due to Intra-arrest Prognostication.

Grunau B, Puyat J, Wong H, Scheuermeyer FX, Reynolds JC, Kawano T, Singer J, Dick W, Christenson J.

Abstract

OBJECTIVE: Prognostication bias, in which a clinician predicts a negative outcome and terminates resuscitation (TR) thereby ensuring a poor outcome, is a rarely identified limitation of out-of-hospital cardiac arrest (OHCA) research. We sought to estimate the number of deaths due to intra-arrest prognostication in a cohort of OHCA's, and use this data to estimate the incremental benefit of continuing resuscitation.

METHODS: This study examined a cohort of consecutive non-traumatic EMS-treated OHCAs from a provincial ambulance service, between 2007 and 2011 inclusive. We used Cox and logistic regression modeling, adjusting for Utstein covariates, to estimate the probability of ROSC, survival, and favorable neurological outcomes as a function of resuscitation time, and applied these models to estimate the number of missed survivors in those who had TR (prior to 20, 30, or 40 minutes). We determined the time juncture at which (1) the likelihood of survival fell below 1%, and (2) the proportion of survivors who had achieved ROSC exceeded 99%.

RESULTS: Of 5674 adult EMS-treated cases, 46% achieved ROSC, and 12% survived. The median time of TR was 27.0 minutes (IQR 19.0-35.0). Continuing resuscitation until 40 minutes yielded an estimated 17 additional survivors (95% CI 13-21), 10 (95% CI 7-13) with favorable neurological outcomes. The probability of survival of those in refractory arrest decreased below 1% at 28 minutes (95% CI 24-30 minutes). At 36 minutes (95% CI 34-38 minutes) >99% of survivors had achieved ROSC.

CONCLUSION: We identified possible deaths due to intra-arrest prognostication. Resuscitation should be continued for a minimum of 30 minutes in all patients, however for those with initial shockable rhythms 40 minutes appears to be warranted. Interventional trials and observational studies should standardize or adjust for duration of resuscitation prior to TR.

[Dispatchers' impressions and actual quality of cardiopulmonary resuscitation during telephone-assisted bystander cardiopulmonary resuscitation: a pooled analysis of 94 simulated, manikin-based scenarios].

[Article in Spanish; Abstract available in Spanish from the publisher]

van Tulder R1, Roth D1, Laggner R1, Krammel M2, Schriefl C1, Kienbacher C1, Novosad H3, Constantin Chwojka C3, Sterz F1, Havel C1, Schreiber W1, Herkner H1.

Abstract

OBJECTIVES: The quality of telephone-assisted cardiopulmonary resuscitation (CPR) needs improvement. This study investigates whether a dispatchers' perception is an adequate measure of the actual quality of CPR provided by laypersons.

MATERIAL AND METHODS: Individual participant data from 3 randomized simulation trials, with identical methodology but different interventions, were combined for this analysis. Professional dispatchers gave telephone assistance to laypersons, who each provided 10 minutes of CPR on a manikin. Dispatchers were requested to classify the quality of providers' CPR as adequate or inadequate. Based on actual readings from manikins we classified providers' performance as adequate at 5-6 cm for depth and 100-120 compressions per minute (cpm) for rate. We calculated metrics of dispatcher accuracy.

RESULTS: Six dispatchers rated the performance of 94 laypersons (38 women [42%]) with a mean (SD) age of 37 (14) years. In 905 analyzed minutes of telephone-assisted CPR, the mean compression depth and rate was 41 (13) mm and 98 (24) cpm, respectively. Analysis of dispatchers' diagnostic test accuracy for adequate compression depth yielded a sensitivity of 65% (95 CI 36%-95%) and specificity of 42% (95% CI, 32%-53%). Analysis of their assessment of adequate compression rate yielded a sensitivity of 75% (95% CI, 64%-86%) and specificity of 42% (95% CI, 32%-52%). Although dispatchers always underestimated the actual values of CPR parameters, the female dispatchers evaluations were less inaccurate than the evaluations of make dispatchers; the dispatchers overall (males and females together) underestimated the adequacy of female laypersons' CPR performance to a greater degree than female dispatchers did.

CONCLUSION: The ability of dispatchers to estimate the quality of telephone-assisted CPR is limited. Dispatchers estimates of CPR adequacy needs to be studied further in order to find ways that telephone-assisted CPR might be improved.

REGISTRES, REVISIONS I EDITORIALS

Epinephrine in Out-of-hospital Cardiac Arrest: Helpful or Harmful?
Shao H1, Li CS1.
Abstract
OBJECTIVE: Epinephrine is the primary drug administered during cardiopulmonary resuscitation (CPR) to reverse cardiac arrest. The evidence for the use of adrenaline in out-of-hospital cardiac arrest (OHCA) and in-hospital resuscitation is inconclusive. We conducted a systematic review on the clinical efficacy of adrenaline in adult OHCA patients to evaluate whether epinephrine provides any overall benefit for patients.
DATA SOURCES: The EMBASE and PubMed databases were searched with the key words "epinephrine," "cardiac arrest," and variations of these terms.
STUDY SELECTION: Data from clinical randomized trials, meta-analyses, guidelines, and recent reviews were selected for review.
RESULTS: Sudden cardiac arrest causes 544,000 deaths in China each year, with survival occurring in <1% of cases (compared with 12% in the United States). The American Heart Association recommends the use of epinephrine in patients with cardiac arrest, as part of advanced cardiac life support. There is a clear evidence of an association between epinephrine and increased return of spontaneous circulation (ROSC). However, there are conflicting results regarding long-term survival and functional recovery, particularly neurological outcome, after CPR. There is currently insufficient evidence to support or reject epinephrine administration during resuscitation. We believe that epinephrine may have a role in resuscitation, as administration of epinephrine during CPR increases the probability of restoring cardiac activity with pulses, which is an essential intermediate step toward long-term survival.
CONCLUSIONS: The administration of adrenaline was associated with improved short-term survival (ROSC). However, it appears that the use of adrenaline is associated with no benefit on survival to hospital discharge or survival with favorable neurological outcome after OHCA, and it may have a harmful effect. Larger placebo-controlled, double-blind, randomized control trials are required to definitively establish the effect of epinephrine.

The effect of national implementation of Utstein recommendation from the global resuscitation alliance on ten steps to improve outcomes from Out-of-Hospital cardiac arrest: a ten-year observational study in Korea.
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of Emergency Medicine, Seoul National University Boramae Medical Center, Seoul, Korea.
Abstract
OBJECTIVES: The Utstein ten-step implementation strategy (UTIS) proposed by the Global Resuscitation Alliance, a bundle of community cardiopulmonary resuscitation (CPR) programs to improve outcomes after out-of-hospital cardiac arrests (OHCAs), has been developed. However, it is not documented whether UTIS programs are associated with better outcomes or not. The study aimed to test the association between the UTIS programme and better outcomes after OHCA.
METHODS: The study was a before- and after-intervention study. Adults OHCAs treated by emergency medical service (EMS) from 2006 to 2015 in Korea were collected, excluding patients witnessed by ambulance personnel and without outcomes. Phase 1 (2009-2011) after implementing three programs (national OHCA registry, obligatory CPR education, and public report of OHCA outcomes), and phase 2 (2012-2015) after implementing two programs (telephone-assisted CPR and EMS quality assurance programme) were compared with the control period (2006-2008) when no UTIS programme were implemented. The primary outcome was good neurological recovery (cerebral performance scale 1 or 2). We tested the association between the phases and outcomes, adjusting for confounders using a multivariate logistic regression model to calculate adjusted odds ratios (AORs) with 95% confidence intervals (CIs).
RESULTS: A total of 1 28 888 eligible patients were analysed. The control, phase 1, and phase two study groups were 19.4%, 30.5%, and 50.0% of the whole, respectively. There were significant changes in pre-hospital ROSC (0.8% in 2006 and 7.1% in 2015), survival to discharge (3.0% in 2006 and 6.1% in 2015), and good neurological recovery (1.2% in 2006 and 4.1% in 2015). The AORs (95% CIs) for good neurological recovery were 1.82 (1.53-2.15) or phase 1 and 2.21 (1.78-2.75) for phase two compared with control phase.
CONCLUSION: The national implementation of the five UTIS programs was significantly associated with better OHCA outcomes in Korea.

Survival of cardiac arrest patients on ski slopes: A 10-year analysis of the Northern French Alps Emergency Network.

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Abstract

AIM: Intense physical activity, cold and altitude make mountain sports a cause of increased risk of out-of-hospital cardiac arrest (OHCA). The difficulties of pre-hospital management related to this challenging environment could be mitigated by the presence of ski-patrollers in ski areas and use of helicopters for medical rescue. We assess whether this particular situation positively impacts the chain of survival compared to the general population.

METHODS: Analysis of prospectively collected data from the cardiac arrest registry of the Northern French Alps Emergency Network (RENAU) from 2004 to 2014.

RESULTS: 19,341 OHCAs were recorded during the period, including 136 on-slope events. Compared to other OHCAs, on-slope patients were younger (56 [40-65] vs. 66 [52-79] years, p<0.001) and more often in shockable initial rhythm (41.2% vs 20.1%, p<0.001). Resuscitation was more frequently started by a witness (43.4% vs 26.8%, p<0.001) and the time to the first electric shock was shorter (7.5min vs 14min, p<0.001), whereas time to the advanced life support (ALS) rescue arrival did not differ. The 30-day survival rate was higher for on-slope arrests (21.3% vs 5.9%, p<0.001, RR=3.61). In multivariate analysis, on-slope CA remained a positive 30-day survival factor with a 2.6 odds ratio (95% confidence interval, 1.42-4.81, p=0.002).

CONCLUSION: Despite difficult access and management conditions, patients undergoing OHCAs on ski slopes presented a higher survival rate, possibly explained by a healthier population, the efficiency of resuscitation by ski-patrols and similar time to ALS facilities compared to other cardiac arrests.

Recurrent out-of-hospital cardiac arrest.

Nehme Z1, Andrew E2, Nair R3, Bernard S4, Smith K5.

Abstract

BACKGROUND: Little is known about the burden of recurrent out-of-hospital cardiac arrest (OHCA) episodes in initial survivors of OHCA. We sought to investigate the frequency of recurrent OHCA, describe time-to-event trends, and establish baseline predictors of occurrence.

METHODS: Between January 2000 and June 2015, we included consecutive OHCA survivors to hospital discharge from the Victorian Ambulance Cardiac Arrest Registry. Patient identifiers were used to match index and recurrent episodes of OHCA, and death records from a government database. Kaplan-Meier curves and a Cox proportional-hazards model were used to estimate the long-term risk of recurrent OHCA and identify index characteristics associated with their occurrence.

RESULTS: Among 3,581 survivors, 214 (6.0%) experienced a recurrent OHCA over a median time-at-risk of 5.0 years (interquartile range [IQR]: 2.0, 8.1). The median age at recurrent OHCA was 69 years, 72.9% were male, and 92.0% of events were fatal. Fatal recurrent OHCA episodes accounted for more than one-quarter of all deaths at follow-up. The probability of recurrent OHCA at 1, 5, 10 and 15 years was 2.4% (95% CI: 2.0%, 3.0%), 6.0% (95% CI: 5.2%, 6.9%), 8.4% (95% CI: 7.3%, 9.8%), and 11.2% (95% CI: 9.1%, 13.8%), respectively. In the multivariable model, the following baseline predictors were significantly associated with recurrent OHCA: respiratory (HR 1.88, 95% CI: 1.02, 3.47; p=0.045) or overdose/poisoning aetiology (HR 2.47, 95% CI: 1.08, 5.62; p=0.03), diabetes (HR 1.92, 95% CI: 1.17, 3.14, p=0.01), heart failure (HR 2.22, 95% CI: 1.28, 3.85; p=0.005), and renal insufficiency (HR 2.43, 95% CI: 1.23, 4.82; p=0.01). The risk of recurrent OHCA did not decline over the study period (per year increase: HR 0.97, 95% CI: 0.93, 1.01; p=0.13).

CONCLUSION: Recurrent OHCA episodes occur frequently in OHCA survivors, and could account for as many as one-quarter of all deaths at follow-up. Index characteristics may help to identify at-risk patients.

Age is related to neurological outcome in patients with out-of-hospital cardiac arrest (OHCA) receiving therapeutic hypothermia (TH).

Oh SJ1, Kim JJ2, Jang JH3, Hwang IC 4, Woo JH5, Lim YS6, Yang HJ7.

Abstract

INTRODUCTION: In this study, we retrospectively reviewed the patients' outcomes after cardiac arrest based on age in one center, to determine whether geriatric patients had worse outcomes.

METHODS: This was a single-center, retrospective cohort study. The patients admitted to the intensive care unit on successful resuscitation after OHCA were retrospectively identified and evaluated.

RESULTS: This was a retrospective cohort study of patients over 18years of-age with return of spontaneous circulation (ROSC) (>24h) after cardiac arrest who were admitted to the emergency intensive care unit (EICU) and received post-cardiac arrest care between March 2007 and December 2013. Finally, a total of 295 patients were enrolled during the study period; of these, 79 patients (36.6%) had a good cerebral performance category (CPC). In stepwise multivariate analysis, young age (per 10years) (odds ratio [OR] 1.42, 95% CI 1.00-1.99, p=0.044), high hemoglobin level (per 1g/dL) (OR 1.31, 95% CI 1.07-1.60, p=0.008), non-diabetic patients (OR 15.21, 95% CI 1.85-125.3, p=0.01), cardiogenic cardiac arrest (OR 8.68, 95% CI 3.72-20.30, p<0.001), pre-hospital cardiopulmonary resuscitation (CPR) by bystander (OR 3.61, 95% CI 1.23-10.57, p=0.019), short time from collapsed to ACLS (per 1min) (OR 1.12, 95% CI 1.06-1.18, p<0.001) had good CPC at 6-month post-admission.

CONCLUSION: Elderly patients with OHCA had a poor neurological outcome; but several other factors were also related with the outcome. In decision-making for resuscitation, physicians should consider the patients' physiologic factors as well as age.

6.Resuscitation. 2017 Aug 9. pii: S0300-9572(17)30333-7. doi: 10.1016/j.resuscitation.2017.08.008. [Epub ahead of print]

Prehospital Sodium Bicarbonate Use Could Worsen Long Term Survival with Favorable Neurological Recovery among Patients with Out-of-Hospital Cardiac Arrest.

Kawano T1, Grunau B2, Scheuermeyer FX3, Gibo K4, Dick W5, Fordyce CB6, Dorian P7, Stenstrom R2, Straight R8, Christenson J9.

Abstract

BACKGROUND: Sodium bicarbonate (SB) is widely used for resuscitation in out-of- hospital cardiac arrest (OHCA); however, its effect on long term outcomes is unclear.

METHODS: From 2005 to 2016, we prospectively conducted a province-wide population-based observational study including adult non-traumatic OHCA patients managed by paramedics. SB was administered by paramedics based on their clinical assessments. To examine the association of SB administration and survival and favorable neurological outcome to hospital discharge, defined as modified Rankin scale of 3 or less, we performed a multivariable logistic regression analysis: (1) within propensity score matched comparison groups, and; (2) within the full cohort with missing variables addressed by multiple imputation techniques.

RESULTS: Of 15 601 OHCA patients, 13,865 were included in this study with 5,165 (37.3%) managed with SB. In the SB treated group, 118 (2.3%) patients survived and 62 (1.2%) had favorable neurological outcomes to hospital discharge, compared to 1,699 (19.8%) and 831 (10.6%) in the non-SB treated group, respectively. In the 1:1 propensity matched cohort including 5,638 OHCA patients, SB was associated with decreased probability of outcomes (adjusted OR for survival: 0.64, 95% CI 0.45 to 0.91, and adjusted OR for favorable neurological outcome: 0.59, 95% CI 0.39 - 0.88, respectively). The association remained consistent in the multiply imputed cohort (adjusted OR 0.48, 95 CI 0.36-0.64, and adjusted OR 0.54, 95% CI 0.38-0.76, respectively).

CONCLUSIONS: In OHCA patients, prehospital SB administration was associated with worse survival rate and neurological outcomes to hospital discharge.

TRAUMA

1. Eur J Trauma Emerg Surg. 2017 Aug 22. doi: 10.1007/s00068-017-0829-z. [Epub ahead of print]

Non-traumatic hemorrhage is controlled with REBOA in acute phase then mortality increases gradually by non-hemorrhagic causes: DIRECT-IABO registry in Japan.

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Collaborators: (18)

Hagawa N, Ishida T, Ishida K, Yamamura E, Umakoshi K, Yamada KC, Homma Y, Hirose T, Fujii M, Ito C, Yamamoto T, Orita T, Matsumoto J, Idoguchi K, Kon Y, Tomita K, Shinjo T, Toyoda Y.

Abstract

PURPOSE: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is now a feasible and less invasive resuscitation procedure. This study aimed to compare the clinical course of trauma and non-trauma patients undergoing REBOA.

METHODS: Patient demographics, etiology, bleeding sites, hemodynamic response, length of critical care, and cause of death were recorded. Characteristics and outcomes were compared between non-trauma and trauma patients. Kaplan-Meier survival analysis was then conducted.

RESULTS: Between August 2011 and December 2015, 142 (36 non-trauma; 106 trauma) cases were analyzed. Non-traumatic etiologies included gastrointestinal bleeding, obstetrics and gynecology-derived events, visceral aneurysm, abdominal aortic aneurysm, and post-abdominal surgery. The abdomen was a common bleeding site (69%), followed by the pelvis or extra-pelvic retroperitoneum. None of the non-trauma patients had multiple bleeding sites, whereas 45% of trauma patients did (P < 0.001). No non-trauma patients required resuscitative thoracotomy compared with 28% of the trauma patients (P < 0.001). Non-trauma patients presented a lower 24-h mortality than trauma patients (19 vs. 51%, P = 0.001). The non-trauma cases demonstrated a gradual but prolonged increased mortality, whereas survival in trauma cases rapidly declined (P = 0.009) with similar hospital mortality (68 vs. 64%). Non-trauma patients who survived for 24 h had 0 ventilator-free days and 0 ICU-free days vs. a median of 19 and 12, respectively, for trauma patients (P = 0.33 and 0.39, respectively). Non-hemorrhagic death was more common in non-trauma vs. trauma patients (83 vs. 33%, P < 0.001).

CONCLUSIONS: Non-traumatic hemorrhagic shock often resulted from a single bleeding site, and resulted in better 24-h survival than traumatic hemorrhage among Japanese patients who underwent REBOA. However, hospital mortality increased steadily in non-trauma patients affected by non-hemorrhagic causes after a longer period of critical care.

[Emergency treatment for traumatic cardiac arrest: prognostic factors and hospital outcome].
[Article in Spanish; Abstract available in Spanish from the publisher]
Viejo-Moreno R1, García-Fuentes C1, Chacón-Alves S1, Terceros-Almanza LJ1, Montejo-González JC1, Chico-Fernández M1.
Abstract
OBJECTIVES: To identify prehospital and on-arrival factors associated with hospital outcome in patients with traumatic cardiac arrest (TCA) discharged with recovered spontaneous circulation from the emergency department.

MATERIAL AND METHODS: Multipurpose prospective cohort study of patients with TCA who recovered after treatment at a tertiary care hospital emergency department between 2003 and 2016. We gathered data on epidemiologic variables, type and cause of injuries, and prehospital and hospital emergency care. The outcome was overall hospital mortality.

RESULTS: A total of 130 TCA cases were included; 123 patients (94.6%) had received blunt trauma injuries and 65 (50%) had been in traffic accidents. The mean (SD) age was 39 (16) years, and 96 (73.8%) were male. Fifty patients (65%) were in asystole and 42 (32.3%) had pulseless electrical activity. Sixteen (12.3%) survived to be discharged; 13 of the survivors (81.3%) had recovered neurological activity. Factors that were independently associated with hospital mortality were asystole on arrival of first responders (odds ratio [OR], 25; 95% CI, 2.5-247; P=.006), nonreactive pupils on arrival at the hospital (OR, 13; 95% CI, 2.0-79; P=.006), and an Injury Severity Score over 25 (OR, 13; 95% CI, 1.8-94; P=.011).

CONCLUSION: Twelve percent of patients in this cohort survived to discharge after TCA and 8 out of 10 of the surviving patients recovered neurologically. Asystole at start of prehospital care, nonreactive pupils on hospital arrival, and a severity score over 25 may indicate poor prognosis after TCA.

The use of aortic balloon occlusion in traumatic shock: first report from the ABO trauma registry.
Sadeghi M1, Nilsson KF2, Larzon T2, Pirouzram A2, Toivola A2, Skoog P3, Idoguchi K4, Kon Y5, Ishida T6, Matsumara Y7,8, Matsumoto J9, Reva V10,11, Maszkowski M1, Bersztel A1, Caragounis E12, Falkenberg M13, Handolin L14, Kessel B15, Hebron D15, Coccolini F16, Ansaloni L16, Morrison JJ17, Hörer TM18, Madurska MJ17.
Abstract
PURPOSE: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a technique for temporary stabilization of patients with non-compressible torso hemorrhage. This technique has been increasingly used worldwide during the past decade. Despite the good outcomes of translational studies, clinical studies are divided. The aim of this multicenter-international study was to capture REBOA-specific data and outcomes.

METHODS:

REBOA practicing centers were invited to join this online register, which was established in September 2014. REBOA cases were reported, both retrospective and prospective. Demographics, injury patterns, hemodynamic variables, REBOA-specific data, complications and 30-days mortality were reported.

RESULTS: inety-six cases from 6 different countries were reported between 2011 and 2016. Mean age was 52 ± 22 years and 88% of the cases were blunt trauma with a median injury severity score (ISS) of 41 (IQR 29-50). In the majority of the cases, Zone I REBOA was used. Median systolic blood pressure before balloon inflation was 60 mmHg (IQR 40-80), which increased to 100 mmHg (IQR 80-128) after inflation. Continuous occlusion was applied in 52% of the patients, and 48% received non-continuous occlusion. Occlusion time longer than 60 min was reported as 38 and 14% in the non-continuous and continuous groups, respectively. Complications, such as extremity compartment syndrome (n = 3), were only noted in the continuous occlusion group. The 30-day mortality for non-continuous REBOA was 48%, and 64% for continuous occlusion.

CONCLUSIONS: This observational multicenter study presents results regarding continuous and non-continuous REBOA with favorable outcomes. However, further prospective studies are needed to be able to draw conclusions on morbidity and mortality.

Predicting outcomes in traumatic out-of-hospital cardiac arrest: the relevance of Utstein factors.

Beck B1, Bray JE1,2,3, Cameron P1,3, Straney L1, Andrew E1,4, Bernard S1,4,5, Smith K1,4,6.

Abstract

BACKGROUND: Given low survival rates in cases of traumatic out-of-hospital cardiac arrest (OHCA), there is a need to identify factors associated with outcomes. We aimed to investigate Utstein factors associated with achieving return of spontaneous circulation (ROSC) and survival to hospital in traumatic OHCA.

METHODS: The Victorian Ambulance Cardiac Arrest Registry (VACAR) was used to identify cases of traumatic OHCA that received attempted resuscitation and occurred between July 2008 and June 2014. We excluded cases aged <16 years or with a mechanism of hanging or drowning.

RESULTS: Of the 660 traumatic OHCA patients who received attempted resuscitation, ROSC was achieved in 159 patients (24%) and 95 patients (14%) survived to hospital (ROSC on hospital handover). Factors that were positively associated with achieving ROSC in multivariable logistic regression models were age ≥65 years (adjusted OR (AOR)=1.56, 95% CI: 1.01 to 2.43) and arresting rhythm (shockable (AOR=3.65, 95% CI: 1.64 to 8.11) and pulseless electrical activity (AOR=2.15, 95% CI: 1.36 to 3.39) relative to asystole). Similarly, factors positively associated with survival to hospital were arresting rhythm (shockable (AOR=3.92, 95% CI: 1.64 to 9.41) relative to asystole), and the mechanism of injury (falls (AOR=2.16, 95% CI: 1.03 to 4.54) relative to motor vehicle collisions), while trauma type (penetrating (AOR=0.27, 95% CI: 0.08 to 0.91) relative to blunt trauma) and event region (rural (AOR=0.39, 95% CI: 0.19 to 0.80) relative to urban) were negatively associated with survival to hospital.

CONCLUSIONS: Few patient and arrest characteristics were associated with outcomes in traumatic OHCA. These findings suggest there is a need to incorporate additional information into cardiac arrest registries to assist prognostication and the development of novel interventions in these trauma patients.

FV

Coronary Artery Disease in Patients With Out-of-Hospital Refractory Ventricular Fibrillation Cardiac Arrest.

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Abstract

BACKGROUND: The prevalence of coronary artery disease (CAD) among patients with refractory out-of-hospital (OH) ventricular fibrillation (VF)/ventricular tachycardia (VT) cardiac arrest is unknown.

OBJECTIVES: The goal of this study was to describe the prevalence and complexity of CAD and report survival to hospital discharge in patients experiencing refractory VF/VT cardiac arrest treated with a novel protocol of early transport to a cardiac catheterization laboratory (CCL) for extracorporeal life support (ECLS) and revascularization.

METHODS: Between December 1, 2015, and December 1, 2016, consecutive adult patients with refractory OH VF/VT cardiac arrest requiring ongoing cardiopulmonary resuscitation were transported by emergency medical services to the CCL. ECLS, coronary angiography, and percutaneous coronary intervention were performed, as

appropriate. Functionally favorable survival to hospital discharge (Cerebral Performance Category 1 or 2) was determined. Outcomes in a historical comparison group were also evaluated.

RESULTS: Sixty-two (86%) of 72 transported patients met emergency medical services transport criteria. Fifty-five (89%) of the 62 patients met criteria for continuing resuscitation on CCL arrival; 5 had return of spontaneous circulation, 50 received ECLS, and all 55 received coronary angiography. Forty-six (84%) of 55 patients had significant CAD, 35 (64%) of 55 had acute thrombotic lesions, and 46 (84%) of 55 had percutaneous coronary intervention with 2.7 ± 2.0 stents deployed per patient. The mean SYNTAX score was 29.4 ± 13.9. Twenty-six (42%) of 62 patients were discharged alive with Cerebral Performance Category 1 or 2 versus 26 (15.3%) of 170 in the historical comparison group (odds ratio: 4.0; 95% confidence interval: 2.08 to 7.7; $p < 0.0001$).

CONCLUSIONS: Complex but treatable CAD was prevalent in patients with refractory OH VF/VT cardiac arrest who also met criteria for continuing resuscitation in the CCL. A systems approach using ECLS and reperfusion seemed to improve functionally favorable survival.

ORGANITZACIÓ I ENTRENAMENT

Community socioeconomic status and public access defibrillators: A multilevel analysis.
Lee SY1, Do YK2, Shin SD3, Park YJ4, Ro YS5, Lee EJ6, Lee KW7, Lee YJ8.
Abstract
BACKGROUND: Although current guidelines recommend that distribution of public-access defibrillators (PADs) should take into account area-level risk of out-of-hospital cardiac arrest (OHCA), community socioeconomic status (SES) can unduly influence policy implementation in positioning PADs. Using recent, complete data from Seoul Metropolitan City, Korea, this study aims to examine whether community SES is associated with distribution of PADs, in terms of per capita count and risk-grid coverage.

METHODS: A cross-sectional, observational study was conducted using three sources of administrative data: 1) PAD registry data (2007-2015), 2) OHCA database (2010-2014), and 3) community socioeconomic characteristics of two sub-city levels (neighborhoods nested in districts). We examined the relationship between neighborhood per capita tax, a SES proxy, with each of the two outcome variables. After examining per capita number of PADs and risk-grid coverage by neighborhood tax quartile, multilevel linear regression analysis was conducted to account for the nested nature of data and also to control for OHCA risk in the model.

RESULTS: A total of 6,609 PADs in 405 neighborhoods were included in the analysis. The average number of positioned PADs per 10,000 persons was 7.45, showing a gradient by neighborhood SES (4.92 in the lowest SES quartile vs 12.66 in the highest). Risk-grid coverage was around 10% across all neighborhood SES quartiles. These findings remained valid in the multilevel analysis: per capita number of PADs was still positively associated with neighborhood SES, while risk-grid coverage of PADs was not.

CONCLUSIONS: More affluent neighborhoods in Seoul exhibit higher per capita PADs, even accounting for OHCA risk, while risk-grid coverage is generally low regardless of community SES. Seoul's ongoing program aimed to increase PAD coverage should also pay attention to improving community-level inequality as well as distributional efficiency.

An innovative design for cardiopulmonary resuscitation manikins based on a human-like thorax and embedded flow sensors.
Thielen M1, Joshi R1,2, Delbressine F1, Bambang Oetomo S1,3, Feijs L1.
Abstract
Cardiopulmonary resuscitation manikins are used for training personnel in performing cardiopulmonary resuscitation. State-of-the-art cardiopulmonary resuscitation manikins are still anatomically and physiologically low-fidelity designs. The aim of this research was to design a manikin that offers high anatomical and physiological fidelity and has a cardiac and respiratory system along with integrated flow sensors to monitor cardiac output and air displacement in response to cardiopulmonary resuscitation. This manikin was designed in accordance with anatomical dimensions using a polyoxymethylene rib cage connected to a vertebral column from an anatomical female model. The respiratory system was composed of silicon-coated memory foam mimicking lungs, a polyvinylchloride bronchus and a latex trachea. The cardiovascular system was composed of two sets of latex tubing representing the pulmonary and aortic arteries which were connected to latex balloons mimicking the ventricles and lumped abdominal volumes, respectively. These

balloons were filled with Life/form simulation blood and placed inside polyether foam. The respiratory and cardiovascular systems were equipped with flow sensors to gather data in response to chest compressions. Three non-medical professionals performed chest compressions on this manikin yielding data corresponding to force-displacement while the flow sensors provided feedback. The force-displacement tests on this manikin show a desirable nonlinear behaviour mimicking chest compressions during cardiopulmonary resuscitation in humans. In addition, the flow sensors provide valuable data on the internal effects of cardiopulmonary resuscitation. In conclusion, scientifically designed and anatomically high-fidelity designs of cardiopulmonary resuscitation manikins that embed flow sensors can improve physiological fidelity and provide useful feedback data.
Free Article

CURES POST ROSC

Recorded time periods of bispectral index values equal to zero predict neurological outcome after out-of-hospital cardiac arrest.
Eertmans W1,2, Genbrugge C3,4, Haesevoets G3,4, Dens J3,5, Boer W4, Jans F3,4, De Deyne C3,4.
Abstract
BACKGROUND: Prognostication in out-of-hospital cardiac arrest (OHCA) survivors is often difficult. Recent studies have shown the predictive ability of bispectral index (BIS) monitoring to assist with early neuroprognostication. The aim of this study was to investigate whether characteristics of BIS values equal to zero (BIS 0) (i.e. duration and/or uni- versus bilateral presence) instead of simply their occurrence are better indicators for poor neurological outcome after OHCA by aiming at a specificity of 100%.
METHODS: Between 2011 and 2015, all successfully resuscitated OHCA patients were treated with targeted temperature management (TTM) at 33 °C for 24 hours followed by rewarming over 12 hours (0.3 °C/h). In total, BIS values were registered in 77 OHCA patients. The occurrence of unilateral (BIS 0 at one hemisphere) and bilateral (BIS 0 at both hemispheres) BIS 0 values as well as their total duration were calculated. Receiver operating characteristic (ROC) curves were constructed using the total duration with BIS 0 values calculated from the initiation of TTM onwards to determine poor neurological outcome.
RESULTS: In 30 of 77 OHCA patients (39%), at least one BIS 0 value occurred during the first 48 hours after admission. Of these 30 patients, six (20%) had a good (cerebral performance category (CPC) 1-2) and 24 (80%) a poor neurological outcome (CPC3-5) at 180 days post-CA. Within these 30 patients, the incidence of bilateral BIS 0 values was higher in patients with poor neurological outcome (CPC1-2: 2 (33%) vs. CPC3-5: 19 (79%); p = 0.028). The presence of a BIS 0 value predicted poor neurological outcome with a sensitivity of 62% and specificity of 84% (AUC: 0.729; p = 0.001). With a ROC analysis, a total duration of 30,3 minutes with BIS 0 values calculated over the first 48 hours predicted poor neurological outcome with a sensitivity of 63% and specificity of 100% (AUC: 0.861; p = 0.007).
CONCLUSIONS: This study shows that a prolonged duration with (bilateral) BIS 0 values serves as a better outcome predictor after OHCA as compared to a single observation.
Free Article

Long-term mortality in patients with STEMI transported primary or secondary to the cardiac center and treated by primary PCI.
Almawiri A1, Jan V1, Ziad A2, Martin J3,4, Josef S1.
Abstract
BACKGROUND: The purpose of this study was to compare long-term outcomes of primary transport (PT) and secondary transport (ST) in patients with STEMI.
METHOD: We assigned consecutive 869 patients referred for STEMI during a 2-year period (2008-2009). The primary endpoint was to compare long-term outcomes and mortality of PT to a catheterization laboratory and ST from regional hospitals to a catheterization laboratory. Six hundred seventy-seven patients (77.9%) were enrolled for the final evaluation, 192 (22.1%) having been excluded.
RESULTS: The median DBT was 34 ± 15.92 min for PT patients (n = 354) and 100 ± 28.82 min for ST patients (n = 323) (P < 0.005). One-month mortality was 3.95% in the PT group versus 9.46% in the ST group (P = 0.002). One-year mortality in the PT was 7.35% and 20.51% in the ST group (P < 0.005). Eight-year mortality was in the PS 26.8% versus 32.6% in the ST group (P = 0.035). Left ventricular ejection fraction (LVEF) was 45 ± 12.14% versus 45 ± 12.48% (P = 0.21); creatine kinase (CK) was 22.78 ± 78.69 ukat/L versus 23.21 ± 82.61 ukat/L,

(P = 0.58); and length of hospitalization was 4.98 ± 4.61 days in the PT group versus 5.25 ± 5.86 days in the ST group (P = 0.22). The air transport was used in the PT group (RR 0.85, 95% CI 0.63-1.09); and ST group (RR 1.17, 95% CI 0.91-1.40); P = 0.22). Time distribution of cardiac arrest median for PT 1432 days (n = 25) versus ST 266 (n = 31) P = 0.24.
CONCLUSION: The mortality benefits of PT to a PCI capable hospital persist throughout an 8-year follow-up.

TARGET TEMPERATURE MANAGEMENT

Safety and feasibility of selective intracoronary hypothermia in acute myocardial infarction.
Otterspoor LC1, van 't Veer M, van Nunen LX, Brueren GRG, Tonino PAL, Wijnbergen IF, Helmes H, Zimmermann FM, Van Hagen E, Johnson NP, Pijls NHJ.
Abstract
AIMS: Hypothermia reduces reperfusion injury and infarct size in animal models of acute myocardial infarction if started before reperfusion. Human studies have not confirmed benefit, probably due to insufficient myocardial cooling and adverse systemic effects. This study assessed safety and feasibility of a novel method for selective, sensor- monitored intracoronary hypothermia.
METHODS AND RESULTS: Ten patients undergoing primary percutaneous coronary intervention (PPCI) were included. Saline at room temperature was administered distal to the culprit lesion through an inflated over-the-wire balloon (OTWB) in order to cool the endangered myocardium for 10 minutes (occlusion phase). Next, the OTWB was deflated and cooling continued with saline at 4°C for another 10 minutes (reperfusion phase). A sensor-tipped temperature wire in the distal coronary artery allowed titration of the infusion rate to achieve the desired coronary temperature (6°C below body temperature). Target coronary temperature was achieved within 27 seconds (median; IQR 21 - 46). Except two patients with inferior wall infarction experiencing transient conduction disturbances, no side effects occurred. Systemic temperature remained unchanged. Finally, PPCI was performed as per routine.
CONCLUSIONS: Selective hypothermia of the infarct area by intracoronary infusion of saline provides a novel method to reduce coronary temperature quickly and guarantee local myocardial hypothermia. In anterior wall myocardial infarctions the protocol appeared safe, without serious hemodynamic or systemic side effects. In inferior wall myocardial infarctions, quickly transient conduction abnormalities occurred. Potentially, selective intracoronary delivery of hypothermia could attenuate reperfusion injury caused by traditional PPCI.

Target temperature 34 vs. 36°C after out-of-hospital cardiac arrest - a retrospective observational study.
Arvidsson L1, Lindgren S1, Martinell L1, Lundin S1, Rylander C1.
Abstract
BACKGROUND: Intensive care for comatose survivors of cardiac arrest includes targeted temperature management (TTM) to attenuate cerebral reperfusion injury. A recent multi-center clinical trial did not show any difference in mortality or neurological outcome between TTM targeting 33°C or 36°C after out-of-hospital-cardiac-arrest (OHCA). In our institution, the TTM target was changed accordingly from 34 to 36°C. The aim of this retrospective study was to analyze if this change had affected patient outcome.
METHODS: Intensive care registry and medical record data from 79 adult patients treated for OHCA with TTM during 2010 (n = 38; 34°C) and 2014 (n = 41; 36°C) were analyzed for mortality and neurological outcome were assessed as cerebral performance category. Student's t-test was used for continuous data and Fischer's exact test for categorical data, and multivariable logistic regression was applied to detect influence from patient factors differing between the groups.
RESULTS: Witnessed arrest was more common in 2010 (95%) vs. 2014 (76%) (P = 0.03) and coronary angiography was more common in 2014 (95%) vs. 2010 (76%) (P = 0.02). The number of patients awakening later than 72 h after the arrest did not differ. After adjusting for gender, hypertension, and witnessed arrest, neither 1-year mortality (P = 0.77), nor 1-year good neurological outcome (P = 0.85) differed between the groups.
CONCLUSION: Our results, showing no difference between TTM at 34°C and TTM at 36°C as to mortality or neurological outcome after OHCA, are in line with the previous TTM-trial results, supporting the use of either target temperature in our institution.

Dysglycemia, Glycemic Variability, and Outcome After Cardiac Arrest and Temperature Management at 33°C and 36°C.

Borgquist O1, Wise MP, Nielsen N, Al-Subaie N, Cranshaw J, Cronberg T, Glover G, Hassager C, Kjaergaard J, Kuiper M, Smid O, Walden A, Friberg H; TTM-Trial Investigators.

Abstract
OBJECTIVES: Dysglycemia and glycemic variability are associated with poor outcomes in critically ill patients. Targeted temperature management alters blood glucose homeostasis. We investigated the association between blood glucose concentrations and glycemic variability and the neurologic outcomes of patients randomized to targeted temperature management at 33°C or 36°C after cardiac arrest.
DESIGN: Post hoc analysis of the multicenter TTM-trial. Primary outcome of this analysis was neurologic outcome after 6 months, referred to as "Cerebral Performance Category."
SETTING: hirty-six sites in Europe and Australia.
PATIENTS: All 939 patients with out-of-hospital cardiac arrest of presumed cardiac cause that had been included in the TTM-trial.
INTERVENTIONS: Targeted temperature management at 33°C or 36°C.
MEASUREMENTS AND MAIN RESULTS:
Nonparametric tests as well as multiple logistic regression and mixed effects logistic regression models were used. Median glucose concentrations on hospital admission differed significantly between Cerebral Performance Category outcomes (p < 0.0001). Hyper- and hypoglycemia were associated with poor neurologic outcome (p = 0.001 and p = 0.054). In the multiple logistic regression models, the median glycemic level was an independent predictor of poor Cerebral Performance Category (Cerebral Performance Category, 3-5) with an odds ratio (OR) of 1.13 in the adjusted model (p = 0.008; 95% CI, 1.03-1.24). It was also a predictor in the mixed model, which served as a sensitivity analysis to adjust for the multiple time points. The proportion of hyperglycemia was higher in the 33°C group compared with the 36°C group.
CONCLUSION: Higher blood glucose levels at admission and during the first 36 hours, and higher glycemic variability, were associated with poor neurologic outcome and death. More patients in the 33°C treatment arm had hyperglycemia.

VENTILACIÓ

A comparison of pediatric airway management techniques during out-of-hospital cardiac arrest using the CARES database.

Hansen ML1, Lin A1, Eriksson C2, Daya M 1, McNally B3, Fu R4, Yanez D4, Zive D1, Newgard C1; CARES surveillance group.

Abstract
OBJECTIVE: To compare odds of survival to hospital discharge among pediatric out-of-hospital cardiac arrest (OHCA) patients receiving either bag-valve-mask ventilation (BVM), supraglottic airway (SGA) or endotracheal intubation (ETI), after adjusting for the propensity to receive a given airway intervention.
METHODS: Retrospective cohort study using the Cardiac Arrest Registry to Enhance Survival (CARES) database from January 1 201-December 31, 2015. The CARES registry includes data on cardiac arrests from 17 statewide registries and approximately 55 additional US cities. We included patients less than 18 years of age who suffered a non-traumatic OHCA and received a resuscitation attempt by Emergency Medical Services (EMS). The key exposure was the airway management strategy (BVM, ETI, or SGA). The primary outcome was survival to hospital discharge.
RESULTS: Of the 3793 OHCA cases included from 405 EMS agencies, 1724 cases were analyzed after limiting the analysis to EMS agencies that used all 3 devices. Of the 1724, 781 (45.3%) were treated with BVM only, 727 (42.2%) ETI, and 215 (12.5%) SGA. Overall, 20.7% had ROSC and 10.9% survived to hospital discharge. After using a propensity score analysis, the odds ratio for survival to hospital discharge for ETI compared to BVM was 0.39 (95%CI 0.26-0.59) and for SGA compared to BVM was 0.32 (95% CI 0.12-0.84). These relationships were robust to the sensitivity analyses including complete case, EMS-agency matched, and age-stratified.
CONCLUSIONS: BVM was associated with higher survival to hospital discharge compared to ETI and SGA. A large randomized clinical trial is needed to confirm these findings. (Ull, que no sigui que en els que utilitzen el baló ressuscitador no es recuperin abans i per això no acabin intubats o amb SG)

A Turbine-Driven Ventilator Improves Adherence to Advanced Cardiac Life Support Guidelines During a Cardiopulmonary Resuscitation Simulation.

Allen SG1, Brewer L2, Gillis ES3, Pace NL4, Sakata DJ2, Orr JA4.

Abstract

BACKGROUND: Research has shown that increased breathing frequency during cardiopulmonary resuscitation is inversely correlated with systolic blood pressure. Rescuers often hyperventilate during cardiopulmonary resuscitation (CPR). Current American Heart Association advanced cardiac life support recommends a ventilation rate of 8 -10 breaths/min. We hypothesized that a small, turbine-driven ventilator would allow rescuers to adhere more closely to advanced cardiac life support (ACLS) guidelines.

METHODS: Twenty-four ACLS-certified health-care professionals were paired into groups of 2. Each team performed 4 randomized rounds of 2-min cycles of CPR on an intubated mannikin, with individuals altering between compressions and breaths. Two rounds of CPR were performed with a self-inflating bag, and 2 rounds were with the ventilator. The ventilator was set to deliver 8 breaths/min, pressure limit 22 cm H_2O. Frequency, tidal volume (VT), peak inspiratory pressure, and compression interruptions (hands-off time) were recorded. Data were analyzed with a linear mixed model and Welch 2-sample t test.

RESULTS: The median (interquartile range [IQR]) frequency with the ventilator was 7.98 (7.98 -7.99) breaths/min. Median (IQR) frequency with the self-inflating bag was 9.5 (8.2-10.7) breaths/min. Median (IQR) ventilator VT was 0.5 (0.5- 0.5) L. Median (IQR) self-inflating bag VT was 0.6 (0.5- 0.7) L. Median (IQR) ventilator peak inspiratory pressure was 22 (22-22) cm H_2O. Median (IQR) self-inflating bag peak inspiratory pressure was 30 (27-35) cm H_2O. Mean ± SD hands-off times for ventilator and self-inflating bag were 5.25 ± 2.11 and 6.41 ± 1.45 s, respectively.

CONCLUSIONS: When compared with a ventilator, volunteers ventilated with a self-inflating bag within ACLS guidelines. However, volunteers ventilated with increased variation, at higher VT levels, and at higher peak pressures with the self-inflating bag. Hands-off time was also significantly lower with the ventilator.

DONACIÓ D'ÒRGANS

[Factors affecting the survival of transplants from donors after prehospital cardiac death].
[Article in Spanish; Abstract available in Spanish from the publisher]
Antonio Mateos Rodríguez A1, Andrés Belmonte A2, Del Río Gallegos F3, Coll E4.

Abstract

OBJECTIVES: To evaluate factors that influence the survival of transplanted organs from donors after prehospital cardiac death.

MATERIAL AND METHODS: Retrospective observational study of data collected from hospital emergency service records. Information included prehospital cardiac deaths evaluated as donors as well as patients who received transplants.

RESULTS: Two hundred cases from 2008 through 2011 were studied. Sixty-nine potential donors (34.5%) were rejected. Three hundred organs were extracted from the remaining 131 donor cases, to yield a mean (SD) of 2.32 (0.83) transplanted organs/donor or 1.52 (1.29) organs/potential donor. One hundred fifty-two potential donors (76%) were treated with mechanical cardiopumps during transport. We detected no significant differences between cases transported with manual chest compressions and cases treated with cardiopumps regarding age (40.1 vs 43.5 years, P=.06), responder arrival times (13 min 54 s vs 12 min 54 s, P=.45), or transport times (1 h 27 min vs 1 h 32 min). However, case transported with manual chest compressions yielded significantly more kidneys (mean, 1.96/potential donor) than those transported with cardiopump compressions (mean, 1.38/potential donor) (P=.008). Eleven of the 229 kidneys harvested (4%) were not transplanted. The median (interquartile range) serum creatinine concentrations after kidney transplants at 6 and 12 months, respectively, were 1.37 (1.10-1.58) mg/dL and 1.43 (1.11-1.80) mg/dL.

CONCLUSION: Our findings suggest that the use of a cardiopump reduces donor recruitment. Long-term creatinine levels are similar after transplantation of kidneys from donors transported with a cardiopump or with manual compressions.

Hypothermic pulsatile preservation of kidneys from uncontrolled deceased donors after cardiac arrest.
Matillon X1, Danjou F2, Petruzzo P1,3, Thaunat O4,5, Rimmele T6, Delsuc C6, Faure A6, Rabeyrin M7, Meas Yedid V8, Hanf W9, Morelon E4,5, Badet L1, Codas R1.
Abstract

Kidneys from uncontrolled donors after cardiac arrest (uDCD) suffer from a period of warm ischemia between cardiac arrest and cold flushing. Aim of the study was to evaluate renal outcomes of uDCD kidneys selected on the basis of renal Resistance Index (RI) and its influence on graft function and survival. The study included 44 kidneys procured from 26 uDCD starting 1.1.2006 until 31.12.2013. The donors (Maastricht category II) underwent cardiopulmonary resuscitation by assisted ventilation and chest compression; the organs were preserved with "in situ" cold perfusion or a normothermic regional perfusion. All kidneys were perfused on hypothermic (1-4°C) pulsatile perfusion machine (RM3, Waters Medical System) and discarded when RI≥0.5 mmHg/mL/min after 6 hours of perfusion. There was one (2.2%) primary non-function, while 37 recipients (84.1%) experienced delayed graft function. Graft survival was 97.6% at 1 and 3 post-transplantation years. Linear regression models showed that lower values of RI at the end of perfusion were associated to higher values of MDRD at 3 (p=0.049) and 6 months after transplantation (p=0.010) and to higher values of inulin clearance at 1 year (p=0.030). RI showed to be a useful tool to select uDCD kidneys allowing to achieve good clinical results.

Evaluation of the Boussignac Cardiac arrest device (B-card) during cardiopulmonary resuscitation in an animal model.
Moore JC1, Lamhaut L2, Hutin A2, Dodd KW 3, Robinson AE3, Lick MC4, Salverda BJ3, Hinke MB3, Larabere J5, Debaty G5, Segal N6.
Abstract
AIM OF THE STUDY: The purpose of this study was to examine continuous oxygen insufflation (COI) in a swine model of cardiac arrest. The primary hypothesis was COI during standard CPR (S-CPR) should result in higher intrathoracic pressure (ITP) during chest compression and lower ITP during decompression versus S-CPR alone. These changes with COI were hypothesized to improve hemodynamics. The second hypothesis was that changes in ITP with S-CPR+COI would result in superior hemodynamics compared with active compression decompression (ACD) + impedance threshold device (ITD) CPR, as this method primarily lowers ITP during chest decompression.
METHODS: After 6min of untreated ventricular fibrillation, S-CPR was initiated in 8 female swine for 4min, then 3min of S-CPR+COI, then 3min of ACD+ITD CPR, then 3min of S-CPR+COI. ITP and hemodynamics were continuously monitored.
RESULTS: During S-CPR+COI, ITP was always positive during the CPR compression and decompression phases. ITP compression values with S-CPR+COI versus S-CPR alone were 5.5±3 versus 0.2±2 (p<0.001) and decompression values were 2.8±2 versus -1.3±2 (p<0.001), respectively. With S-CPR+COI versus ACD+ITD the ITP compression values were 5.5±3 versus 1.5±2 (p<0.01) and decompression values were 2.8±2 versus -4.7±3 (p<0.001), respectively.
CONCLUSION: COI during S-CPR created a continuous positive pressure in the airway during both the compression and decompression phase of CPR. At no point in time did COI generate a negative intrathoracic pressures during CPR in this swine model of cardiac arrest

ECMO

High rate of arterial complications in patients supported with extracorporeal life support for drug intoxication-induced refractory cardiogenic shock or cardiac arrest.
Pozzi M1, Koffel C2, Djaref C1, Grinberg D1, Fellahi JL2, Hugon-Vallet E3, Prieur C3, Robin J1, Obadia JF1.
Abstract
BACKGROUND: Cardiac failure is still a leading cause of death in drug intoxication. Extracorporeal life support (ECLS) could be used as a rescue therapeutic option in patients developing refractory cardiogenic shock or cardiac arrest. The aim of this report is to present our results of ECLS in the setting of poisoning from cardiotoxic drugs.
METHODS: We included in this analysis consecutive patients who received an ECLS for refractory cardiogenic shock or in-hospital cardiac arrest due to drug intoxication. The primary endpoint of our study was survival to hospital discharge with good neurological recovery after ECLS support.
RESULTS: Between January 2010 and December 2015, we performed 12 ECLS. Mean age was 44.2±17.8 years and there was a predominance of females (66.7%). Drug intoxication was mainly due to beta-blockers and/or calcium channel inhibitors (83.3%) and 5 (41.7%) patients had multiple drugs overdose. Weaning rate and

survival to hospital discharge with good neurological recovery were 75% (9 patients). Among patients weaned from ECLS, mean duration of support was 2.4±1.1 days. Three (25%) patients underwent ECLS implantation during cardiopulmonary resuscitation, 2 (66.6%) of them died while on mechanical circulatory support (MCS). Six (50%) patients developed lower limb ischemia. Each patient was managed with ECLS decannulation: 2 (16.7%) patients underwent a concomitant iliofemoral thrombectomy, 3 (25%) needed further fasciotomy and the remaining patient (8.3%) required an amputation.

CONCLUSIONS: Refractory cardiogenic shock due to drug intoxication is still one of the best indications for ECLS owing to the satisfactory survival with good neurological outcome in such a critically ill population. Further data are however necessary in order to best understand the possible relation between drug intoxication and lower limb ischemia, which was quite superior to the reported rates.

Central Cannulation as a Viable Alternative to Peripheral Cannulation in Extracorporeal Membrane Oxygenation.

Ranney DN1, Benrashid E1, Meza JM1, Keenan JE 1, Bonadonna DK2, Bartz R3, Milano CA1, Hartwig MG1, Haney JC1, Schroder JN1, Daneshmand MA4.

Abstract

Arterial cannulation for veno-arterial (VA) extracorporeal membrane oxygenation (ECMO) is most commonly established via the aorta, axillary, or femoral vessels, yet their inherent complications are not well characterized. The purpose of this study was to compare the outcomes and complication rates of central vs peripheral cannulation. Adult patients undergoing VA ECMO between June 2009 and April 2015 were reviewed in this retrospective single-center study. Patient characteristics, clinical outcomes, and details related to deployment were extracted from the medical record. Complications and survival rates were compared between patients by cannulation strategy. Of 131 VA ECMO patients, there were 36 aortic (27.5%), 16 axillary (12.2%), and 79 femoral (60.3%) cannulations. Other than a lower mean age with femoral cannulations (53.9 ± 13.9 years) vs aortic (60.3 ± 12.2 years) and axillary (59.8 ± 12.4 years) (P = 0.032), the baseline patient characteristics were not statistically different. Central cannulation was more common in patients transferred from outside facilities (74.3% central vs 51.6% peripheral) (P = 0.053). Seven of 36 aortic cannulations were via anterior thoracotomy (19.4%). Forty of 131 patients underwent extracorporeal cardiopulmonary resuscitation (30.5%), 33 of whom were femorally cannulated. Peripheral cannulation carried a 29.5% rate of vascular complications compared with an 11.1% rate of mediastinal bleeding with central cannulation. Incidence of stroke and overall survival between groups were not statistically different. Central cannulation is a viable alternative to peripheral cannulation. Central cannulation avoids high rates of extremity morbidity without causing significant risks of alternative morbidity or death.

Predictors of Survival for Nonhighly Selected Patients Undergoing Resuscitation With Extracorporeal Membrane Oxygenation After Cardiac Arrest.

Pabst D1, El-Banayosy A, Soleimani B, Brehm CE.

Abstract

In several case reports and case series, extracorporeal membrane oxygenation during chest compression (CPR) has been shown to be a reasonable tool to improve outcome of patients under resuscitation. Although recommendations for ECPR include younger patients with shockable rhythm and short previous CPR-time, it remains unclear if nonhighly selected patients have a similar outcome. Aim of this study was to determine outcome in our nonhighly selected patient population treated with ECPR and investigate possible predictors of survival. We made a retrospective single-center study of adults who underwent ECPR for in-hospital cardiac arrest between June 2008 and September 2016. Outcome and predictors of survival were identified. In this period of time, 59 patients underwent ECPR due to cardiac arrest. Fifteen patients (25.4%) survived discharge of which all had a good neurological outcome (cerebral performance category, ≤ 2). Survival to discharge of patients with shockable rhythm (ventricular fibrillation or ventricular tachycardia) was 40.7%. Serum lactate ≥ 8, pulseless electrical activity (PEA) or asystole and male gender could be identified as predictors for low survival rate. Age, body mass index, renal replacement-dependent kidney injury had no significant influence on survival outcome. Mean CPR-time was 41.1 minutes (interquartile range, ±29.25 minutes). Extracorporeal membrane oxygenation seems to be a useful tool to improve the outcome of CPR also in nonhighly selected patients when compared with CPR alone and could be considered in patients with refractory cardiac arrest

also after longer previous CPR-time. Serum lactate and heart rhythm should be taken into account for patient selection.

Cerebral Tissue Oxygenation Index Using Near-infrared Spectroscopy during Extracorporeal Cardio-pulmonary Resuscitation Predicted Good Neurological Recovery in a Patient with Acute Severe Anemia.
Koyama Y1, Mizutani T1, Marushima A1, Sonobe A1, Shimojo N1, Kawano S1.
Abstract
We herein report the clinical course of a patient who had a good neurological outcome despite severe anemia, high serum lactate levels, and a long period of time from cardiac arrest (CA) to extracorporeal cardio-pulmonary resuscitation (ECPR) establishment. During the period of resuscitation, the tissue oxygenation index (TOI) values were measured continuously by a near-infrared spectroscopy monitoring device and were kept within the normal range. The TOI seems to reflect cerebral perfusion and the balance between the oxygen supply and demand in the brain during ECPR, thereby predicting the neurological outcome. Continuous TOI monitoring is useful for predicting the neurological outcome during ECPR.

Is Extracorporeal Cardiopulmonary Resuscitation Practical in Severe Chest Trauma? : A Systematic Review in Single Center of Developing Country.
Huh U1, Song S, Chung SW, Kim SP, Lee CW, Ahn HY, Bae M, Kim SH.
Abstract
BACKGROUND: We report our experience with extracorporeal cardiopulmonary resuscitation (ECPR) in patients with rupture of heart and major vessels caused by severe chest trauma.
METHODS: From April 2015 to May 2016, 10 patients with suspected injuries to the heart and major vessels following focused assessment with sonography in trauma or computed tomography were selected from patients admitted at a level I trauma centre presenting with cardiac tamponade and tension haemothorax due to severe chest trauma. Patients were divided as follow: Group A (n=3), patients without cardiac arrest before entering the operating theatre; Group B (n=5), patients with cardiac arrest for whom ECPR was applied and Group C (n=2), patients with cardiac arrest for whom ECPR was not applied.
RESULTS: All patients underwent exploratory thoracotomy or sternotomy. Injuries included cardiac chamber ruptures (n=8), lesions in the internal mammary arteries (n=1), and lesions of the bronchial arteries (n=1). In Group B, extracorporeal membrane oxygenation (ECMO) was initiated and circulation was restored promptly with adequate extracorporeal blood flow in all 5 cases. These patients were weaned off ECMO uneventfully after controlling the bleeding in the operating theatre. Mean ECMO time was 142 ± 48.2 min. Conversely, both patients in Group C died: one due to low cardiac output on postoperative day (POD) 1, and the other due to multiple-organ failure on POD 7.
CONCLUSIONS: ECPR may be an option to rescue and stabilize patients with cardiac arrest due to severe chest trauma.
LEVELS OF EVIDENCE: Therapeutic/Care Management, Level V STUDY TYPE: Brief reports.

RECERCA EXPERIMENTAL

Glycocalyx degradation leads to blood-brain barrier dysfunction and brain edema after asphyxia cardiac arrest in rats.
Zhu J1, Li X1, Yin J1, Hu Y1, Gu Y1, Pan S1.
Abstract
The role of glycocalyx in blood-brain barrier (BBB) integrity and brain damage is poorly understood. Our study aimed to investigate the impacts of endothelial glycocalyx on BBB function in a rat model of cardiac arrest (CA) and cardiopulmonary resuscitation (CPR). Male Sprague-Dawley rats subjected to 8-min asphyxia CA/CPR. Compared to controls, glycocalyx was mildly injured by CA, severely disrupted by hyaluronidase (HAase) with CA, and mitigated by hydrocortisone (HC) with CA. More importantly, the disruption of glycocalyx caused by HAase treatment was associated with higher BBB permeability and aggravated brain edema at 24 h after return of spontaneous circulation, as well as lower survival rate and poorer neurologic outcome at seventh day. Reversely, less degradation of glycocalyx by HC treatment was accompanied by higher seven-day survival rate and better neurologic outcome. Mechanistically, HAase treatment further increased CA/CPR-induced

activation of glia cells and expression of inflammatory factors, whereas HC decreased them in the brain cortex and hippocampus. Glycocalyx degradation results in BBB leakage, brain edema, and deteriorates neurologic outcome after asphyxia CA/CPR in rats. Preservation of glycocalyx by HC could improve neurologic outcome and reduce BBB permeability, apparently through reduced gene transcription-protein synthesis and inflammation.

End-Tidal CO2-Guided Chest Compression Delivery Improves Survival in a Neonatal Asphyxial Cardiac Arrest Model.
Hamrick JT1, Hamrick JL, Bhalala U, Armstrong JS, Lee JH, Kulikowicz E, Lee JK, Kudchadkar SR, Koehler RC, Hunt EA, Shaffner DH.
Abstract
OBJECTIVES: To determine whether end-tidal CO2-guided chest compression delivery improves survival over standard cardiopulmonary resuscitation after prolonged asphyxial arrest.
DESIGN: Preclinical randomized controlled study.
SETTING: University animal research laboratory.
SUBJECTS: 1-2-week-old swine.
INTERVENTIONS: After undergoing a 20-minute asphyxial arrest, animals received either standard or end-tidal CO2-guided cardiopulmonary resuscitation. In the standard group, chest compression delivery was optimized by video and verbal feedback to maintain the rate, depth, and release within published guidelines. In the end-tidal CO2-guided group, chest compression rate and depth were adjusted to obtain a maximal end-tidal CO2 level without other feedback. Cardiopulmonary resuscitation included 10 minutes of basic life support followed by advanced life support for 10 minutes or until return of spontaneous circulation.
MEASUREMENTS AND MAIN RESULTS: Mean end-tidal CO2 at 10 minutes of cardiopulmonary resuscitation was 34 ± 8 torr in the end-tidal CO2 group (n = 14) and 19 ± 9 torr in the standard group (n = 14; p = 0.0001). The return of spontaneous circulation rate was 7 of 14 (50%) in the end-tidal CO2 group and 2 of 14 (14%) in the standard group (p = 0.04). The chest compression rate averaged 143 ± 10/min in the end-tidal CO2 group and 102 ± 2/min in the standard group (p < 0.0001). Neither asphyxia-related hypercarbia nor epinephrine administration confounded the use of end-tidal CO2-guided chest compression delivery. The response of the relaxation arterial pressure and cerebral perfusion pressure to the initial epinephrine administration was greater in the end-tidal CO2 group than in the standard group (p = 0.01 and p = 0.03, respectively). The prevalence of resuscitation-related injuries was similar between groups.
CONCLUSIONS: End-tidal CO2-guided chest compression delivery is an effective resuscitation method that improves early survival after prolonged asphyxial arrest in this neonatal piglet model. Optimizing end-tidal CO2 levels during cardiopulmonary resuscitation required that chest compression delivery rate exceed current guidelines. The use of physiologic feedback during cardiopulmonary resuscitation has the potential to provide optimized and individualized resuscitative efforts.

In vivo opening of the mitochondrial permeability transition pore in a rat model of ventricular fibrillation and closed-chest resuscitation.
Ayoub IM1, Radhakrishnan J1, Gazmuri RJ1,2.
Abstract
Opening of the mitochondrial permeability transition pore (mPTP) is considered central to reperfusion injury. Yet, most of our knowledge comes from observations in isolated mitochondria, cells, and organs. We used a rat model of ventricular fibrillation (VF) and closed-chest resuscitation to examine whether the mPTP opens in vivo and whether cyclosporine A (CsA) attenuates the associated myocardial injury. Two series of 26 and 18 rats each underwent 10 minutes of untreated VF before attempting resuscitation. In series-1, rats received 50 μCi of tritium-labeled 2-deoxyglucose ([3H]DOG) harvesting their hearts at baseline (n=5), during VF (n=5), during resuscitation (n=6), and at post-resuscitation 60 minutes (n=5) and 240 minutes (n=5). mPTP opening was estimated measuring the ratio of mitochondria to left ventricular intracellular [3H]. In series-2, rats received 10 mg/kg of CsA or vehicle before resuscitation, measuring mitochondrial NAD+ content to indirectly assess mPTP opening. In Series-1, the mPTP opening ratio vs baseline (10.4 ± 1.9) increased during VF (16.8 ± 2.4, NS), closed-chest resuscitation (20.8 ± 6.3, P<0.05), and at post-resuscitation 60 minutes (20.9 ± 4.7, P<0.05) and 240 minutes (25.7 ± 11.0, P<0.01). In series 2, CsA failed to attenuate reductions in mitochondrial NAD+ and did not affect plasma cytochrome c, plasma cardiac troponin I, myocardial function, and survival. We report for the first time in an intact rat model of VF that mPTP opens during closed-chest resuscitation

consistent with previous observations in mitochondria, cells, and organs of mPTP opening upon reperfusion. CsA, at the dose of 10 mg/kg neither prevented mPTP opening nor attenuated post-resuscitation myocardial injury.
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Evaluation of the Boussignac Cardiac arrest device (B-card) during cardiopulmonary resuscitation in an animal model.
Moore JC1, Lamhaut L2, Hutin A2, Dodd KW 3, Robinson AE3, Lick MC4, Salverda BJ3, Hinke MB3, Larabere J5, Debaty G5, Segal N6.
Abstract
AIM OF THE STUDY: The purpose of this study was to examine continuous oxygen insufflation (COI) in a swine model of cardiac arrest. The primary hypothesis was COI during standard CPR (S-CPR) should result in higher intrathoracic pressure (ITP) during chest compression and lower ITP during decompression versus S-CPR alone. These changes with COI were hypothesized to improve hemodynamics. The second hypothesis was that changes in ITP with S-CPR+COI would result in superior hemodynamics compared with active compression decompression (ACD) + impedance threshold device (ITD) CPR, as this method primarily lowers ITP during chest decompression.
METHODS: After 6min of untreated ventricular fibrillation, S-CPR was initiated in 8 female swine for 4min, then 3min of S-CPR+COI, then 3min of ACD+ITD CPR, then 3min of S-CPR+COI. ITP and hemodynamics were continuously monitored.
RESULTS: During S-CPR+COI, ITP was always positive during the CPR compression and decompression phases. ITP compression values with S-CPR+COI versus S-CPR alone were 5.5±3 versus 0.2±2 (p<0.001) and decompression values were 2.8±2 versus -1.3±2 (p<0.001), respectively. With S-CPR+COI versus ACD+ITD the ITP compression values were 5.5±3 versus 1.5±2 (p<0.01) and decompression values were 2.8±2 versus -4.7±3 (p<0.001), respectively.
CONCLUSION: COI during S-CPR created a continuous positive pressure in the airway during both the compression and decompression phase of CPR. At no point in time did COI generate a negative intrathoracic pressures during CPR in this swine model of cardiac arrest

PEDIATRIA

[Current international recommendations for pediatric cardiopulmonary resuscitation: the European guidelines].
[Article in Spanish; Abstract available in Spanish from the publisher]
López-Herce J1, Rodríguez Núñez A2, Maconochie I3, Van de Voorde P4, Biarent D5, Eich C6, Bingham R7, Rajka T8, Zideman D9, Carrillo Á10, de Lucas N11, Calvo C12, Manrique I13; Grupo Pediátrico del Consejo ERC; Grupo Español de RCP Pediátrica y Neonatal.
Abstract
OBJECTIVES:
This summary of the European guidelines for pediatric cardiopulmonary resuscitation (CPR) emphasizes the main changes and encourages health care professionals to keep their pediatric CPR knowledge and skills up to date. Basic and advanced pediatric CPR follow the same algorithm in the 2015 guidelines. The main changes affect the prevention of cardiac arrest and the use of fluids. Fluid expansion should not be used routinely in children with fever in the abuse of signs of shock because too high a volume can worsen prognosis. Rescue breaths should last around 1 second in basic CPR, making pediatric recommendations consistent with those for adults. Chest compressions should be at least as deep as one-third the anteroposterior diameter of the thorax. Most children in cardiac arrest lack a shockable rhythm, and in such cases a coordinated sequence of breaths, chest compressions, and administration of adrenalin is essential. An intraosseous canula may be the first choice for introducing fluids and medications, especially in young infants. In treating supraventricular tachycardia with cardioversion, an initial dose of 1 J/kg is currently recommended (vs the dose of 0.5 J/kg previously recommended). After spontaneous circulation is recovered, measures to control fever should be taken. The goal is to reach a normal temperature even before arrival to the hospital.

A Mobile Device App to Reduce Medication Errors and Time to Drug Delivery During Pediatric Cardiopulmonary Resuscitation: Study Protocol of a Multicenter Randomized Controlled Crossover Trial.

Siebert JN1, Ehrler F#2, Lovis C2, Combescure C3, Haddad K1, Gervaix A1, Manzano S1.

Abstract

BACKGROUND: During pediatric cardiopulmonary resuscitation (CPR), vasoactive drug preparation for continuous infusions is complex and time-consuming. The need for individual specific weight-based drug dose calculation and preparation places children at higher risk than adults for medication errors. Following an evidence-based and ergonomic driven approach, we developed a mobile device app called Pediatric Accurate Medication in Emergency Situations (PedAMINES), intended to guide caregivers step-by-step from preparation to delivery of drugs requiring continuous infusion. In a prior single center randomized controlled trial, medication errors were reduced from 70% to 0% by using PedAMINES when compared with conventional preparation methods.

OBJECTIVE: The purpose of this study is to determine whether the use of PedAMINES in both university and smaller hospitals reduces medication dosage errors (primary outcome), time to drug preparation (TDP), and time to drug delivery (TDD) (secondary outcomes) during pediatric CPR when compared with conventional preparation methods.

METHODS: This is a multicenter, prospective, randomized controlled crossover trial with 2 parallel groups comparing PedAMINES with a conventional and internationally used drug infusion rate table in the preparation of continuous drug infusion. The evaluation setting uses a simulation-based pediatric CPR cardiac arrest scenario with a high-fidelity manikin. The study involving 120 certified nurses (sample size) will take place in the resuscitation rooms of 3 tertiary pediatric emergency departments and 3 smaller hospitals. After epinephrine-induced return of spontaneous circulation, nurses will be asked to prepare a continuous infusion of dopamine using either PedAMINES (intervention group) or the infusion table (control group) and then prepare a continuous infusion of norepinephrine by crossing the procedure. The primary outcome is the medication dosage error rate. The secondary outcome is the time in seconds elapsed since the oral prescription by the physician to drug delivery by the nurse in each allocation group. TDD includes TDP. Stress level during the resuscitation scenario will be assessed for each participant by questionnaire and recorded by the heart rate monitor of a fitness watch. The study is formatted according to the Consolidated Standards of Reporting Trials Statement for Randomized Controlled Trials of Electronic and Mobile Health Applications and Online TeleHealth (CONSORT-EHEALTH) and the Reporting Guidelines for Health Care Simulation Research.

RESULTS: Enrollment and data analysis started in March 2017. We anticipate the intervention will be completed in late 2017, and study results will be submitted in early 2018 for publication expected in mid-2018. Results will be reported in line with recommendations from CONSORT-EHEALTH and the Reporting Guidelines for Health Care Simulation Research .

CONCLUSIONS: his paper describes the protocol used for a clinical trial assessing the impact of a mobile device app to reduce the rate of medication errors, time to drug preparation, and time to drug delivery during pediatric resuscitation. As research in this area is scarce, results generated from this study will be of great importance and might be sufficient to change and improve the pediatric emergency care practice.

TRIAL REGISTRATION: ClinicalTrials.gov NCT03021122; https://clinicaltrials.gov/ct2/show/NCT03021122 (Archived by WebCite at http://www.webcitation.org/6nfVJ5b4R).
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Out-of-hospital sudden cardiac arrest in children with congenital heart defects.

Jortveit J1, Klcovansky J2, Døhlen G2, Eskedal L3 , Birkeland S4, Holmstrøm H2,5.

Abstract

AIMS: Out-of-hospital sudden cardiac arrest (SCA) is a rare but devastating event in children and adolescents. The risk is assumed to be higher in children with congenital heart defects (CHDs) than in healthy individuals. The aim of the present study was to investigate the rate of and survival after out-of-hospital cardiac arrest in children 2-18 years old with CHDs.

METHODS AND RESULTS: Data concerning all live births in Norway between 1994 and 2009 were retrieved from the Medical Birth Registry of Norway, the patient administrative systems at all hospitals in Norway, the Oslo University Hospital's Clinical Registry for Congenital Heart Defects and the Norwegian Cause of Death Registry. Survivors were followed through 2012, and supplementary information for the deceased children was retrieved from medical records at Norwegian hospitals. Among the 943 871 live births in Norway from 1994 to 2009, 11 272 (1.2%) children had a CHD. We identified 11 (0.1%) children 2-18 years old with CHDs

who experienced out-of-hospital SCA. The estimated rate of out-of-hospital SCA in children 2-18 years old with CHD was 10 per 100 000 person-years. Early cardiopulmonary resuscitation was initiated in all patients. Three children survived.

CONCLUSIONS: The incidence of and survival after out-of-hospital SCA in children with CHDs were comparable to the reported rates in the general child population.

Pediatric Survivors of Out-of-Hospital Ventricular Fibrillation: Etiologies and Outcomes.
Silka MJ1, Kobayashi RL2, Hill AC2, Bar-Cohen Y2.

Abstract
BACKGROUND: In general, the prognosis is poor for pediatric patients who experience out-of-hospital (OOH) cardiac arrest, with survival rates 12-29%.

OBJECTIVE: This study describes the causes and outcomes of pediatric patients with documented ventricular fibrillation (VF) at resuscitation from OOH cardiac arrest with sustained return of spontaneous circulation (ROSC) following defibrillation and survival to hospital admission.

METHODS: Retrospective analysis of OOH-VF patients <19 years of age evaluated between 2004-2016. Primary outcome measures included demographics, arrest and resuscitation parameters, cardiac diagnoses, survival and neurologic outcome.

RESULTS: 45 patients fulfilled study criteria, median age 12 years (range: 2 months-18 years). Cardiac arrest occurred in public in 68% of cases with bystander CPR in 42% prior to emergency medical services arrival. All patients underwent defibrillation (1-6 shocks) with ROSC and survival to hospital admission. Underlying etiologies were primary electrical disease (33%) cardiomyopathy (27%), congenital heart (11%), other (13%) and unknown (16%). Prior to arrest, 40% of patients had a cardiac diagnosis and 26% had symptoms. Ultimately 40 of 45 patients (89%) survived resuscitation to hospital discharge. During 72 +37 months follow-up, 38% of survivors had a normal neurologic outcome, whereas 32% had mild neurologic impairment and 30% moderate to severe neurologic impairment.

CONCLUSION: In pediatric patients resuscitated from OOH-VF, a cardiovascular cause was identified in >80%. Regardless of cause, survival and neurologic prognosis appear improved compared to patients with asystole or pulseless electrical activity. These findings support early rhythm assessment and advanced CPR protocols in pediatric cardiac arrest victims.

Safety events in pediatric out-of-hospital cardiac arrest.
Hansen M1, Eriksson C2, Skarica B3, Meckler G4, Guise JM4.

Abstract
OBJECTIVE: The objective of this study was to explore the types of patient safety events that take place during pediatric out-of-hospital cardiac arrest resuscitation.

METHODS:
Retrospective medical record review from a single large urban EMS system of EMS-treated pediatric (<18years of age) out-of-hospital cardiac arrests (OHCA) occurring between 2008 and 2011. A chart review tool was developed for this project and each chart was reviewed by a multidisciplinary review panel. Safety events were identified in the following clinical domains: resuscitation; assessment, impression/diagnosis, and clinical decision making; airway/breathing; fluids and medications; procedures; equipment; environment; and system.

RESULTS: rom a total of 497 critical transports during the study period, we identified 35 OHCA cases (7%). A total of 87% of OHCA cases had a safety event identified. Epinephrine overdoses were identified in 31% of the OHCA cases, most of which were 10-fold overdoses. Other medication errors included failure to administer epinephrine when indicated and administration of atropine when not indicated. In 20% of OHCA cases, 3 or more intubation attempts took place or intubation attempts were ultimately not successful. Lack of end-tidal C02 use for tube confirmation was also common. The most common arrest algorithm errors were placing an advanced airway too early (before administration of epinephrine) and giving a medication not included in the algorithm, primarily atropine, both occurring in almost 1/3 of cases.

CONCLUSIONS: Safety events were common during pediatric OHCA resuscitation especially in the domains of medications, airway/breathing, and arrest algorithms.

CASE REPORTS

Neurological recovery from multiple cardiac arrests due to acute massive pulmonary embolism managed by cardiopulmonary resuscitation and extracorporeal membrane oxygenation.

Algahtani H1, Azzam M2, Albanna AS3, Shirah B3.

Abstract

Cardiac arrest is one of the leading causes of death worldwide. Anoxic-ischemic encephalopathy resulting from cardiac arrest is the third leading cause of coma requiring admission to the intensive care unit (following trauma and drug overdose). In this article, we aim to report a case of multiple cardiac arrests due to acute massive pulmonary embolism managed by cardiopulmonary resuscitation (CPR) and extracorporeal membrane oxygenation (ECMO) with an excellent neurological recovery. The present case illustrates that a good neurologic recovery can be achieved following multiple cardiac arrests and prolonged CPR for a massive pulmonary embolism. The use of ECMO in such case is believed to reduce the mortality rate and increase the likelihood of survival with good neurological outcomes. Given the potential for success and the lifesaving results, ECMO should be considered in all cases of massive pulmonary embolism with cardiopulmonary compromise.

A case of cardiopulmonary arrest due to spontaneous coronary artery dissection in a pregnant woman.

Ejima E1, Murasato Y1.

Abstract

We present the case of a young pregnant woman with cardiopulmonary arrest due to acute coronary syndrome. Emergent coronary angiography (CAG) and intravascular ultrasound (IVUS) showed extensive coronary artery dissection in the left anterior descending artery, which was treated with primary percutaneous coronary intervention. After managing the heart failure and disseminated intravascular coagulation, a dead fetus was delivered via caesarean section 4 days after admission to the hospital. Follow-up CAG and IVUS at 18 months showed persistent dissection in the non-stented site; hence, another stent was implanted. Dual antiplatelet therapy was discontinued 6 months later; however, aspirin and beta-blockers were continued lifelong.

Cardiac arrest due to ventricular fibrillation in a 23-year-old woman with broken heart syndrome.

Del Buono MG1, O'Quinn MP2, Garcia P3, Gerszten E3, Roberts C2, Moeller FG4, Abbate A5.

Abstract

Broken heart syndrome, also known as takotsubo cardiomyopathy, is a syndrome characterized by a transient regional systolic dysfunction of the left ventricle associated to a psychological stress. We herein describe a case of a 23-year-old female habitual marijuana user who was resuscitated after cardiac arrest and then diagnosed with midventricular stress cardiomyopathy complicated by subendocardial hemorrhage. We discuss this unique pathological finding, the incidence of arrhythmias in this syndrome, and the possible relation with chronic cannabis and tobacco use. Unfortunately, the patient did not survive, but had she survived, the management of the patient for secondary prevention would have been challenging considering the risk of recurrence with this disease.

Extracorporeal cardiopulmonary resuscitation for blunt cardiac rupture: A case report.

Kudo S1, Tanaka K2, Okada K2, Takemura T3.

Abstract

Extracorporeal cardiopulmonary resuscitation (ECPR) followed by operating room sternotomy, rather than resuscitative thoracotomy, might be life-saving for patients with blunt cardiac rupture and cardiac arrest who do not have multiple severe traumatic injuries. A 49-year-old man was injured in a vehicle crash and transferred to the emergency department. On admission, he was hemodynamically stable, but a plain chest radiograph revealed a widened mediastinum, and echocardiography revealed hemopericardium. A computed tomography scan revealed hemopericardium and mediastinal hematoma, without other severe traumatic

injuries. However, the patient's pulse was lost soon after he was transferred to the intensive care unit, and cardiopulmonary resuscitation was initiated. We initiated ECPR using femorofemoral veno-arterial extracorporeal membrane oxygenation (ECMO) with heparin administration, which achieved hemodynamic stability. He was transferred to the operating room for sternotomy and cardiac repair. Right ventricular rupture and pericardial sac laceration were identified intraoperatively, and cardiac repair was performed. After repairing the cardiac rupture, the cardiac output recovered spontaneously, and ECMO was discontinued intraoperatively. The patient recovered fully and was discharged from the hospital on postoperative day 7. In this patient, ECPR rapidly restored brain perfusion and provided enough time to perform operating room sternotomy, allowing for good surgical exposure of the heart. Moreover, open cardiac massage was unnecessary. ECPR with sternotomy and cardiac repair is advisable for patients with blunt cardiac rupture and cardiac arrest who do not have severe multiple traumatic injuries.

RCP

Effect of an interactive cardiopulmonary resuscitation assist device with an automated external defibrillator synchronised with a ventilator on the CPR performance of emergency medical service staff: a randomised simulation study.
Nitzschke R1, Doehn C2, Kersten JF3, Blanz J2, Kalwa TJ4, Scotti NA4, Kubitz JC2.
Abstract
BACKGROUND: The present study evaluates whether the quality of advanced cardiac life support (ALS) is improved with an interactive prototype assist device. This device consists of an automated external defibrillator linked to a ventilator and provides synchronised visual and acoustic instructions for guidance through the ALS algorithm and assistance for face-mask ventilations.
METHODS: We compared the cardiopulmonary resuscitation (CPR) quality of emergency medical system (EMS) staff members using the study device or standard equipment in a mannequin simulation study with a prospective, controlled, randomised cross-over study design. Main outcome was the effect of the study device compared to the standard equipment and the effect of the number of prior ALS trainings of the EMS staff on the CPR quality. Data were analysed using analyses of covariance (ANCOVA) and binary logistic regression, accounting for the study design.
RESULTS: In 106 simulations of 56 two-person rescuer teams, the mean hands-off time was 24.5% with study equipment and 23.5% with standard equipment (Difference 1.0% (95% CI: -0.4 to 2.5%); p = 0.156). With both types of equipment, the hands-off time decreased with an increasing cumulative number of previous CPR trainings (p = 0.042). The study equipment reduced the mean time until administration of adrenaline (epinephrine) by 23 s (p = 0.003) and that of amiodarone by 17 s (p = 0.016). It also increased the mean number of changes in the person doing chest compressions (0.6 per simulation; p < 0.001) and decreased the mean number of chest compressions (2.8 per minute; p = 0.022) and the mean number of ventilations (1.8 per minute; p < 0.001). The chance of administering amiodarone at the appropriate time was higher, with an odds ratio of 4.15, with the use of the study equipment CPR.com compared to the standard equipment (p = 0.004). With an increasing number of prior CPR trainings, the time intervals in the ALS algorithm until the defibrillations decreased with standard equipment but increased with the study device.
CONCLUSIONS: EMS staff with limited training in CPR profit from guidance through the ALS algorithm by the study device. However, the study device somehow reduced the ALS quality of well-trained rescuers and thus can only be recommended for ALS provider with limited experience.
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REGISTRES REVISIONS I EDITORIALS

Improving Outcomes of Witnessed Out-of-Hospital Cardiac Arrest After Implementation of International Liaison Committee on Resuscitation 2010 Consensus: A Nationwide Prospective Observational Population-Based Study.
Kaneko H1, Hara M2,3, Mizutani K3, Yoshiyama M3, Yokoi K4, Kabata D5, Shintani A5, Kitamura T6.
Abstract
BACKGROUND: The International Liaison Committee on Resuscitation (ILCOR) periodically updates the consensus recommendations for cardiopulmonary resuscitation to improve the outcomes of out-of-hospital

cardiac arrest (OHCA). However, little is known about the differences in outcomes of witnessed OHCA following the publication of the ILCOR 2010 and the ILCOR 2005 recommendations.

METHODS AND RESULTS: We enrolled 241 990 adults who experienced witnessed OHCA between 2007 and 2013 from a prospective, nation-wide, population-based cohort database in Japan. We compared neurologically favorable 1-month survival and 1-month survival rates post-OHCA by dividing the study period into 2 categories: the ILCOR 2005 period and ILCOR 2010 period. The associations between guideline periods and outcomes were estimated using multivariable logistic regression analysis and reported as adjusted odds ratio and 95% CI. Among 241 990 patients examined in this study, OHCA was witnessed in 44 706 patients (18%) by emergency medical service personnel and in 197 284 patients (82%) by citizens. Compared with the ILCOR 2005 period, the neurologically favorable 1-month survival rate improved from 4.6% to 5.2% (adjusted odds ratio, 1.54; 95% CI, 1.42-1.67; P<0.001), and the 1-month survival rate improved from 9.0% to 9.7% (adjusted odds ratio, 1.34; 95% CI, 1.27-1.42; P<0.001) in the ILCOR 2010 period. These improvements were also shown in patients receiving conventional versus compression-only cardiopulmonary resuscitation.

CONCLUSIONS: Outcomes of witnessed OHCA were better in the ILCOR 2010 period than those in the ILCOR 2005 period. Our results can provide baseline data for many future prospective studies.

The association between the first locating emergency ambulance being single crewed and cardiac arrest outcomes in New Zealand.

Dicker B1, Davey P2, Smith T3.

Abstract

AIM: This study investigated the association between the first locating emergency ambulance being single crewed on outcomes following out-of-hospital cardiac arrest in New Zealand.

METHOD: Using data from the St John cardiac arrest registry for the period of 1 October 2013 to 30 June 2015, cases were included if a resuscitation attempt was made and the patient was an adult. Logistic regression modelling was used to account for confounding factors. The primary outcome was survival to hospital discharge.

RESULTS: A total of 2,347 cases were included. There was no difference in the rate of return of spontaneous circulation sustained to hospital handover in patients attended by either single-crewed (27%) or double-crewed ambulances (32%); p=0.059. However, patients were significantly less likely to survive to hospital discharge when attended by single-crewed (12%) compared to double-crewed ambulances (17%) with an OR of 0.533, 95% confidence interval 0.320-0.888 and p=0.016.

CONCLUSION: Patients had lower survival to hospital discharge outcomes when the first locating ambulance was single crewed than those where the first locating ambulance was double crewed.

The Value of Arterial Blood Gas Parameters for Prediction of Mortality in Survivors of Out-of-hospital Cardiac Arrest.

von Auenmueller KI1, Christ M1, Sasko BM1, Trappe HJ 1.

Abstract

CONTEXT: Sudden cardiac death is one of the leading causes of death in Europe, and early prognostication remains challenging. There is a lack of valid parameters for the prediction of survival after cardiac arrest.

AIMS: This study aims to investigate if arterial blood gas parameters correlate with mortality of patients after out-of-hospital cardiac arrest.

MATERIALS AND METHODS: All patients who were admitted to our hospital after resuscitation following out-of-hospital cardiac arrest between January 1, 2008, and December 31, 2013, were included in this retrospective study. The patient's survival 5 days after resuscitation defined the study end-point. For the statistical analysis, the mean, standard deviation, Student's t-test, Chi-square test, and logistic regression analyses were used (level of significance $P < 0.05$).

RESULTS: Arterial blood gas samples were taken from 170 patients. In particular, pH < 7.0 (odds ratio [OR]: 7.20; 95% confidence interval [CI]: 3.11-16.69; $P < 0.001$) and lactate ≥ 5.0 mmol/L (OR: 6.79; 95% CI: 2.77-16.66; $P < 0.001$) showed strong and independent correlations with mortality within the first 5 days after hospital admission.

CONCLUSION: Our study results indicate that several arterial blood gas parameters correlate with mortality of patients after out-of-hospital resuscitation. The most relevant parameters are pH and lactate because they are strongly and independently associated with mortality within the first 5 days after resuscitation. Despite this

correlation, none of these parameters by oneself is strong enough to allow an early prognostication. Still, these parameters can contribute as part of a multimodal approach to assessing the patients' prognosis.

Association of Neighborhood Demographics With Out-of-Hospital Cardiac Arrest Treatment and Outcomes: Where You Live May Matter.
Starks MA1, Schmicker RH2, Peterson ED1, May S2 , Buick JE3, Kudenchuk PJ2, Drennan IR3, Herren H2, Jasti J4, Sayre M2, Stub D5, Vilke GM6, Stephens SW7, Chang AM8, Nuttall J9, Nichol G2; Resuscitation Outcomes Consortium (ROC).
Abstract
Importance: We examined whether resuscitation care and outcomes vary by the racial composition of the neighborhood where out-of-hospital cardiac arrests (OHCAs) occur.
Objective: To evaluate the association between bystander treatments (cardiopulmonary resuscitation and automatic external defibrillation) and timing of emergency medical services personnel on OHCA outcomes according to the racial composition of the neighborhood where the OHCA event occurred.
Design, Setting, and Participants: This retrospective observational cohort study examined patients with OHCA from January 1, 2008, to December 31, 2011, using data from the Resuscitation Outcomes Consortium. Neighborhoods where OHCA occurred were classified by census tract, based on percentage of black residents: less than 25%, 25% to 50%, 51% to 75%, or more than 75%. Multilevel mixed-effects logistic regression modeling examined the association between racial composition of neighborhoods and OHCA survival, adjusting for patient, neighborhood, and treatment characteristics.
Main Outcomes and Measures: Survival to discharge, return of spontaneous circulation on emergency department arrival, and favorable neurologic status at discharge.
Results: We examined 22 816 adult patients with nontraumatic OHCA at Resuscitation Outcomes Consortium sites in the United States. The median age of patients with OHCA was 64 years (interquartile range [IQR], 51-78). Compared with patients who experienced OHCA in neighborhoods with a lower proportion of black residents, those in neighborhoods with more than 75% black residents were slightly younger, were more frequently women, had lower rates of initial shockable rhythm, and less frequently experienced OHCA in a public location. The percentage of patients with OHCA receiving bystander cardiopulmonary resuscitation or a lay automatic external defibrillation was inversely associated with the percentage of black residents in neighborhoods. Compared with OHCA in predominantly white neighborhoods (<25% black), those with OHCA in mixed to majority black neighborhoods had lower adjusted survival rates to hospital discharge (25%-50% black: odds ratio, 0.76; 95% CI, 0.61-0.93; 51%-75% black: odds ratio, 0.67; 95% CI, 0.49-0.90; >75% black: odds ratio, 0.63; 95% CI, 0.50-0.79; P < .001). There was similar mortality risk for black and white patients with OHCA in each neighborhood racial quantile. When the primary model included geographic site, there was an attenuated nonsignificant association between racial composition in a neighborhood and survival.
Conclusions and Relevance: Those with OHCA in predominantly black neighborhoods had the lowest rates of bystander cardiopulmonary resuscitation and automatic external defibrillation use and significantly lower likelihood for survival compared with predominantly white neighborhoods. Improving bystander treatments in these neighborhoods may improve cardiac arrest survival.

Improving Trend in Ventricular Fibrillation/Pulseless Ventricular Tachycardia Out-of-Hospital Cardiac Arrest in Rochester Minnesota: A 26-Year Observational Study from 1991 to 2016.
Okubo M1, Atkinson EJ2, Hess EP3, White RD4.
Abstract
BACKGROUND: Mortality from out-of-hospital cardiac arrest (OHCA) is characterized by substantial regional variation. The Institute of Medicine (IOM) recently recommended enhancing the capabilities of EMS systems to improve outcome. In this study, we analyzed the trend in outcome from ventricular fibrillation/pulseless ventricular tachycardia (VF/pVT) OHCA in Rochester MN. Survival from these forms of arrest is commonly employed as a benchmark of Emergency Medical Services (EMS) system performance.
METHODS: Using a population-based Utstein-style registry in Rochester MN where a first responder early defibrillation system is utilized, we evaluated outcome from all EMS-treated VF/pVT arrests and the subgroup of bystander-witnessed VF/pVT from 1991 to 2016. Outcome measurement was neurologically intact survival to discharge, defined as Cerebral Performance Category (CPC) 1 or 2. We divided the 26-year study into three periods: 1991-1997, 1998-2008, and 2009-2016, based on initiation of the first responder system of police

officers in 1991 and fire-rescue personnel in 1998, and the latter period for comparison with our previous report in 2009.

RESULTS: We observed 355 all VF/pVT arrests and 292 bystander-witnessed VF/pVT arrests between 1991 and 2016. In 2009-2016, neurologically intact survival to discharge from overall VF/pVT and bystander-witnessed VF/pVT increased to 53.7% and 65.2%, respectively, compared with 39.5% and 43.4% in 1991-1997. Using multivariable analysis, survival significantly increased in 2009-2016 among all VF/pVT arrests (adjusted OR, 3.10; 95% CI, 1.54-6.40) and bystander- witnessed VF/pVT (adjusted OR, 4.28; 95% CI, 2.01-9.50), compared with those in 1991-1997.

CONCLUSIONS: We observed a significant improving secular trend in neurologically intact survival from VF/pVT cardiac arrests with a relatively high recent survival rate in this EMS System.

6. J Rural Health. 2017 Aug 26. doi: 10.1111/jrh.12266. [Epub ahead of print]

The Effect of Rurality on Out-of-Hospital Cardiac Arrest Resuscitation Incidence: An Exploratory Study of a National Registry Utilizing a Categorical Approach.

Masterson S1, Teljeur C2, Cullinan J3, Murphy AW1, Deasy C4, Vellinga A1.

Abstract

PURPOSE: Variation in incidence is a universal feature of out-of-hospital cardiac arrest (OHCA). One potential source of variation is the rurality of the location where the OHCA incident occurs. While previous work has used a simple binary approach to define rurality, the purpose of this study was to use a categorical approach to quantify the impact of urban-rural classification on OHCA incidence in the Republic of Ireland.

METHODS: The observed versus expected ratio of OHCA incidence where resuscitation was attempted for the period January 1, 2012, to December 31, 2014, was calculated for each of the 3,408 electoral divisions (ED). EDs were then classified into 1 of 6 urban-rural classes. Multilevel modeling was used to test for variation in incidence ratios (IR) across the urban-rural classes.

FINDINGS: A total of 4,755 cases of adult OHCA, not witnessed by Emergency Medical Services, where resuscitation was attempted were included in the study. The number of EDs in each category was as follows: city (n = 477); town (n = 293); near village (n = 182); remote village (n = 84); near rural (n = 1,479); remote rural (n = 893). The IR per ED varied from 0 to 18.38 (EDs, n = 3,408). Multilevel modeling showed that 2.36% of variation in IR was due to urban-rural classification. This dropped to 0.45% when adjusted for ED deprivation score and median distance to an ambulance station. The addition of other explanatory variables did not improve the model.

CONCLUSION: OHCA variation in Ireland is limited and almost fully explained by area-level deprivation and proximity to ambulance stations.

CAUSES D'ACR

BJA: Based on these results, cumulative comorbidity can help explain survival variability and improve prognostic accuracy!

1. Resuscitation. 2017 Aug 28. pii: S0300-9572(17)30591-9. doi: 10.1016/j.resuscitation.2017.08.239. [Epub ahead of print]

The relationship between chronic health conditions and outcome following out-of-hospital ventricular fibrillation cardiac arrest.

Dumas F1, Blackwood J2, White L2, Fahrenbruch C2, Jouven X3, Cariou A3, Rea T2.

Abstract

INTRODUCTION: The cumulative burden of chronic health conditions could contribute to out-of-hospital cardiac arrest (OHCA) physiology and response to attempted resuscitation. Yet little is known about how chronic health conditions influence prognosis. We evaluated the relationship between cumulative comorbidity and outcome following ventricular fibrillation OHCA using 3 different scales.

METHODS: We performed a cohort investigation of persons >=18years who suffered non-traumatic OHCA and presented with ventricular fibrillation between January 1, 2007 and December 31, 2013 in a metropolitan emergency medical service (EMS) system. Chronic conditions were ascertained from EMS reports. The primary relationship between cumulative comorbidity and outcome (survival to hospital discharge) used the Charlson Index and two other scales. Analyses used logistical regression (LR), multiple imputation and inverse probability weighting.

RESULTS: During the study period 1166/1488 potential patients were included. The median Charlson Index was 1 (25th-75th%: 0-2). Overall survival was 43.9%. Comorbidity was associated with a dose-dependent decrease

in the likelihood of survival. Compared to Charlson Score of 0, the odds ratio of survival was 0.68 (0.48-0.96) for Charslon of 1, 0.49 (0.35-0.69) for Charlson of 2, and 0.43 (0.30-0.61) for Charlson of >=3 after adjustment for Utstein predictors using multivariable LR. This inverse comorbidity-survival association was similar for the other 2 scales and was observed for different clinical outcomes (admission to hospital, functional survival, 30-day survival, and 1-year survival).

CONCLUSION: Based on these results, cumulative comorbidity can help explain survival variability and improve prognostic accuracy. Whether information about cumulative comorbidity or specific health conditions can inform resuscitation care is unknown though the results suggest comorbidity may influence acute pathophysiology and treatment response.

Description of Abnormal Breathing Is Associated With Improved Outcomes and Delayed Telephone Cardiopulmonary Resuscitation Instructions.
Fukushima H1,2,3, Panczyk M4, Hu C5, Dameff C3, Chikani V4, Vadeboncoeur T6, Spaite DW3, Bobrow BJ4,3,7.
Abstract
BACKGROUND: Emergency 9-1-1 callers use a wide range of terms to describe abnormal breathing in persons with out-of-hospital cardiac arrest (OHCA). These breathing descriptors can obstruct the telephone cardiopulmonary resuscitation (CPR) process.
METHODS AND RESULTS: We conducted an observational study of emergency call audio recordings linked to confirmed OHCAs in a statewide Utstein-style database. Breathing descriptors fell into 1 of 8 groups (eg, gasping, snoring). We divided the study population into groups with and without descriptors for abnormal breathing to investigate the impact of these descriptors on patient outcomes and telephone CPR process. Callers used descriptors in 459 of 2411 cases (19.0%) between October 1, 2010, and December 31, 2014. Survival outcome was better when the caller used a breathing descriptor (19.6% versus 8.8%, P<0.0001), with an odds ratio of 1.63 (95% confidence interval, 1.17-2.25). After exclusions, 379 of 459 cases were eligible for process analysis. When callers described abnormal breathing, the rates of telecommunicator OHCA recognition, CPR instruction, and telephone CPR were lower than when callers did not use a breathing descriptor (79.7% versus 93.0%, P<0.0001; 65.4% versus 72.5%, P=0.0078; and 60.2% versus 66.9%, P=0.0123, respectively). The time interval between call receipt and OHCA recognition was longer when the caller used a breathing descriptor (118.5 versus 73.5 seconds, P<0.0001).
CONCLUSIONS: Descriptors of abnormal breathing are associated with improved outcomes but also with delays in the identification of OHCA. Familiarizing telecommunicators with these descriptors may improve the telephone CPR process including OHCA recognition for patients with increased probability of survival.

TRAUMA

Fewer REBOA complications with smaller devices and partial occlusion: evidence from a multicentre registry in Japan.
Matsumura Y1, Matsumoto J2, Kondo H3, Idoguchi K4, Ishida T5, Kon Y6, Tomita K7, Ishida K8, Hirose T9, Umakoshi K10, Funabiki T11; DIRECT-IABO Investigators.
Abstract
BACKGROUND: Resuscitative endovascular balloon occlusion of the aorta (REBOA) performed by emergency physicians has been gaining acceptance as a less invasive technique than resuscitative thoracotomy.
OBJECTIVE: To evaluate access-related complications and duration of occlusions during REBOA.
METHODS: Patients with haemorrhagic shock requiring REBOA, from 18 hospitals in Japan, included in the DIRECT-IABO Registry were studied. REBOA-related characteristics were compared between non-survivors and survivors at 24 hours. 24-Hour survivors were categorised into groups with small (≤8 Fr), large (≥9 Fr) or unusual sheaths (oversized or multiple) to assess the relationship between the sheath size and complications. Haemodynamic response, occlusion duration and outcomes were compared between groups with partial and complete REBOA.
RESULTS: Between August 2011 and December 2015, 142 adults undergoing REBOA were analysed. REBOA procedures were predominantly (94%) performed by emergency medicine (EM) physicians. The median duration of the small sheath (n=53) was 19 hours compared with 7.5 hours for the larger sheaths (p=0.025).

Smaller sheaths were more likely to be removed using external manual compression (96% vs 45%, p<0.001). One case of a common femoral artery thrombus (large group) and two cases of amputation (unusual group) were identified. Partial REBOA was carried out in more cases (n=78) and resulted in a better haemodynamic response than complete REBOA (improvement in haemodynamics, 92% vs 70%, p=0.004; achievement of stability, 78% vs 51%, p=0.007) and allowed longer occlusion duration (median 58 vs 33 min, p=0.041). No statistically significant difference in 24-hour or 30-day survival was found between partial and complete REBOA.

CONCLUSION: In Japan, EM physicians undertake the majority of REBOA procedures. Smaller sheaths appear to have fewer complications despite relatively prolonged placement and require external compression on removal. Although REBOA is a rarely performed procedure, partial REBOA, which may extend the occlusion duration without a reduction in survival, is used more commonly in Japan.

Resuscitative Endovascular Balloon Occlusion of the Aorta in trauma: a systematic review of the literature.
Gamberini E1, Coccolini F2, Tamagnini B3, Martino C1, Albarello V1, Benni M1, Bisulli M4, Fabbri N5, Hörer TM6, Ansaloni L2, Coniglio C7, Barozzi M8, Agnoletti V1.
Abstract
AIMS: Resuscitative endovascular balloon occlusion of the aorta has been a hot topic in trauma resuscitation during these last years. The aims of this systematic review are to analyze when, how, and where this technique is performed and to evaluate preliminary results.
METHODS: The literature search was performed on online databases in December 2016, without time limits. Studies citing endovascular balloon occlusion of the aorta in trauma were retrieved for evaluation.
RESULTS: Sixty-one articles met the inclusion criteria and were selected for the systematic review. Overall, they included 1355 treated with aortic endovascular balloon occlusion, and 883 (65%) patients died after the procedure. In most of the included cases, a shock state seemed to be present before the procedure. Time of death and inflation site was not described in the majority of included studies. Procedure-related and shock-related complications are described. Introducer sheath size and comorbidity seems to play the role of risk factors.
CONCLUSIONS: Resuscitative endovascular balloon occlusion of the aorta is increasingly used in trauma victim resuscitation all over the world, to elevate blood pressure and limit fluid infusion, while other procedures aimed to stop the bleeding are performed. High mortality rate is probably due to the severity of the injuries. Time and place of balloon insertion, zone of balloon inflation, and inflation cutoff time are very heterogeneous.
Free Article

MONITORATGE

Cerebral oximetry versus end tidal CO2 in predicting ROSC after cardiac arrest.
Singer AJ1, Nguyen RT2, Ravishankar ST2, Schoenfeld ER3, Thode HC Jr4, Henry MC4, Parnia S2.
Abstract
STUDY OBJECTIVE: Both end tidal CO2 (ETCO2) and cerebral oxygen saturations (rSO2) have been studied to determine their ability to monitor the effectiveness of CPR and predict return of spontaneous circulation (ROSC). We compared the accuracy of ETCO2 and rSO2 at predicting ROSC in ED patients with out-of-hospital cardiac arrest (OHCA).
METHODS: We performed a prospective, observational study of adult ED patients presenting in cardiac arrest. We collected demographic and clinical data including age, gender, presenting rhythm, rSO2, and ETCO2. We used receiver operating characteristic curves to compare how well rSO2 and ETCO2 predicted ROSC.
RESULTS: 225 patients presented to the ED with cardiac arrest between 10/11 and 10/14 of which 100 had both rSO2 and ETCO2 measurements. Thirty three patients (33%) had sustained ROSC, only 2 survived to discharge. The AUCs for rSO2 and ETCO2 were similar (0.69 [95% CI, 0.59-0.80] and 0.77 [95% CI, 0.68-0.86], respectively), however, rSO2 and ETCO2 were poorly correlated (0.12, 95% CI, -0.08-0.31). The optimal cutoffs for rSO2 and ETCO2 were 50% and 20mm Hg respectively. At these cutoffs, ETCO2 was more sensitive (100%, 95% CI 87-100 vs. 48%, 31-66) but rSO2 was more specific (85%, 95% CI, 74-92 vs. 45%, 33-57).
CONCLUSIONS: While poorly correlated, rSO2 and ETCO2 have similar diagnostic characteristics. ETCO2 is more sensitive and rSO2 is more specific at predicting ROSC in OHCA.

SIMULACIÓ I ENTRENAMENT

Modeling a Novel Hypothetical Use of Postal Collection Boxes as Automated External Defibrillator Access Points.
Srinivasan S1, Salerno J1, Hajari H2, Weiss LS1, Salcido DD3.

Abstract
INTRODUCTION: Optimizing placement of Automated External Defibrillators (AED) can increase survival after an out-of-hospital cardiac arrest (OHCA). Using postal collection boxes (PCB) as locations for AEDs could potentially enhance accessibility and streamline maintenance. In this study, we modeled the hypothetical effects of deploying AEDs at PCB locations.
HYPOTHESIS: We hypothesized that PCB-AEDs would increase AED coverage overall and in residential areas, and reduce the distance from OHCA to an AED.
METHODS: AEDs in Pittsburgh, PA were identified by the University of Pittsburgh Resuscitation Logistics and Informatics Venture (n=747). PCB locations were obtained from the United States Postal Service (n=479). OHCA locations from 2009 to 2014 were obtained from the Pittsburgh site of the Resuscitation Outcomes Consortium. AED coverage assuming a ¼ mile radius around each AED was estimated for known AEDs, PCB-AEDs (hypothetical AED locations), and known AEDs augmented by PCB-AEDs, both overall and for residential and non-residential zones. Linear distance from each OHCA to the nearest AED was calculated and compared between the sets.
RESULTS: The set of known AEDs augmented with PCB-AEDs covered more of the city overall (55% vs 30%), as well as greater proportions of residential (62% vs 27%) and non-residential areas (45% vs 30%). The median distance from OHCA to AED was significantly shorter when known AEDs were augmented with PCB-AEDs (0.12mi vs 0.32mi; p=0.001).
CONCLUSION: Augmenting existing publicly accessible AEDs with AEDs deployed at PCBs can increase AED spatial coverage in both residential and non-residential areas, and reduce the distance from AED to OHCA.

Manikin Human-Patient Simulator Training.
Horn GT, Bowling FY, Lowe DE, Parimore JG, Stagliano DR, Studer NM.

Abstract
BACKGROUND: Human-patient simulators (HPSs) may help enhance medical education. Manikin HPS devices respond to common field medical interventions, such as cricothyroidotomy, and have realistic feedback features, such as respirations and pulses. This study surveys Special Operations Medics for evaluations of HPS features.
METHODS: Of 518 subjects, 376 completed testing and surveys with valid responses. A total of 102 variables were divided into three categories-general characteristics, procedures, and injuries-and assessed on a fivepoint Likert scale. The Student t test was used to analyze data together and as separate groups against each other and against an aggregated mean.
RESULTS: Features that received high scores (i.e., higher than 4.5/5) corresponded closely with pillars of the Tactical Combat Casualty Care (TCCC) curriculum, basic life support, and realism.
DISCUSSION: US Army Special Operations Command and US Special Operations Command Medics have overall high confidence in manikin HPS devices and specifically in those that align with TCCC training and lifesaving procedures. The skills most valued coincide with difficult-to-practice measures, such as cricothyroidotomy and wound packing. Features such as prerecorded sounds, sex, automated movements, skin color, defibrillation, bowel sounds, and electrocardiogram are rated lower. These evaluations may guide future development or procurement of manikin HPS devices.

State-wide reduction in in-hospital cardiac complications in association with introduction of a national standard for recognising deteriorating patients.
Martin C1, Jones D2, Wolfe R1.
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Unit, Austin Hospital, Studley Road Heidelberg, Victoria, 3084 Australia. Electronic address: Daryl.Jones@austin.org.au.

Abstract
AIM: To examine whether introducing a national standard to improve the recognition of and response to clinical deterioration, was associated with a reduction in cardiovascular events in the hospital environment.
METHOD: Interrupted time series was used to analyse the trajectories of monthly complication rates for 4.69 million admissions in 218 hospitals. Trajectory slopes determined for the "baseline period" (1 July 2007 to 30 June 2010) and the "Intervention period" (1 January 2013 to 30 June 2014) were compared (slope ratio).
RESULTS: Before the intervention, complication rates due to arrhythmias were increasing, acute coronary syndrome (ACS) and all-cause mortality decreasing, but were constant for cardiac arrest and heart failure and pulmonary oedema. Analysis of the overall data suggested reduction in the rate of cardiac and ACS complications after the intervention, but no significant change in overall hospital mortality. Analysis by age category showed significant reductions in monthly rate trajectories in the 80 plus years age group for cardiac arrest (slope ratio 0.983, 95% CI: 0.972 - 0.994) and ACS (0.989, 95% CI: 0.981 - 0.997) complications. Slope ratios indicating reduced monthly rates were seen in females for cardiac arrest (0.985, 95% CI: 0.977 - 0.994), ACS (0.991, 95% CI: 0.984 - 0.998) and heart failure (0.993, 95% CI: 0.986 - 1.000) complications. There were also significant reductions in cardiac arrest (0.983, 95% CI: 0.969 - 0.996), ACS (0.991, 95% CI: 0.982 - 1.000) and arrhythmia (0.996, 95% CI: 0.994 - 0.998) complications for surgical patients.
CONCLUSIONS: Introduction of a national standard for deteriorating hospitalised patients was associated with a reduction in the rates of in-hospital cardiac arrests and acute coronary syndromes in acute hospitals. Greatest benefit was seen in the elderly, female and surgical patients.

Use of a Real-Time Training Software (Laerdal QCPR®) Compared to Instructor-Based Feedback for High-Quality Chest Compressions Acquisition in Secondary School Students: A Randomized Trial.

Cortegiani A1, Russotto V1, Montalto F1, Iozzo P1, Meschis R1, Pugliesi M1, Mariano D1, Benenati V1, Raineri SM1, Gregoretti C1, Giarratano A1.

Abstract
High-quality chest compressions are pivotal to improve survival from cardiac arrest. Basic life support training of school students is an international priority. The aim of this trial was to assess the effectiveness of a real-time training software (Laerdal QCPR®) compared to a standard instructor-based feedback for chest compressions acquisition in secondary school students. After an interactive frontal lesson about basic life support and high quality chest compressions, 144 students were randomized to two types of chest compressions training: 1) using Laerdal QCPR® (QCPR group- 72 students) for real-time feedback during chest compressions with the guide of an instructor who considered software data for students' correction 2) based on standard instructor-based feedback (SF group- 72 students). Both groups had a minimum of a 2-minute chest compressions training session. Students were required to reach a minimum technical skill level before the evaluation. We evaluated all students at 7 days from the training with a 2-minute chest compressions session. The primary outcome was the compression score, which is an overall measure of chest compressions quality calculated by the software expressed as percentage. 125 students were present at the evaluation session (60 from QCPR group and 65 from SF group). Students in QCPR group had a significantly higher compression score (median 90%, IQR 81.9-96.0) compared to SF group (median 67%, IQR 27.7-87.5), p = 0.0003. Students in QCPR group performed significantly higher percentage of fully released chest compressions (71% [IQR 24.5-99.0] vs 24% [IQR 2.5-88.2]; p = 0.005) and better chest compression rate (117.5/min [IQR 106-123.5] vs 125/min [115-135.2]; p = 0.001). In secondary school students, a training for chest compressions based on a real-time feedback software (Laerdal QCPR®) guided by an instructor is superior to instructor-based feedback training in terms of chest compression technical skill acquisition.
TRIAL REGISTRATION: Australian New Zealand Clinical Trials Registry ACTRN12616000383460.
Free Article

CURES POST-RCE

Continuous versus intermittent neuromuscular blockade in patients during targeted temperature management after resuscitation from cardiac arrest-A randomized, double blinded, double dummy, clinical trial.

Stöckl M1, Testori C2, Sterz F2, Holzer M2, Weiser C2, Schober A2, Nichol G3, Frossard M2, Herkner H2, Kechvar J4, Losert H5.

Abstract

AIM OF THE STUDY: Current guidelines recommend targeted temperature management to improve neurological outcome after cardiac arrest. Evidence regarding an ideal sedative/analgesic regimen including skeletal muscle paralysis is limited.

METHODS: Patients were randomized to either a continuous administration of rocuronium (continuous-NMB-group) or to a continuous administration of saline supplemented by rocuronium bolus administration if demanded (bolus-NMB-group). The primary outcome was the number of shivering episodes. Secondary outcomes included survival and neurological status one year after cardiac arrest, time to awakening, length of stay as well as required cumulative dose of rocuronium, midazolam and fentanyl.

RESULTS: Sixty-three patients (32 continuous-NMB-group; 31 bolus-NMB-group) were enrolled. Differences in baseline characteristics were not significant. Shivering episodes were detected in 94% of the patients in the bolus-NMB-group compared to 25% of the patients receiving continuous rocuronium infusion (p<0.01). The continuous-NMB-group received significant lower doses of midazolam (4.3±0.8mg/kg vs. 5.1±0.9mg/kg, p<0.01) and fentanyl (62±14μg/kg vs. 71±7μg/kg, p<0.01), but higher cumulative doses of rocuronium (7.8±1.8mg/kg vs. 2.3±1.6mg/kg, p<0.01). Earlier awakening (2 [IQR 2;3] vs. 4 [IQR 2;7.5] days, p=0.04) and decreased length of stay at the ICU (6 [IQR 3;5.9] vs. 10 [IQR 5;15] days, p=0.03) were observed in the continuous-NMB-group. There were no significant differences in survival and quality of life 12 months after cardiac arrest.

CONCLUSIONS: Continuous neuromuscular blockade during the first day after resuscitation reduced shivering, midazolam and fentanyl requirement, time to awakening and discharge from intensive care unit. There were no differences in overall survival, cooling rate and time to target temperature

2. Resuscitation. 2017 Aug 24. pii: S0300-9572(17)30551-8. doi: 10.1016/j.resuscitation.2017.08.217. [Epub ahead of print]

Early Detection of brain death using the Bispectral Index (BIS) in patients treated by extracorporeal cardiopulmonary resuscitation (E-CPR) for refractory cardiac arrest.

Jouffroy R1, Lamhaut L2, Guyard A1, Philippe P1, An K1, Spaulding C3, Baud F4, Carli P2, Vivien B5.

Abstract

BACKGROUND: Despite increasing use of extracorporeal cardiopulmonary resuscitation (e-CPR) for treatment of refractory cardiac arrest patients, prognosis remains dismal, often resulting in brain-death. However, clinical assessment of brain-death occurence is difficult in post-cardiac arrest patients, sedated, paralyzed, under mild therapeutic hypothermia (MTH). Our objective was to assess the usefulness of Bispectral-Index (BIS) monitoring at bedside for an early detection of brain-death occurrence in refractory cardiac arrest patients treated by e-CPR.

METHODS: This prospective study was performed in an intensive care unit of an university hospital. Forty-six patients suffering from refractory cardiac arrest treated by e-CPR were included. BIS was continuously recorded during ICU hospitalization. Clinical brain-death was confirmed when appropriate by EEG and/or cerebral CT angiography.

RESULTS: Twenty-nine patients evolved into brain-death and had average BIS values under MTH and after rewarming (temperature ≥35°C) of 4 (0-47) and 0 (0-82), respectively. Among these, 11 (38%) entered into a procedure of organs donation. Among the 17 non-brain-dead patients, the average BIS values at admission and after rewarming were 39 (0-65) and 59 (22-82), respectively. Two patients had on admission a BIS value equal to zero and evolved to a poor prognostic (CPC 4) and died after care limitations. BIS values were significantly different between patients who developed brain death and those who did not. In both groups, no differences were observed between the AUCs of ROC curves for BIS values under MTH and after rewarming (respectively 0.86 vs 0.83, NS).

CONCLUSIONS: Initial values of BIS could be used as an assessment tool for early detection of brain-death in refractory cardiac arrest patients treated by mild therapeutic hypothermia and e-CPR.

ELECTROFISIO Y DESFIBRILACIÓN

1. Resuscitation. 2017 Aug 24. pii: S0300-9572(17)30553-1. doi: 10.1016/j.resuscitation.2017.08.219. [Epub ahead of print]

Predictive Value of Amplitude Spectrum Area of Ventricular Fibrillation Waveform in Patients with Acute or Previous Myocardial Infarction in Out-of-Hospital Cardiac Arrest.

Hulleman M1, Salcido DD2, Menegazzi JJ2, Souverein PC3, Tan HL4, Blom MT4, Koster RW4.

Abstract

BACKGROUND: Amplitude spectrum area (AMSA) of ventricular fibrillation (VF) has been associated with survival from out-of-hospital cardiac arrest (OHCA). Ischemic heart disease has been shown to change AMSA. We studied whether the association between AMSA and survival changes with acute ST-elevation myocardial infarction (STEMI) as cause of the OHCA and/or previous MI.

METHODS: Multivariate logistic regression with log-transformed AMSA of first artifact-free VF segment was used to assess the association between AMSA and survival, according to presence of STEMI or previous MI, adjusting for resuscitation characteristics, medication use and comorbidities.

RESULTS: Of 716 VF-patients included from an OHCA-registry in the Netherlands, 328 (46%) had STEMI as cause of OHCA. Previous MI was present in 186 (26%) patients. Survival was 66%; neither previous MI (P=0.11) nor STEMI (P=0.78) altered survival. AMSA was a predictor of survival (ORadj: 1.52, 95%-CI: 1.28-1.82). STEMI was associated with lower AMSA (8.4 mV-Hz [3.7-16.5] vs. 12.3 mV-Hz [5.6-23.0]; P<0.001), but previous MI was not (9.5 mV-Hz [3.9-18.0] vs 10.6 mV-Hz [4.6-19.3]; P=0.27). When predicting survival, there was no interaction between previous MI and AMSA (P=0.14). STEMI and AMSA had a significant interaction (P=0.002), whereby AMSA was no longer a predictor of survival (ORadj: 1.03, 95%-CI: 0.77-1.37) in STEMI-patients. In patients without STEMI, higher AMSA was associated with higher survival rates (ORadj: 1.80, 95%-CI: 1.39-2.35).

CONCLUSIONS: The prognostic value of AMSA is altered by the presence of STEMI: while AMSA has strong predictive value in patients without STEMI, AMSA is not a predictor of survival in STEMI-patients.

Optimizing a Drone Network to Deliver Automated External Defibrillators.
Boutilier JJ1, Brooks SC1, Janmohamed A1, Byers A1, Buick JE1, Zhan C1, Schoellig AP1, Cheskes S1, Morrison LJ1, Chan TCY2; Rescu Epistry Investigators.

Abstract

BACKGROUND: Public access defibrillation programs can improve survival after out-of-hospital cardiac arrest, but automated external defibrillators (AEDs) are rarely available for bystander use at the scene. Drones are an emerging technology that can deliver an AED to the scene of an out-of-hospital cardiac arrest for bystander use. We hypothesize that a drone network designed with the aid of a mathematical model combining both optimization and queuing can reduce the time to AED arrival.

METHODS: We applied our model to 53 702 out-of-hospital cardiac arrests that occurred in the 8 regions of the Toronto Regional RescuNET between January 1, 2006, and December 31, 2014. Our primary analysis quantified the drone network size required to deliver an AED 1, 2, or 3 minutes faster than historical median 911 response times for each region independently. A secondary analysis quantified the reduction in drone resources required if RescuNET was treated as a large coordinated region.

RESULTS: The region-specific analysis determined that 81 bases and 100 drones would be required to deliver an AED ahead of median 911 response times by 3 minutes. In the most urban region, the 90th percentile of the AED arrival time was reduced by 6 minutes and 43 seconds relative to historical 911 response times in the region. In the most rural region, the 90th percentile was reduced by 10 minutes and 34 seconds. A single coordinated drone network across all regions required 39.5% fewer bases and 30.0% fewer drones to achieve similar AED delivery times.

CONCLUSIONS: An optimized drone network designed with the aid of a novel mathematical model can substantially reduce the AED delivery time to an out-of-hospital cardiac arrest event.

ECMO

Prognostic indicators of survival and survival prediction model following extracorporeal cardiopulmonary resuscitation in patients with sudden refractory cardiac arrest.
Lee SW1, Han KS1, Park JS1, Lee JS 2, Kim SJ3.

Abstract

BACKGROUND: Extracorporeal cardiopulmonary resuscitation (ECPR) has been considered in selected candidates with potentially reversible causes during a limited period. Candidate selection and the identification of predictable conditions are important factors in determining outcomes during CPR in the emergency department (ED). The objective of this study was to determine the key indicators and develop a prediction model for survival to hospital discharge in patients with sudden cardiac arrest who received ECPR.

METHODS: This retrospective analysis was based on a prospective cohort, which included data on CPR with ECPR-related variables. Patients with sudden cardiac arrest who received ECPR at the ED from May 2006 to June 2016 were included. The primary outcome was survival to discharge. Prognostic indicators and the prediction model were analyzed using logistic regression.

RESULTS: Out of 111 ECPR patients, there were 18.9% survivors. Survivors showed younger age, shorter CPR duration ($p < 0.05$) and had tendencies of higher rate of initial shockable rhythm ($p = 0.055$) and higher rate of any ROSC event before ECPR ($p = 0.066$) than non-survivors. Eighty-one percent of survivors showed favorable neurologic outcome at discharge. In univariate analysis, the following factors were associated with survival: no preexisting comorbidities, initial serum hemoglobin level ≥14 g/dL, and mean arterial pressure ≥60 mmHg after ECPR. Based on multivariate logistic regression, predictors for survival in ECPR were as follows: age ≤56 years, no asystole as the initial arrest rhythm, CPR duration of ≤55 min, and any return of spontaneous circulation (ROSC) event before ECPR. The prediction scoring model for survival had a c-statistic of 0.875.

CONCLUSIONS: With careful consideration of differences in the inclusion criteria, the prognostic indicators and prediction scoring model for survival in our study may be helpful in the rapid decision-making process for ECPR implementation during CPR in the ED.

RECERCA EXPERIMENTAL

1. Shock. 2017 Aug 25. doi: 10.1097/SHK.0000000000000971. [Epub ahead of print]

Activation of Pyruvate Dehydrogenase Activity Bydichloroacetate Improves Survival and Neurologic Outcomes After Cardiac Arrest in Rats.

Wang P1, Chen M, Yang Z, Yu T, Zhu J, Zhou L, Lin J, Fang X, Huang Z, Jiang L, Tang W.

Abstract

No pharmacological interventions are currently available to provide neuroprotection for patients suffering from cardiac arrest. Dichloroacetate (DCA) is a pyruvate dehydrogenase kinase inhibitor, which activates pyruvate dehydrogenase (PDH), and increases cell adenosine triphosphate (ATP) production by promoting influx of pyruvate into the Krebs cycle. In this study, we investigated the effects of DCA on post-resuscitation neurological injury in an asphyxial cardiac arrest rat model. Asphyxial cardiac arrest was established by endotracheal tube clamping. A total of 111 rats were randomized into 3 groups: Sham group, Control group and DCA intervention group. Animals in DCA intervention group were intraperitoneally administered DCA with a loading dose of 80 mg/kg at 15 minutes after return of spontaneous circulation (ROSC), whereas rats in the Control group received equivalent volume of saline. DCA treatment increased 3-day survival time, and reduced neurologic deficit scores at 24, 48 and 72 hours after ROSC. It also attenuated cellular apoptosis and neuronal damage in the hippocampal cornuammonis 1 region by hematoxylin-eosin staining and TdT-mediated dUTP nick-end labeling assay. In addition, DCA reduced the messenger RNA expression of TNF-α and IL-1β in brain hippocampus and cortex after ROSC. Furthermore, DCA treatment significantly increased ATP production, PDH activity, and decreased blood glucose, lactate and brain pyruvate levels after ROSC. Our results suggested that DCA has neuroprotective effects on brain injury after cardiac arrest, and its salutary effects were associated with an increase of mitochondrial energy metabolism in the brain through activation of PDH activity

PEDIATRIA

1. Otolaryngol Head Neck Surg. 2017 Aug 1:194599817719400. doi: 10.1177/0194599817719400. [Epub ahead of print]

Critical Airway Team: A Retrospective Study of an Airway Response System in a Pediatric Hospital.

Sterrett EC1, Myer CM 4th2,3, Oehler J4, Das B 5, Kerrey BT6.

Abstract

Objective Study the performance of a pediatric critical airway response team. Study Design Case series with chart review. Setting Freestanding academic children's hospital. Subjects and Methods A structured review of the electronic medical record was conducted for all activations of the critical airway team. Characteristics of the activations and patients are reported using descriptive statistics. Activation of the critical airway team occurred 196 times in 46 months (March 2012 to December 2015); complete data were available for 162 activations (83%). For 49 activations (30%), patients had diagnoses associated with difficult intubation; 45 (28%) had a history of difficult laryngoscopy. Results Activation occurred at least 4 times per month on average (vs 3 per month for hospital-wide codes). The most common reasons for team activation were anticipated difficult intubation (45%) or failed intubation attempt (20%). For 79% of activations, the team performed an airway procedure, most commonly direct laryngoscopy and tracheal intubation. Bronchoscopy was performed

in 47% of activations. Surgical airway rescue was attempted 4 times. Cardiopulmonary resuscitation occurred in 41 activations (25%). Twenty-nine patients died during or following team activation (18%), including 10 deaths associated with the critical airway event. Conclusion Critical airway team activation occurred at least once per week on average. Direct laryngoscopy, tracheal intubation, and bronchoscopic procedures were performed frequently; surgical airway rescue was rare. Most patients had existing risk factors for difficult intubation. Given our rate of serious morbidity and mortality, primary prevention of critical airway events will be a focus of future efforts.

Evaluation of the Augmented Infant Resuscitator: A Monitoring Device for Neonatal Bag-Valve-Mask Resuscitation.
Bennett DJ1, Itagaki T, Chenelle CT, Bittner EA, Kacmarek RM.
Abstract
BACKGROUND: Annually, 6 million newborns require bag-valve-mask resuscitation, and providing live feedback has the potential to improve the quality of resuscitation. The Augmented Infant Resuscitator (AIR), a real-time feedback device, has been designed to identify leaks, obstructions, and inappropriate breath rates during bag-valve-mask resuscitation. However, its function has not been evaluated.
METHODS: The resistance of the AIR was measured by attaching it between a ventilator and a ventilator tester. To test the device's reliability in training and clinical-use settings, it was placed in-line between a ventilation bag or ventilator and a neonatal manikin and a clinical lung model simulator. The lung model simulator simulated neonates of 3 sizes (2, 4, and 6 kg). Leaks, obstructions, and respiratory rate alterations were introduced.
RESULTS: At a flow of 5 L/min, the pressure drop across the AIR was only 0.38 cm H2O, and the device had almost no effect on ventilator breath parameters. During the manikin trials, it was able to detect all leaks and obstructions, correctly displaying an alarm 100% of the time. During the simulated clinical trials, the AIR performed best on the 6-kg neonatal model, followed by the 4-kg model, and finally the 2-kg model. Over all 3 clinical models, the prototype displayed the correct indicator 73.5% of the time, and when doing so, took 1.6 ± 0.9 seconds.
CONCLUSIONS: The AIR is a promising innovation that has the potential to improve neonatal resuscitation. It introduces only marginal resistance and performs well on neonatal manikins, but its firmware should be improved before clinical use.