This week's PubMed 3rd – 9th December 2023: articles of interest n = 47

CPR AND COVID-19

No articles identified.

CPR/MECHANICAL CHEST COMPRESSION

No articles identified.

REGISTRIES, REVIEWS AND EDITORIALS

1. J Clin Med. 2023 Nov 29;12(23):7383. doi: 10.3390/jcm12237383.
Application of Technology in Cardiopulmonary Resuscitation, a Narrative Review.
Levitt CV(1), Boone K(1), Tran QK(2)(3), Pourmand A(1).
ABSTRACT
Novel medical technologies are designed to aid in cardiopulmonary resuscitation both in and out of the hospital. Out-of-hospital innovations utilize the skills of paramedics, bystanders, and other prehospital personnel, while in-hospital innovations traditionally aid in physician intervention. Our review of current literature aims to describe the benefits and limitations of six main technologic advancements with wide adoption for their practicality and functionality. The six key technologies include: extracorporeal membrane oxygenation (ECMO), real-time feedback devices, smart devices, video review, point-of-care ultrasound, and unmanned aerial vehicle (drone) automated external defibrillator (AED) delivery. The benefits and limitations of each technology were independently reviewed and expounded upon. Newer technologies like drone AED delivery, paramedic ultrasound use, and smart devices have been demonstrated to be safe and feasible, however, further studies are needed to compellingly demonstrate improved patient outcomes. In-hospital use of ECMO and ultrasound is well established by current literature to aid in cardiopulmonary resuscitation and improve patient outcomes.

2. J Clin Med. 2023 Nov 28;12(23):7374. doi: 10.3390/jcm12237374.
Adjunctive Therapeutics in the Management of Cardiopulmonary Resuscitation: A Narrative Literature Review.
Hoffer M(1), Pena RCF(1), Tran QK(2)(3), Pourmand A(1).
ABSTRACT
Nearly 565,000 patients will suffer from prehospital and inpatient cardiac arrest in the United States per annum. Cardiopulmonary resuscitation and all associated interventions used to achieve it remain an essential focus of emergency medicine. Current ACLS guidelines give clear instructions regarding mainstay medications such as epinephrine and antiarrhythmics; however, the literature remains somewhat controversial regarding the application of adjunctive therapeutics such as calcium, magnesium, sodium bicarbonate, and corticosteroids. The available data acquired in this field over the past three decades offer mixed pictures for each of these medications on the effects of core metrics of cardiopulmonary resuscitation (e.g., rate of return of spontaneous circulation, survival-to-hospitalization and discharge, 24 h and 30 d mortality, neurological outcome), as well as case-specific applications for each of these interventions (e.g., polymorphic ventricular tachycardia, electrolyte derangements, acidosis, post-arrest shock). This narrative literature review provides a

comprehensive summary of current guidelines and published data available for these four agents and their use in clinical practice.

What Else Is Needed to Improve Survival from Out-of-Hospital Cardiac Arrest to Hospital Admission? Data from a Prospective Registry for the Years 2020-2023 in the Italian Province of Varese.
De Ponti R(1), Arnò C(1), Piemonti A(1), Centineo P(2), Genoni P(1), Golino M(1), Savastano S(3), Garzena G(4), Campi S(2).
ABSTRACT
Around the world, data on out-of-hospital cardiac arrest (OHCA) are heterogeneous in terms of outcomes and reporting, and not all registries follow the Utstein recommendations for uniform OHCA data collection. This study reports data on OHCA occurring in recent years in a limited territory to analyze, in a homogenous setting, the circumstances and interventions affecting survival to hospital admission. OHCA data from the province of Varese for the years 2020-2022 were extracted from a prospective registry. For survival to hospital admission, the impact of pandemic waves and variables known to affect survival was evaluated both in the overall population and in the subgroup of patients in whom cardiopulmonary resuscitation (CPR) was initiated or continued by the emergency medical service (EMS). Overall, 3263 OHCAs occurred mainly at home (88%), with a time to intervention of 13.7 min, which was significantly longer during lockdown (15.7 min). Bystanders performed CPR in 22% of the cases and used automatic external defibrillator (AED) in 2.2% of the cases. Overall survival to hospital admission was 7.7%. In the multivariate analysis, in the general population, occurrence near a public building (OR 1.92), the presence of witnesses (OR 2.65), and a shockable rhythm (OR 7.04) were independent predictors of survival to hospital admission, whereas age (OR 0.97) and occurrence during a pandemic wave (OR 0.62) were associated with significantly worse survival to hospital admission. In the group of patients who received CPR, AED shock by bystanders was the only independent predictor of survival (OR 3.14) to hospital admission. Among other factors, early defibrillation was of crucial importance to improve survival to hospital admission in possibly rescuable patients. The occurrence of OHCA during pandemic waves was associated with longer intervention time and worse survival to hospital admission.

Chest compressions at altitude are of decreased quality, require more effort and cannot reliably be self-evaluated.
van Veelen MJ(1)(2), Brugger H(3)(4), Falla M(3)(5), Strapazzon G(3)(4).
NO ABSTRACT AVAILABLE

Can we personalise mean arterial blood pressure goals based on admission lactate in patients after out-of-hospital cardiac arrest?
Skrifvars M(1).
NO ABSTRACT AVAILABLE

IN-HOSPITAL CARDIAC ARREST

Predicting Cardiopulmonary Arrest with Digital Biomarkers: A Systematic Review.

De Sario Velasquez GD(1), Forte AJ(1), McLeod CJ(2), Bruce CJ(2), Pacheco-Spann LM(3), Maita KC(1), Avila FR(1), Torres-Guzman RA(1), Garcia JP(1), Borna S(1), Felton CL(4), Carter RE(3), Haider CR(4).
ABSTRACT

(1) Background: Telemetry units allow the continuous monitoring of vital signs and ECG of patients. Such physiological indicators work as the digital signatures and biomarkers of disease that can aid in detecting abnormalities that appear before cardiac arrests (CAs). This review aims to identify the vital sign abnormalities measured by telemetry systems that most accurately predict CAs. (2) Methods: We conducted a systematic review using PubMed, Embase, Web of Science, and MEDLINE to search studies evaluating telemetry-detected vital signs that preceded in-hospital CAs (IHCAs). (3) Results and Discussion: Out of 45 studies, 9 met the eligibility criteria. Seven studies were case series, and 2 were case controls. Four studies evaluated ECG parameters, and 5 evaluated other physiological indicators such as blood pressure, heart rate, respiratory rate, oxygen saturation, and temperature. Vital sign changes were highly frequent among participants and reached statistical significance compared to control subjects. There was no single vital sign change pattern found in all patients. ECG alarm thresholds may be adjustable to reduce alarm fatigue. Our review was limited by the significant dissimilarities of the studies on methodology and objectives. (4) Conclusions: Evidence confirms that changes in vital signs have the potential for predicting IHCAs. There is no consensus on how to best analyze these digital biomarkers. More rigorous and larger-scale prospective studies are needed to determine the predictive value of telemetry-detected vital signs for IHCAs.

A model for predicting return of spontaneous circulation and neurological outcomes in adults after in-hospital cardiac arrest: development and evaluation.
Li Z(1), Xing J(1).
ABSTRACT

INTRODUCTION: In-hospital CA (IHCA) is associated with rates of high incidence, low return of spontaneous circulation (ROSC), low survival to discharge, and poor neurological outcomes. We aimed to construct and evaluate prediction models for non-return of spontaneous circulation (non-ROSC) and poor neurological outcomes 12 months after ROSC (PNO-12). METHODS: We retrospectively analyzed baseline and clinical data from patients experiencing cardiac arrest (CA) in a big academic hospital of Jilin University in China. Patients experiencing CA between September 1, 2019 and December 31, 2020 were categorized into the ROSC and non-ROSC groups. Patients maintaining ROSC >20 min were divided into the good and PNO-12 subgroups. RESULTS: Univariate and multivariate logistic regression identified independent factors associated with non-ROSC and PNO-12. Two nomogram prediction models were constructed and evaluated. Of 2,129 patients with IHCA, 851 were included in the study. Multivariate logistic regression analysis revealed that male sex, age >80 years, CPR duration >23 min, and total dose of adrenaline >3 mg were significant risk factors for non-ROSC. Before CA, combined arrhythmia, initial defibrillation rhythm, and advanced airway management (mainly as endotracheal intubation) also influenced outcomes. The area under the receiver operating characteristic curve in the prediction model was 0.904 (C-index: 0.901). Respiratory failure, shock, CA in the monitoring area, advanced airway management, and noradrenaline administration were independent risk factors for PNO-12. The AUC was 0.912 (C-index: 0.918). CONCLUSIONS: Prediction models based on IHCA data could be helpful to reduce mortality rates and improve prognosis.

Development of early prediction model of in-hospital cardiac arrest based on laboratory parameters.
Ding X(#)(1)(2), Wang Y(#)(2), Ma W(#)(1)(2), Peng Y(1)(2), Huang J(3)(4), Wang M(1)(2), Zhu H(5)(6).
ABSTRACT

BACKGROUND: In-hospital cardiac arrest (IHCA) is an acute disease with a high fatality rate that burdens individuals, society, and the economy. This study aimed to develop a machine learning (ML) model using routine laboratory parameters to predict the risk of IHCA in rescue-treated patients. METHODS: This retrospective cohort study examined all rescue-treated patients hospitalized at the First Medical Center of the PLA General Hospital in Beijing, China, from January 2016 to December 2020. Five machine learning algorithms, including support vector machine, random forest, extra trees classifier (ETC), decision tree, and logistic regression algorithms, were trained to develop models for predicting IHCA. We included blood counts, biochemical markers, and coagulation markers in the model development. We validated model performance using fivefold cross-validation and used the SHapley Additive exPlanation (SHAP) for model interpretation. RESULTS: A total of 11,308 participants were included in the study, of which 7779 patients remained. Among these patients, 1796 (23.09%) cases of IHCA occurred. Among five machine learning models for predicting IHCA, the ETC algorithm exhibited better performance, with an AUC of 0.920, compared with the other four machine learning models in the fivefold cross-validation. The SHAP showed that the top ten factors accounting for cardiac arrest in rescue-treated patients are prothrombin activity, platelets, hemoglobin, N-terminal pro-brain natriuretic peptide, neutrophils, prothrombin time, serum albumin, sodium, activated partial thromboplastin time, and potassium. CONCLUSIONS: We developed a reliable machine learning-derived model that integrates readily available laboratory parameters to predict IHCA in patients treated with rescue therapy.

INJURIES AND CPR

No articles identified.

CAUSE OF THE ARREST

Suspension syndrome: a scoping review and recommendations from the International Commission for Mountain Emergency Medicine (ICAR MEDCOM).
Rauch S(#)(1)(2)(3), Lechner R(#)(4), Strapazzon G(5)(6)(7), Mortimer RB(6)(8), Ellerton J(6), Skaiaa SC(6)(9), Huber T(10), Brugger H(5)(11)(6), Pasquier M(6)(12), Paal P(6)(13).
ABSTRACT
BACKGROUND: Suspension syndrome describes a multifactorial cardio-circulatory collapse during passive hanging on a rope or in a harness system in a vertical or near-vertical position. The pathophysiology is still debated controversially. AIMS: The International Commission for Mountain Emergency Medicine (ICAR MedCom) performed a scoping review to identify all articles with original epidemiological and medical data to understand the pathophysiology of suspension syndrome and develop updated recommendations for the definition, prevention, and management of suspension syndrome. METHODS: A literature search was performed in PubMed, Embase, Web of Science and the Cochrane library. The bibliographies of the eligible articles for this review were additionally screened. RESULTS: The online literature search yielded 210 articles, scanning of the references yielded another 30 articles. Finally, 23 articles were included into this work. CONCLUSIONS: Suspension Syndrome is a rare entity. A neurocardiogenic reflex may lead to bradycardia, arterial hypotension, loss of consciousness and cardiac arrest. Concomitant causes, such as pain from being suspended, traumatic injuries and accidental hypothermia may contribute to the development of the Suspension Syndrome. Preventive factors include using a well-fitting sit harness, which does not cause discomfort while being suspended, and activating the muscle pump of the legs. Expediting help to extricate the suspended person is key. In a peri-arrest situation, the person should be

positioned supine and standard advanced life support should be initiated immediately. Reversible causes of cardiac arrest caused or aggravated by suspension syndrome, e.g., hyperkalaemia, pulmonary embolism, hypoxia, and hypothermia, should be considered. In the hospital, blood and further exams should assess organ injuries caused by suspension syndrome.

2. Sci Rep. 2023 Dec 1;13(1):21341. doi: 10.1038/s41598-023-48357-1.
Family history, socioeconomic factors, comorbidities, health behaviors, and the risk of sudden cardiac arrest.
Jung E(1)(2), Park JH(3)(4)(5), Ro YS(2)(6)(7), Ryu HH(1), Cha KC(8), Do Shin S(2)(6)(7), Hwang SO(8); Cardiac Arrest Pursuit Trial with Unique Registration, Epidemiologic Surveillance (CAPTURES) project investigators.

ABSTRACT
Genetic, environment, and behaviour factors have a role in causing sudden cardiac arrest (SCA). We aimed to determine the strength of the association between various risk factors and SCA incidence. We conducted a multicentre case-control study at 17 hospitals in Korea from September 2017 to December 2020. The cases included out-of-hospital cardiac arrest aged 19-79 years with presumed cardiac aetiology. Community-based controls were recruited at a 1:1 ratio after matching for age, sex, and urban residence level. Multivariable conditional logistic regression analysis was conducted. Among the 1016 cases and 1731 controls, 948 cases and 948 controls were analysed. A parental history of SCA, low educational level, own heart disease, current smoking, and non-regular exercise were associated with SCA incidence (Adjusted odds ratio [95% confidence interval]: 2.51 [1.48-4.28] for parental history of SCA, 1.37 [1.38-2.25] for low edication level, 3.77 [2.38-5.90] for non-coronary artery heart disease, 4.47 [2.84-7.03] for coronary artery disease, 1.39 [1.08-1.79] for current smoking, and 4.06 [3.29-5.02] for non-regular exercise). Various risk factors related to genetics, environment, and behaviour were independently associated with the incidence of SCA. Establishing individualised SCA prevention strategies in addition to general prevention strategies is warranted.

END-TIDAL CO$_2$

No articles identified.

ORGAN DONATION

1. Transplantation. 2023 Dec 8. doi: 10.1097/TP.0000000000004849. Online ahead of print.
Later Brain Death Declaration Correlates to Favorable Donor Characteristics but Decreased Heart Acceptance.
Greenberg JW(1), Kantemneni EC, Kulshrestha K, Clothier JS, Desai MV, Winlaw DS, Zafar F, Morales DLS.

ABSTRACT
BACKGROUND: With rates of potential donor heart discard as high as 66% nationally, quality improvement efforts must seek to optimize donor utilization. Whether the timing of donor brain death declaration (BDD) influences organ acceptance is understudied. The authors sought to characterize the impacts of time between donor hospital admission and BDD on heart utilization and posttransplant outcomes. METHODS: All potential heart donors and recipients in the United Network for Organ Sharing database were identified (2006-2021). Admission-to-BDD cohorts were: 1 to 2 d (n = 52 469), 3 to 4 d (n = 44 033), 5 to 7 d (n = 24 509), and 8 to 10 d (n = 8576). Donor clinical characteristics were compared between cohorts, and donor acceptance was assessed using

multivariable binary logistic regression. Recipient posttransplant survival was assessed with the Kaplan-Meier method. RESULTS: Donor demographics and comorbidity profiles (diabetes and hypertension) were comparable across cohorts. Anoxia/overdose deaths were more common (10% > 21% > 24% > 18%, respectively) and cardiopulmonary resuscitation requirements were higher (37% > 52% > 58% > 47%) when BDD occurred longer after admission. Renal dysfunction (44% > 44% > 35% > 29%) and inotrope requirements (52% > 25% > 36% > 29%) were lower in the later BDD cohorts. Proportions of hepatic dysfunction (18%-21%) and left ventricular ejection fraction <50% (13%-16%) were clinically equivalent. Donor acceptance differed by admission-to-BDD cohort (36% [1-2 d], 34% [3-4 d], 30% [5-7 d], and 28% [8-10 d]). Admission-to-BDD >4 d was independently associated with lower odds of acceptance on multivariable analysis (odds ratio 0.79, P < 0.001). Recipients experienced equivalent posttransplant survival for all donor admission-to-BDD cohorts (P = 0.999 adults and P = 0.260 pediatrics). CONCLUSIONS: Heart donors with later BDD were disproportionately discarded despite similar-to-favorable overall clinical profiles, resulting in nearly 3000 fewer transplants during the study. Increased utilization of donors with later BDD and "high-risk" characteristics (eg, anoxia/overdose, cardiopulmonary resuscitation requirement) can improve rates of transplantation without compromising outcomes.

2. Resuscitation. 2023 Dec;193:110002. doi: 10.1016/j.resuscitation.2023.110002.
Pre hospital interventions and organ donation in out of hospital cardiac arrest.
Lazzeri C(1), Bonizzoli M(1), Peris A(1).
NO ABSTRACT AVAILABLE

FEEDBACK

No articles identified.

DRUGS

1. Resuscitation. 2023 Dec;193:109979. doi: 10.1016/j.resuscitation.2023.109979.
Explaining differences in early postresuscitation hemodynamics between trials of vasopressin and steroids for in-hospital cardiac arrest.
Mentzelopoulos SD(1).
NO ABSTRACT AVAILABLE

TRAUMA

1. Cureus. 2023 Nov 2;15(11):e48181. doi: 10.7759/cureus.48181. eCollection 2023 Nov.
A Contemporary Study of Pre-hospital Traumatic Cardiac Arrest: Distinguishing Exsanguination From Non-exsanguination Arrest With a Review of Current Literature.
Serpa E(1), Zimmerman SO(2), Bauman ZM(3), Kulvatunyou N(2).
ABSTRACT
Background Traumatic cardiac arrest (TCA) remains a challenging problem in terms of diagnosis and management. This is due to difficulty distinguishing the TCA cause and therefore understanding the pathophysiology. The goal of this study was to analyze a contemporary series of TCA patients and classify the causes of TCA into exsanguination (EX) arrest and non-exsanguination (non-EX) arrest. Methods This was a retrospective review of patients suffering TCA during 2019 at a level I trauma center. We excluded patients whose arrests were from medical causes such as ventricular

fibrillation, ventricular tachycardia, pulmonary embolus, etc., hanging, drowning, thermal injury, outside transfer, and pediatric patients (age <13 as this is our institutional definition for pediatric trauma patients). We reviewed pre-hospital run-sheets, hospital charts including autopsy findings, and classified patients into EX and non-EX TCA. We defined a witnessed arrest (WA) using the traditional outside hospital cardiac (non-trauma) arrest definition. Outcomes included the incidence of EX arrest, survival to discharge, and hospital costs. Descriptive statistics were used. Significance was set at $p < 0.05$. Results After exclusion, 54 patients suffered TCA with a mean age of 45.9 (±19.8) years. Eighty-three percent of patients were male. The average cost per TCA was ~$16,000. Of the 54 TCAs, 26 (48%) were WA, with one (1.85%) survivor (no non-WA TCA patients survived). Twenty-two (41%) patients died from EX-arrest; 59% penetrating vs. 28% blunt ($p = 0.03$). The one EX-arrest survivor was a 19-year-old gunshot wound to the leg whose arrest was witnessed, with a short downtime, and the cause of arrest (bleeding leg wound) was quickly reversible. Conclusion We classified 41% of TCAs to have died from EX-arrest with only a 1.85% survival rate. This study calls for a TCA pre-hospital registry with accurate and consistent data definitions and collection. The registry should capture the cause of arrest for future research, management decision-making, and prognostication.

VENTILATION

1. Crit Care. 2023 Dec 1;27(1):471. doi: 10.1186/s13054-023-04740-y.
Effects of lower versus higher oxygen targets on out-of-hospital cardiac arrest.
Zhao Y(1), Wang Q(2), Zang B(3).
NO ABSTRACT AVAILABLE

CERERBRAL MONITORING

1. J Clin Anesth. 2023 Dec 2;93:111323. doi: 10.1016/j.jclinane.2023.111323. Online ahead of print.
High amplitude spectrum area measured in real-time during cardiopulmonary resuscitation is associated with favourable long-term neurological outcome after out-of-hospital cardiac arrest.
Meessen JMTA(1), Ruggeri L(1), Fumagalli F(1), Semeraro F(2), Bernasconi F(3), Magliocca A(4), Cerrato M(1), Merigo G(5), De Giorgio D(1), Migliari M(6), Latini R(1), Ristagno G(7).
NO ABSTRACT AVAILABLE

ULTRASOUND AND CPR

1. Ultrasound J. 2023 Dec 8;15(1):46. doi: 10.1186/s13089-023-00344-3.
Additional predictive value of optic nerve sheath diameter for neurological prognosis after cardiac arrest: a prospective cohort study.
Verhulst MMLH(1)(2), Visser IM(3)(4), Keijzer HM(5), de Kruijf NLM(5)(3), Peters EJG(4), Wilbers T(4), Peelen RV(4), Hofmeijer J(5)(6), Blans MJ(4).
ABSTRACT
BACKGROUND: The goal is to estimate the additional value of ultrasonographic optic nerve sheath diameter (ONSD) measurement on days 1-3, on top of electroencephalography (EEG), pupillary light reflexes (PLR), and somatosensory evoked potentials (SSEP), for neurological outcome prediction of comatose cardiac arrest patients. We performed a prospective longitudinal cohort study in adult comatose patients after cardiac arrest. ONSD was measured on days 1-3 using ultrasound. Continuous EEG, PLR, and SSEP were acquired as standard care. Poor outcome was defined as

cerebral performance categories 3-5 at 3-6 months. Logistic regression models were created for outcome prediction based on the established predictors with and without ONSD. Additional predictive value was assessed by increase in sensitivity for poor (at 100% specificity) and good outcome (at 90% specificity). RESULTS: We included 100 patients, 54 with poor outcome. Mean ONSD did not differ significantly between patients with good and poor outcome. Sensitivity for predicting poor outcome increased by adding ONSD to EEG and SSEP from 25% to 41% in all patients and from 27% to 50% after exclusion of patients with non-neurological death. CONCLUSIONS: ONSD on days 1-3 after cardiac arrest holds potential to add to neurological outcome prediction.

Point-of-Care-Ultrasound in Pediatrics: A Review and Update.
Flores S(1), Su E(2), Moher JM(3), Adler AC(4), Riley AF(5).
ABSTRACT
Point-Of-Care-Ultrasound (POCUS) has encountered a tremendous expansion in patient care. POCUS has taken a central role during invasive procedures. POCUS has expanded to most subspecialties from adult to pediatric and neonatal health care. POCUS in pediatrics has also become part of specific critical situations such as myocardial function assessment during cardiac arrest, ECMO deployment and neurological evaluation. In this review we will go over the most important historical aspects of POCUS. We will also review important aspects of POCUS in the intensive care unit, cardiologist evaluation and in the emergency department among others.

ORGANISATION AND TRAINING

Comparing outcomes of out-of-hospital cardiac arrest patients with initial shockable rhythm in Singapore and Osaka using population-based databases.
Okada Y(1)(2), Shahidah N(3), Ng YY(4)(5), Chia MYC(6), Gan HN(7), Leong BSH(8), Mao DR(9), Ng WM(10), Edwin N(11), Kiguchi T(12)(13), Nishioka N(12), Kitamura T(14), Iwami T(12), Ong MEH(15)(3).
ABSTRACT
BACKGROUND: Previous research indicated outcomes among refractory out-of-hospital cardiac arrest (OHCA) patients with initial shockable rhythm were different in Singapore and Osaka, Japan, possibly due to the differences in access to extracorporeal cardiopulmonary resuscitation. However, this previous study had a risk of selection bias. To address this concern, this study aimed to evaluate the outcomes between Singapore and Osaka for OHCA patients with initial shockable rhythm using only population-based databases. METHODS: This was a secondary analysis of two OHCA population-based databases in Osaka and Singapore, including adult OHCA patients with initial shockable rhythm. A machine-learning-based prediction model was derived from the Osaka data (n = 3088) and applied to the PAROS-SG data (n = 2905). We calculated the observed-expected ratio (OE ratio) for good neurological outcomes observed in Singapore and the expected derived from the data in Osaka by dividing subgroups with or without prehospital ROSC. RESULTS: The one-month good neurological outcomes in Osaka and Singapore among patients with prehospital ROSC were 70% (791/1,125) and 57% (440/773), and among patients without prehospital ROSC were 10% (196/1963) and 2.8% (60/2,132). After adjusting patient characteristics, the outcome in Singapore was slightly better than expected from Osaka in patients with ROSC (OE ratio, 1.067 [95%CI 1.012 to 1.125]), conversely, it was worse than expected in patients without prehospital ROSC (OE ratio, 0.238 [95%CI 0.173 to

0.294]). CONCLUSION: This study showed the outcomes of OHCA patients without prehospital ROSC in Singapore were worse than expected derived from Osaka data even using population-based databases. (249/250 words).

2021 European Resuscitation Council/European Society of Intensive Care Medicine Algorithm for Prognostication of Poor Neurological Outcome After Cardiac Arrest-Can Entry Criteria Be Broadened?

Arctaedius I(1), Levin H(2), Larsson M(1), Friberg H(3), Cronberg T(4), Nielsen N(5), Moseby-Knappe M(6), Lybeck A(1).

ABSTRACT

OBJECTIVES: To explore broadened entry criteria of the 2021 European Resuscitation Council/ European Society of Intensive Care Medicine (ERC/ESICM) algorithm for neuroprognostication including patients with ongoing sedation and Glasgow Coma Scale-Motor score (GCS-M) scores 4-5. DESIGN: Retrospective multicenter observational study. SETTING: Four ICUs, Skane, Sweden. PATIENTS: Postcardiac arrest patients managed at targeted temperature 36°C, 2014-2018. Neurologic outcome was assessed after 2-6 months according to the Cerebral Performance Category scale. INTERVENTIONS: None. MEASUREMENTS AND MAIN RESULTS: In 794 included patients, median age was 69.5 years (interquartile range, 60.6-77.0 yr), 241 (30.4%) were female, 550 (69.3%) had an out-of-hospital cardiac arrest, and 314 (41.3%) had a shockable rhythm. Four hundred ninety-five patients were dead at follow-up, 330 of 495 died after a decision on withdrawal of life-sustaining therapies. At 72 hours after cardiac arrest 218 patients remained unconscious. The entry criteria of the original algorithm (GCS-M 1-3) was fulfilled by 163 patients and 115 patients with poor outcome were identified, with false positive rate (FPR) of 0% (95% CI, 0-79.4%) and sensitivity of 71.0% (95% CI, 63.6-77.4%). Inclusion of patients with ongoing sedation identified another 13 patients with poor outcome, generating FPR of 0% (95% CI, 0-65.8%) and sensitivity of 69.6% (95% CI, 62.6-75.8%). Inclusion of all unconscious patients (GCS-M 1-5), regardless of sedation, identified one additional patient, generating FPR of 0% (95% CI, 0-22.8) and sensitivity of 62.9% (95% CI, 56.1-69.2). The few patients with true negative prediction (patients with good outcome not fulfilling guideline criteria of a poor outcome) generated wide 95% CI for FPR. CONCLUSION: The 2021 ERC/ESICM algorithm for neuroprognostication predicted poor neurologic outcome with a FPR of 0%. Broadening inclusion criteria to include all unconscious patients regardless of ongoing sedation identified an additional small number of patients with poor outcome but did not affect the FPR. Results are limited by high rate of withdrawal of life-sustaining therapies and few patients with true negative prediction.

Joint Modeling of Social Determinants and Clinical Factors to Define Subphenotypes in Out-of-Hospital Cardiac Arrest Survival: Cluster Analysis.

Abbott EE(1)(2)(3)(4), Oh W(3)(5)(6), Dai Y(6), Feuer C(6), Chan L(3)(6)(7), Carr BG(1)(4), Nadkarni GN(2)(3)(5)(6)(7).

ABSTRACT

BACKGROUND: Machine learning clustering offers an unbiased approach to better understand the interactions of complex social and clinical variables via integrative subphenotypes, an approach not studied in out-of-hospital cardiac arrest (OHCA). OBJECTIVE: We conducted a cluster analysis for a cohort of OHCA survivors to examine the association of clinical and social factors for mortality at 1 year. METHODS: We used a retrospective observational OHCA cohort identified from Medicare claims data, including area-level social determinants of health (SDOH) features and hospital-level

data sets. We applied k-means clustering algorithms to identify subphenotypes of beneficiaries who had survived an OHCA and examined associations of outcomes by subphenotype. RESULTS: We identified 27,028 unique beneficiaries who survived to discharge after OHCA. We derived 4 distinct subphenotypes. Subphenotype 1 included a distribution of more urban, female, and Black beneficiaries with the least robust area-level SDOH measures and the highest 1-year mortality (2375/4417, 53.8%). Subphenotype 2 was characterized by a greater distribution of male, White beneficiaries and had the strongest zip code-level SDOH measures, with 1-year mortality at 49.9% (4577/9165). Subphenotype 3 had the highest rates of cardiac catheterization at 34.7% (1342/3866) and the greatest distribution with a driving distance to the index OHCA hospital from their primary residence >16.1 km at 85.4% (8179/9580); more were also discharged to a skilled nursing facility after index hospitalization. Subphenotype 4 had moderate median household income at US $51,659.50 (IQR US $41,295 to $67,081) and moderate to high median unemployment at 5.5% (IQR 4.2%-7.1%), with the lowest 1-year mortality (1207/3866, 31.2%). Joint modeling of these features demonstrated an increased hazard of death for subphenotypes 1 to 3 but not for subphenotype 4 when compared to reference. CONCLUSIONS: We identified 4 distinct subphenotypes with differences in outcomes by clinical and area-level SDOH features for OHCA. Further work is needed to determine if individual or other SDOH domains are specifically tied to long-term survival after OHCA.

Wolf Creek XVII part 3: Automated cardiac arrest diagnosis.
van den Beuken WMF(1), Sayre MR(2), Olasveengen TM(3), Sunshine JE(4)(5).
ABSTRACT
INTRODUCTION: Automated cardiac arrest diagnosis offers the possibility to significantly shorten the interval between onset of out-of-hospital cardiac arrest (OHCA) and notification of EMS, providing the opportunity for earlier resuscitation and possibly increased survival. METHODS: Automated cardiac arrest diagnosis was one of six focus topics for the Wolf Creek XVII Conference held on June 14-17 2023 in Ann Arbor, Michigan, USA. Conference invitees included international thought leaders and scientists in the field of cardiac arrest resuscitation from academia and industry. Participants submitted via online survey knowledge gaps, barriers to translation and research priorities for each focus topic. Expert panels used the survey results and their own perspectives and insights to create and present a preliminary unranked list for each category that was debated, revised and ranked by all attendees to identify the top 5 for each category. RESULTS: Top knowledge gaps include the accuracy of automated OHCA detection technologies and the feasibility and reliability of automated EMS activation. The main barriers to translation are the risk of false positives potentially overburdening EMS, development and application costs of technology and the challenge of integrating new technology in EMS IT systems. The top research priorities are large-scale evaluation studies to measure real world performance and user research regarding the willingness to adopt these technologies. CONCLUSION: Automated cardiac arrest diagnosis has the potential to significantly impact time to resuscitation and survival of OHCA because it could convert unwitnessed events into witnessed events. Validation and feasibility studies are needed. The specificity of the technology must be high not to overburden limited EMS resources. If adequate event classification is achieved, future research could shift toward event prediction, focusing on identifying potential digital biomarkers and signatures of imminent cardiac arrest. Implementation could be challenging due to high costs of development, regulatory considerations and instantiation logistics.

Comparing the EQ-5D-3L with the EQ-5D-5L in out-of-hospital cardiac arrest survivors.

Nehme E(1), Nehme Z(2).

NO ABSTRACT AVAILABLE

Current landscape in US schools for bystander CPR training and AED requirements.

Tamirisa K(1), Patel H(2), Karim S(3), Mehta NK(4).

ABSTRACT

BACKGROUND: Out-of-hospital cardiac arrest is a public health crisis affecting about 356,000 adults and 23,000 children annually in the US with 90% fatality. Early bystander CPR and AED application improve survival. Less than 3% of the US population is CPR trained annually. Since 20% of the US population is at school daily, these represent ideal places to target CPR training. Having standardized state school CPR and AED laws will help with training. METHODS: We performed a systemic search of the state-specific laws for school AED and CPR requirements within the US. We used PubMed and Google search using keywords: school CPR mandates, US laws for CPR in schools, US state laws for AED implementation, and gaps in US school CPR and AED. We searched for mandates for schools in other countries for comparison. RESULTS: The state laws for CPR training for high school graduation and AED requirements in US. schools are highly variable, and funding for AEDs is inadequate, especially in schools in lower socio-economic zip codes. Recent AED legislative efforts focus mainly on athletic areas and don't adequately address school size, number of buildings, non-athletic areas, and engagement of student-led advocacy efforts. CONCLUSION: To improve OHCA survival, we identified potential solutions to consolidate efforts and overcome the barriers-standardize state laws, involve student bodies, increase funding, and allocate appropriate resources. The CPR/AED education needs to start earlier in schools and be part of the standard curriculum rather than implemented as a stopgap check-box mandate.

Athlete Screening and Sudden Cardiac Death.

Spencer R(1)(2), Quraishi S(1).

NO ABSTRACT AVAILABLE

POST-CARDIAC ARREST TREATMENTS

Percutaneous Coronary Intervention in Out-of-Hospital Cardiac Arrest Related to Acute Coronary Syndrome: A Literature Review.

Gall E(1)(2), Mafi D(1), Ghannam T(1), Brami P(1), Pham V(1), Varenne O(1), Picard F(1).

ABSTRACT

Out-of-hospital cardiac arrest (OHCA) continues to be a major global cause of death, affecting approximately 67 to 170 per 100,000 inhabitants annually in Europe, with a persisting high rate of mortality of up to 90% in most countries. Acute coronary syndrome (ACS) represents one of the most significant cause of cardiac arrest, and therefore invasive coronary angiography (CAG) with subsequent percutaneous coronary intervention (PCI) has emerged as a fundamental component in the management of OHCA patients. Recent evidence from large randomized controlled trials (RCTs) challenges the routine use of early CAG in the larger subgroup of patients with non-ST segment elevation myocardial infarction (NSTEMI). Additionally, emerging data suggest that individuals resuscitated from OHCA related to ACS face an elevated risk of thrombotic and bleeding events. Thus, specific invasive coronary strategies and anti-thrombotic therapies tailored to this unique

setting of OHCA need to be considered for optimal in-hospital management. We sought to provide an overview of the prevalence and complexity of coronary artery disease observed in this specific population, discuss the rationale and timing for CAG after return of spontaneous circulation (ROSC), summarize invasive coronary strategies, and examine recent findings on antithrombotic therapies in the setting of ACS complicated by OHCA. By synthesizing the existing knowledge, this review aims to contribute to the understanding and optimization of care for OHCA patients to improve outcomes in this challenging clinical scenario.

TARGETED TEMPERATURE MANAGEMENT

Transnasal Evaporative Cooling in Out-of-Hospital Cardiac Arrest Patients to Initiate Hypothermia- A Substudy of the Target Temperature Management 2 (TTM2) Randomized Trial.
Awad A(1), Dillenbeck E(1), Dankiewicz J(2), Ringh M(1), Forsberg S(1), Svensson L(3), Claesson A(1), Hollenberg J(1), Nordberg P(1)(4).
ABSTRACT
Background: In animal models, early initiation of therapeutic cooling, intra-arrest, or restored circulation has been shown to be neuroprotective shortly after cardiac arrest. We aimed to assess the feasibility and cooling efficacy of transnasal evaporative cooling, initiated as early as possible after hospital arrival in patients randomized to cooling in the TTM2 trial. Methods: This study took the form of a single-center (Södersjukhuset, Stockholm) substudy of the TTM2 trial (NCT02908308) comparing target temperature management (TTM) to 33 °C versus normothermia in OHCA. In patients randomized to TTM33 °C, transnasal evaporative cooling was applied as fast as possible. The primary objectives were the feasibility aspects of initiating cooling in different hospital locations (i.e., in the emergency department, coronary cathlab, intensive care unit (ICU), and during intrahospital transport) and its effectiveness (i.e., time to reach target temperature). Transnasal cooling was continued for two hours or until patients reached a core temperature of <34 °C. Cooling intervals were compared to participants at the same site who were randomized to hypothermia and treated at 33 °C but who for different reasons did not receive transnasal evaporative cooling. Results: From October 2018 to January 2020, 32 patients were recruited, of which 17 were randomized to the TTM33. Among them, 10 patients (8 men, median age 69 years) received transnasal evaporative cooling prior to surface systemic cooling in the ICU. In three patients, cooling was started in the emergency department; in two patients, it was started in the coronary cathlab, and in five patients, it was started in the ICU, of which three patients were subsequently transported to the coronary cathlab or to perform a CT scan. The median time to initiate transnasal cooling from randomization was 9 min (range: 5 to 39 min). The median time from randomization to a core body temperature of 34 °C was 120 min (range 60 to 334) compared to 178 min among those in the TTM33 group that did not receive TNEC and to 33 °C 230 min (range: 152 to 351) vs. 276 min (range: 150 to 546). No feasibility or technical issues were reported. No adverse events occurred besides minor nosebleeds. Conclusions: The early induction of transnasal cooling in out-of-hospital cardiac arrest patients was feasible to initiate in the emergency department, coronary cathlab, ICU, and during intrahospital transport. Time to target temperature was shortened compared to standard cooling.

Editorial: Therapeutic hypothermia in cardiac arrest: Is it time to revisit guidelines.
Zghouzi M(1), Paul TK(2).
NO ABSTRACT AVAILABLE

3. Med Klin Intensivmed Notfmed. 2023 Dec 5. doi: 10.1007/s00063-023-01092-x. Online ahead of print.

[Hypothermic temperature control after successful resuscitation of out-of-hospital cardiac arrest in adults : Statement from the resuscitation and postresuscitation treatment working groups of the German Society of Medical Intensive Care and Emergency Medicine (DGIIN) and the German Interdisciplinary Association for Intensive Care and Emergency Medicine (DIVI), the German Society for Interdisciplinary Emergency and Acute Medicine (DGINA) and the Austrian Association of Emergency Medicine (AAEM)].

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

Busch HJ(1), Behringer W(2), Biever P(3), Böttiger BW(4), Eisenburger P(5), Fink K(6), Herkner H(2), Kreimeier U(7), Pin M(8), Wolfrum S(9).

ABSTRACT

In Germany per year approximately 60,000 and in Austria 5,000 adult patients suffer from out-of-hospital cardiac arrest. Only 10-15% of these patients survive without neurological damage. For decades hypothermic temperature control has been a central component of post-resuscitation treatment, but is controversial due to recently published studies.

4. Ther Hypothermia Temp Manag. 2023 Dec;13(4):208-215. doi: 10.1089/ther.2022.0065. Epub 2023 May 23.

The Effect of Targeted Temperature Management on the Metabolome Following Out-of-Hospital Cardiac Arrest.

Beske RP(1), Obling LER(1), Bro-Jeppesen J(2), Nielsen N(3), Meyer MAS(1), Kjaergaard J(1), Johansson PI(4)(5), Hassager C(1)(5).

ABSTRACT

Targeted temperature management (TTM) may moderate the injury from out-of-hospital cardiac arrest. Slowing the metabolism has been a suggested effect. Nevertheless, studies have found higher lactate levels in patients cooled to 33°C compared with 36°C even days from TTM cessation. Larger studies have not been performed on the TTM's effect on the metabolome. Accordingly, to explore the effect of TTM, we used ultra-performance liquid-mass spectrometry in a substudy of 146 patients randomized in the TTM trial to either 33°C or 36°C for 24 hours and quantified 60 circulating metabolites at the time of hospital arrival (T0) and 48 hours later (T48). From T0 to T48, profound changes to the metabolome were observed: tricarboxylic acid (TCA) cycle metabolites, amino acids, uric acid, and carnitine species all decreased. TTM significantly modified these changes in nine metabolites (Benjamini-Hochberg corrected false discovery rate <0.05): branched amino acids valine and leucine levels dropped more in the 33°C arm (change [95% confidence interval]: -60.9 μM [-70.8 to -50.9] vs. -36.0 μM [-45.8 to -26.3] and -35.5 μM [-43.1 to -27.8] vs. -21.2 μM [-28.7 to -13.6], respectively), whereas the TCA metabolites including malic acid and 2-oxoglutaric acid remained higher for the first 48 hours (-7.7 μM [-9.7 to -5.7] vs. -10.4 μM [-12.4 to -8.4] and -3 μM [-4.3 to -1.7] vs. -3.7 μM [-5 to -2.3]). Prostaglandin E2 only dropped in the TTM 36°C group. The results show that TTM affects the metabolism hours after normothermia have been reached.

ELECTROPHYSIOLOGY AND DEFIBRILLATION

No articles identified.

Chest Compressions for Pediatric Organized Rhythms: A Hemodynamic and Outcomes Analysis.

Zinna SS(1), Morgan RW(1), Reeder RW(2), Ahmed T(3), Bell MJ(4), Bishop R(5), Bochkoris M(6), Burns C(7), Carcillo JA(6), Carpenter TC(5), Cooper KK(1), Michael Dean J(2), Wesley Diddle J(4), Federman M(8), Fernandez R(9), Fink EL(6), Franzon D(10), Frazier AH(11), Friess SH(12), Graham K(1), Hall M(9), Harding ML(2), Hehir DA(1), Horvat CM(6), Huard LL(8), Landis WP(1), Maa T(9), Manga A(12), McQuillen PS(10), Meert KL(3), Mourani PM(13), Nadkarni VM(1), Naim MY(1), Notterman D(14), Pollack MM(4), Sapru A(8), Schneiter C(5), Sharron MP(4), Srivastava N(8), Tilford B(3), Viteri S(15), Wessel D(4), Wolfe HA(1), Yates AR(9), Zuppa AF(1), Berg RA(1), Sutton RM(16).

ABSTRACT

AIM: Pediatric cardiopulmonary resuscitation (CPR) guidelines recommend starting CPR for heart rates (HRs) less than 60 beats per minute (bpm) with poor perfusion. Objectives were to 1) compare HRs and arterial blood pressures (BPs) prior to CPR among patients with clinician-reported bradycardia with poor perfusion ("BRADY") vs. pulseless electrical activity (PEA); and 2) determine if hemodynamics prior to CPR are associated with outcomes. METHODS AND RESULTS: Prospective observational cohort study performed as a secondary analysis of the ICU-RESUScitation trial (NCT028374497). Comparisons occurred 1) during the 15 seconds "immediately" prior to CPR and 2) over the two minutes prior to CPR, stratified by age (≤1 year, >1 year). Poisson regression models assessed associations between hemodynamics and outcomes. Primary outcome was return of spontaneous circulation (ROSC). Pre-CPR HRs were lower in BRADY vs. PEA (≤1 year: 63.8 [46.5, 87.0] min-1 vs. 120 [93.2, 150.0], p<0.001; >1 year: 67.4 [54.5, 87.0] min-1 vs. 100 [66.7, 120], p<0.014). Pre-CPR pulse pressure was higher among BRADY vs. PEA (≤1 year (12.9 [9.0, 28.5] mmHg vs. 10.4 [6.1, 13.4] mmHg, p>0.001). Pre-CPR pulse pressure ≥20 mmHg was associated with higher rates of ROSC among PEA (aRR 1.58 [CI95 1.07, 2.35], p=0.022) and survival to hospital discharge with favorable neurologic outcome in both groups (BRADY: aRR 1.28 [CI95 1.01, 1.62], p=0.040; PEA: aRR 1.94 [CI95 1.19, 3.16], p=0.008). Pre-CPR HR ≥60 bpm was not associated with outcomes. CONCLUSIONS: Pulse pressure and HR are used clinically to differentiate BRADY from PEA. A pre-CPR pulse pressure >20 mmHg was associated with improved patient outcomes.

Association of blood pressure with neurologic outcome at hospital discharge after pediatric cardiac arrest resuscitation.

Ushpol A(1), Je S(2), Niles D(2), Majmudar T(3), Kirschen M(2), Del Castillo J(4), Buysse C(5), Topjian A(2), Nadkarni V(2), Gangadharan S(6); PediRES-Q investigators.

ABSTRACT

BACKGROUND: Poor outcomes are associated with post cardiac arrest blood pressures <5th percentile for age. We aimed to study the relationship of mean arterial pressure (MAP) with favorable neurologic outcome following cardiac arrest and return of spontaneous circulation (ROSC). METHODS: This retrospective, multi-center, observational study analyzed data from the Pediatric Resuscitation Quality Collaborative (pediRES-Q). Children (<18 years) who achieved ROSC following index in-hospital or out-of-hospital cardiac arrest and survived ≥6 hours were included. Lowest documented MAP within the first 6 hours of ROSC was percentile adjusted for age and categorized into 6 groups - Group I: <5th, II: 5-24th, III: 25-49th, IV: 50-74th, V: 75-94th; and VI: 95-100th percentile. Primary outcome was favorable neurologic status at hospital discharge, defined as PCPC score 1, 2, or no change from pre-arrest baseline. Multivariable logistic regression was performed to

analyze the association of MAP group with favorable outcome, controlling for illness category (surgical-cardiac), initial rhythm (shockable), arrest time (weekend or overnight), age, CPR duration, and clustering by site. RESULTS: 787 patients were included: median [Q1,Q3] age 17.9 [4.8,90.6] months; male 58%; OHCA 21%; shockable rhythm 13%; CPR duration 7 [3,16] min; favorable neurologic outcome 54%. Median lowest documented MAP percentile for the favorable outcome group was 13 [3,43] versus 8 [1,37] for the unfavorable group. The distribution of blood pressures by MAP group was I: 37%, II: 28%, III: 13%, IV: 11%, V: 7%, and VI: 4%. Compared with patients in Group I (<5%ile), Groups II, III, and IV had higher odds of favorable outcome (aOR, 1.84 [95% CI, 1.24, 2.73]; 2.20 [95% CI, 1.32, 3.68]; 1.90 [95% CI, 1.12, 3.25]). There was no association between Groups V or VI and favorable outcome (aOR, 1.44 [95% CI, 0.75, 2.80]; 1.11 [95% CI, 0.47, 2.59]). CONCLUSIONS: In the first 6-hours post-ROSC, a lowest documented MAP between the 5th - 74th percentile for age was associated with favorable neurologic outcome compared to MAP < 5th percentile for age.

EXTRACORPOREAL LIFE SUPPORT

Accredited Cardiac Arrest Centers Facilitate eCPR and Improve Neurological Outcome.

Voß F(1), Thevathasan T(2), Heinrich Scholz K(3), Böttiger BW(4), Scheiber D(1), Kabiri P(5), Bernhard M(6), Kienbaum P(7), Jung C(1), Westenfeld R(8), Skurk C(5), Adler C(9), Kelm M(10).

ABSTRACT
BACKGROUND: Out-of-hospital cardiac arrest (OHCA) remains a frequent medical emergency with low survival rates even after a return of spontaneous circulation (ROSC). Growing evidence supports formation of dedicated teams in scenarios like cardiogenic shock to improve prognosis. Thus, the European Resuscitation Council (ERC) recommended introduction of Cardiac Arrest Centers (CAC) in their 2015 guidelines. Here, we aimed to elucidate the effects of newly introduced CACs in Germany regarding survival rate and neurological outcome. METHODS: A multicenter retrospective observational cohort study was performed at three university hospitals and outcomes after OHCA were compared before and after CAC accreditation. Primary outcomes were survival until discharge and favorable neurological status (CPC 1 or 2) at discharge. RESULTS: In total 784 patients (368 before and 416 after CAC accreditation) were analyzed. Rates of immediate percutaneous coronary intervention (40 vs. 52%, p= 0.01) and implementation of extracorporeal CPR (8 vs. 13%, p< 0.05) increased after CAC accreditation. Likelyhood of favorable neurological status at discharge was higher after CAC accreditation (71 vs. 87%, p< 0.01), whereas overall survival remained similar (35 vs. 35%, p> 0.99). CONCLUSION: CAC accreditation is linked to higher rates of favorable neurological outcome and unchanged overall survival.

Exposure to severe hyperoxemia worsens survival and neurological outcome in patients supported by veno-arterial extracorporeal membrane oxygenation: a meta-analysis.

Tigano S(1), Caruso A(2), Liotta C(3), La Via L(4), Vargas M(5), Romagnoli S(6), Landoni G(7), Sanfilippo F(8).

ABSTRACT
BACKGROUND: Veno-arterial Extracorporeal Membrane Oxygenation (VA-ECMO) is a rescue treatment in refractory cardiogenic shock (CS) or refractory cardiac arrest (CA). Exposure to hyperoxemia is common during VA-ECMO, and its impact on patient's outcome remains unclear. METHODS: We conducted a systematic review (PubMed and Scopus) and meta-analysis investigating the effects of exposure to severe hyperoxemia on mortality and poor neurological outcome in patients supported by VA-ECMO. When both adjusted and unadjusted Odds Ratio (OR) were

provided, we used the adjusted one. Results are reported as OR and 95% confidence interval (CI). Subgroup analyses were conducted according to VA-ECMO indication and hyperoxemia thresholds. RESULTS: Data from 10 observational studies were included. Nine studies reported data on mortality (n=5 refractory CA, n=4 CS), and 4 on neurological outcome. As compared to normal oxygenation levels, exposure to severe hyperoxemia was associated with higher mortality (nine studies; OR:1.80 [1.16-2.78];p=0.009;I2=83%; low certainty of evidence) and worse neurological outcome (four studies; OR:1.97 [1.30-2.96];p=0.001;I2=0%; low certainty of evidence). Magnitude and effect of these findings remained valid in subgroup analyses conducted according to different hyperoxemia thresholds (>200 or >300 mmHg) and VA-ECMO indication, although the association with mortality remained uncertain in the refractory CA population (p=0.13). Analysis restricted to studies providing adjusted OR data confirmed an increased likelihood of poorer neurological outcome (three studies; OR:2.11 [1.32-3.38];p=0.002) in patients exposed to severe hyperoxemia but did not suggest higher mortality (five studies; OR:1.68 [0.89-3.18];p=0.11). CONCLUSIONS: Severe hyperoxemia exposure after initiation of VA-ECMO may be associated with an almost doubled increased probability of poor neurological outcome and mortality. Clinical efforts should be made to avoid severe hyperoxemia during VA-ECMO support.

Mortality risk factors in patients receiving ECPR after cardiac arrest: Development and validation of a clinical prognostic prediction model.
Li Z(1), Gao J(2), Wang J(3), Xie H(4), Guan Y(5), Zhuang X(4), Liu Q(5), Fu L(4), Hou X(4), Hei F(6).
ABSTRACT
BACKGROUND: Previous studies have shown an increasing trend of extracorporeal cardiopulmonary resuscitation (ECPR) use in patients with cardiac arrest (CA). Although ECPR have been found to reduce mortality in patients with CA compared with conventional cardiopulmonary resuscitation (CCPR), the mortality remains high. This study was designed to identify the potential mortality risk factors for ECPR patients for further optimization of patient management and treatment selection. METHODS: We conducted a prospective, multicentre study collecting 990 CA patients undergoing ECPR in 61 hospitals in China from January 2017 to May 2022 in CSECLS registry database. A clinical prediction model was developed using cox regression and validated with external data. RESULTS: The data of 351 patients meeting the inclusion criteria before October 2021 was used to develop a prediction model and that of 68 patients after October 2021 for validation. Of the 351 patients with CA treated with ECPR, 227 (64.8%) patients died before hospital discharge. Multivariate analysis suggested that a medical history of cerebrovascular diseases, pulseless electrical activity (PEA)/asystole and higher Lactate (Lac) were risk factors for mortality while aged 45-60, higher pH and intra-aortic balloon pump (IABP) during ECPR have protective effects. Internal validation by bootstrap resampling was subsequently used to evaluate the stability of the model, showing moderate discrimination, especially in the early stage following ECPR, with a C statistic of 0.70 and adequate calibration with GOF chi-square = 10.4 (p = 0.50) for the entire cohort. Fair discrimination with c statistic of 0.65 and good calibration (GOF chi-square = 6.1, p = 0.809) in the external validation cohort demonstrating the model's ability to predict in-hospital death across a wide range of probabilities. CONCLUSION: Risk factors have been identified among ECPR patients including a history of cerebrovascular diseases, higher Lac and presence of PEA or asystole. While factor such as age 45-60, higher pH and use of IABP have been found protective against in-hospital mortality. These factors can be used for risk prediction, thereby improving the management and treatment selection of patients for this resource-intensive therapy.

Extracorporeal cardiopulmonary resuscitation for refractory out-of-hospital cardiac arrest.
Long B(1), Gottlieb M.

Extracorporeal membrane oxygenation in diabetic ketoacidosis-related cardiac and respiratory failure.

Sharif A(1), Brewer JM(1), El Banayosy A(1), Mihu MR(1)(2), Reaves Z(1), Swant LV(1), Schoaps RS(1), Benson C(1), Khalid MI(1), Maybauer MO(3)(4)(5).

ABSTRACT

INTRODUCTION: Diabetic ketoacidosis (DKA) is a common clinical problem. When patients develop severe shock and/or respiratory failure, extracorporeal membrane oxygenation (ECMO) may be considered. This case series describes the clinical presentation and outcomes of patients with DKA supported with ECMO. METHODS: We conducted a retrospective and anonymized review of 15 patients with DKA who required ECMO at our institution. Demographic and ECMO-specific data were collected. Additional variables include ICU length of stay (LOS), acute kidney injury and use of continuous renal replacement therapy, disposition, and mortality. RESULTS: All ECMO cannulations were performed by an intensivist using peripheral vascular access. The majority of patients were female (73%) with a median age of 27 (IQR = 21.5-45) years. A diagnosis of diabetes mellitus (DM) prior to ECMO was present in 11 (73%) patients. Venoarterial ECMO was the initial mode used in 11 (73%) patients. The median duration of ECMO support was 7 (IQR = 6-14) days. The median ICU LOS was 12 (IQR = 8.5-20.5) days, and the median hospital LOS was 21 (IQR = 11-36.5) days. Eight patients had cardiac arrest and underwent extracorporeal cardiopulmonary resuscitation (ECPR) of which 4 (50%) patients survived to discharge. Overall, 10 (66.7%) patients were successfully weaned from ECMO and survived to discharge. CONCLUSION: This is the largest case series regarding the use of ECMO for patients with refractory shock, cardiac arrest, or respiratory failure related to DKA. The findings suggest that ECMO is a viable support option for managing these patients and has excellent outcomes, including patients with cardiac arrest.

Machine learning-based predictor for neurologic outcomes in patients undergoing extracorporeal cardiopulmonary resuscitation.

Kim TW(1), Ahn J(2), Ryu JA(3)(4).

ABSTRACT

BACKGROUND: We investigated the predictors of poor neurological outcomes in extracorporeal cardiopulmonary resuscitation (ECPR) patients using machine learning (ML) approaches. METHODS: This study was a retrospective, single-center, observational study that included adult patients who underwent ECPR while hospitalized between January 2010 and December 2020. The primary outcome was neurologic status at hospital discharge as assessed by the Cerebral Performance Categories (CPC) score (scores range from 1 to 5). We trained and tested eight ML algorithms for a binary classification task involving the neurological outcomes of survivors after ECPR. RESULTS: During the study period, 330 patients were finally enrolled in this analysis; 143 (43.3%) had favorable neurological outcomes (CPC score 1 and 2) but 187 (56.7%) did not. From the eight ML algorithms initially considered, we refined our analysis to focus on the three algorithms, eXtreme Gradient Boosting, random forest, and Stochastic Gradient Boosting, that exhibited the highest accuracy. eXtreme Gradient Boosting models exhibited the highest accuracy among all the machine learning algorithms (accuracy: 0.739, area under the curve: 0.837, Kappa: 0.450, sensitivity: 0.700, specificity: 0.740). Across all three ML models, mean blood pressure emerged as the most influential variable, followed by initial serum lactate, and arrest to extracorporeal membrane oxygenation (ECMO) pump-on-time as important predictors in machine learning models for poor neurological outcomes

following successful ECPR. CONCLUSIONS: In conclusion, machine learning methods showcased outstanding predictive accuracy for poor neurological outcomes in patients who underwent ECPR.

The effect of restrictive versus liberal selection criteria on survival in ECPR: a retrospective analysis of a multi-regional dataset.
Diehl A(1)(2), Read AC(3), Southwood T(4), Buscher H(3), Dennis M(5)(6),Nanjayya VB(7)(8), Burrell AJC(7)(8).

ABSTRACT
BACKGROUND: Extracorporeal cardiopulmonary resuscitation (ECPR) is an established rescue therapy for both out-of-hospital cardiac arrest (OHCA) and in-hospital cardiac arrest (IHCA). However, there remains significant heterogeneity in populations and outcomes across different studies. The primary aim of this study was to compare commonly used selection criteria and their effect on survival and utilisation in an Australian ECPR cohort. METHODS: We performed a retrospective, observational study of three established ECPR centres in Australia, including cases from 1 January 2013 to 31 December 2020 to establish the baseline cohort. We applied five commonly used ECPR selection criteria, ranging from restrictive to liberal. RESULTS: The baseline cohort included 199 ECPR cases: 95 OHCA and 104 IHCA patients. Survival to hospital discharge was 20% for OHCA and 41.4% for IHCA. For OHCA patients, strictly applying the most restrictive criteria would have resulted in the highest survival rate 7/16 (43.8%) compared to the most liberal criteria 16/73 (21.9%). However, only 16/95 (16.8%) in our cohort strictly met the most restrictive criteria versus 73/95 (76.8%) with the most liberal criteria. Similarly, in IHCA, the most restrictive criteria would have resulted in a higher survival rate in eligible patients 10/15 (66.7%) compared to 27/59 (45.8%) with the most liberal criteria. With all criteria a large portion of survivors in IHCA would not have been eligible for ECMO if strictly applying criteria, 33/43 (77%) with restrictive and 16/43 (37%) with the most liberal criteria. CONCLUSIONS: Adherence to different selection criteria impacts both the ECPR survival rate and the total number of survivors. Commonly used selection criteria may be unsuitable to select IHCA ECPR patients.

Extracorporeal Cardiopulmonary Resuscitation for Amniotic Fluid Embolism: Review and Case Report.
Sundin CS, Gomez L, Chapman B.

ABSTRACT
Amniotic fluid embolism (AFE) is a rare, sudden, and catastrophic complication of pregnancy that can result in cardiopulmonary arrest, potentially leading to death. The pathophysiology of an AFE includes an inflammatory and coagulopathic response due to fetal materials entering maternal circulation with the hallmark triad of symptoms: acute respiratory distress, cardiovascular collapse, and coagulopathy. Management of AFE should include high-quality cardiopulmonary resuscitation, immediate delivery of the fetus if applicable, early intubation to provide adequate oxygenation and ventilation, fluid volume resuscitation, and ongoing evaluation of coagulopathy. Priorities include thromboelastography interpretation if available, control of hemorrhage and coagulopathy with blood component therapy, and cardiovascular support through inotropes and vasopressor administration. More recent approaches include implementing the A-OK (atropine, ondansetron, and ketorolac) protocol for suspected AFE protocol, extracorporeal cardiopulmonary resuscitation (ECPR), and extracorporeal membrane oxygenation (ECMO) therapies to increase survival and decrease complications. Venoarterial ECMO is the highest form of life support that provides support in patients with pulmonary and cardiac failure. ECPR is the application of Venoarterial ECMO during cardiopulmonary resuscitation in cases where the cause of arrest is believed to be reversible. Early implementation of ECPR during the acute phase of AFE can provide support for end-organ perfusion

in place of the weakened and recovering heart while optimizing oxygenation, making venoarterial ECMO an ideal adjunctive therapy. Because of the rarity of AFE, many obstetrical teams may have limited prior experience in managing these catastrophic cases; however, with ongoing education and simulation, teams can be better prepared in the recognition and management of these life-threatening events.

Oxygenation During Venoarterial Extracorporeal Membrane Oxygenation: Physiology, Current Evidence, and a Pragmatic Approach to Oxygen Titration.
Premraj L(1), Brown A(2), Fraser JF(3)(4), Pellegrino V(2), Pilcher D(2)(5)(6)(7), Burrell A(2)(5).
ABSTRACT
OBJECTIVES: This review aims to: 1) identify the key circuit and patient factors affecting systemic oxygenation, 2) summarize the literature reporting the association between hyperoxia and patient outcomes, and 3) provide a pragmatic approach to oxygen titration, in patients undergoing peripheral venoarterial extracorporeal membrane oxygenation (ECMO). DATA SOURCES: Searches were performed using PubMed, SCOPUS, Medline, and Google Scholar. STUDY SELECTION: All observational and interventional studies investigating the association between hyperoxia, and clinical outcomes were included, as well as guidelines from the Extracorporeal Life Support Organization. DATA EXTRACTION: Data from relevant literature was extracted, summarized, and integrated into a concise narrative review. For ease of reference a summary of relevant studies was also produced. DATA SYNTHESIS: The extracorporeal circuit and the native cardiorespiratory circuit both contribute to systemic oxygenation during venoarterial ECMO. The ECMO circuit's contribution to systemic oxygenation is, in practice, largely determined by the ECMO blood flow, whereas the native component of systemic oxygenation derives from native cardiac output and residual respiratory function. Interactions between ECMO outflow and native cardiac output (as in differential hypoxia), the presence of respiratory support, and physiologic parameters affecting blood oxygen carriage also modulate overall oxygen exposure during venoarterial ECMO. Physiologically those requiring venoarterial ECMO are prone to hyperoxia. Hyperoxia has a variety of definitions, most commonly Pao_2 greater than 150 mm Hg. Severe hypoxia ($Pao_2 > 300$ mm Hg) is common, seen in 20%. Early severe hyperoxia, as well as cumulative hyperoxia exposure was associated with in-hospital mortality, even after adjustment for disease severity in both venoarterial ECMO and extracorporeal cardiopulmonary resuscitation. A pragmatic approach to oxygenation during peripheral venoarterial ECMO involves targeting a right radial oxygen saturation target of 94-98%, and in selected patients, titration of the fraction of oxygen in the mixture via the air-oxygen blender to target postoxygenator Pao_2 of 150-300 mm Hg. CONCLUSIONS: Hyperoxia results from a range of ECMO circuit and patient-related factors. It is common during peripheral venoarterial ECMO, and its presence is associated with poor outcome. A pragmatic approach that avoids hyperoxia, while also preventing hypoxia has been described for patients receiving peripheral venoarterial ECMO.

Low volume ECMO results study.
Joyce CJ(1)(2), Cook DA(1)(2)(3), Walsham J(1)(2), Krishnan A(1)(2), Lo W(2)(4), Samaan J(2)(5), Semark AJ(2)(6), Pearson DC(6), Stroebel A(7), Provenzano S(7), McKeague R(6), Winearls JR(2)(6)(8)(9).
ABSTRACT
Objectives: To report extracorporeal membrane oxygenation (ECMO) experience at Princess Alexandra and Gold Coast University hospitals and compare mortality with benchmarks. Design: Case series of patients treated with ECMO. Setting: Two adult tertiary Australian intensive care units with low ECMO case volumes. Participants: Patients treated with ECMO, aged > 18 years. Main outcome measures: Patients were categorised into respiratory, cardiac, and extracorporeal

cardiopulmonary resuscitation (eCPR) groups. Observed mortality was compared with mortality predicted using individual risk of death predictions from the Survival after Veno-arterial ECMO (SAVE) and Respiratory ECMO Survival Prediction (RESP) scores; mortality predicted when mortality predictions of the SAVE score were modified to be consistent with the validation cohort in the SAVE study (Alfred Hospital); and with mortality predicted when eCPR patients were all assigned a risk of death equal to Extracorporeal Life Support Organization (ELSO) Registry eCPR mortality. Results: Over 10 years, 86 patients were treated with ECMO. Eight deaths were observed in 49 patients with respiratory failure, below the 95% CI (13-24) for the deaths predicted by the RESP score (P < 0.001). Nine deaths were observed in 27 patients with cardiac failure, below the 95% CI (14-23) for the deaths predicted by the SAVE score (P < 0.001), but within the 95% CI (9-17) for the deaths predicted by the SAVE score modified to be consistent with the Alfred Hospital cohort (P > 0.05). Seven deaths were observed in the ten eCPR patients, within the 95% CI (4-10) predicted using the risk of death derived from the ELSO Registry. Conclusions: Mortality in two low volume ECMO centres was not inferior to benchmarks.

EXPERIMENTAL RESEARCH

Hemodynamics, survival and neurological function with early versus delayed automated head-up CPR in a porcine model of prolonged cardiac arrest.
Pourzand P(1), Moore J(2), Metzger A(3), Salverda B(4), Suresh M(5), Arango S(6), Rosenhagen H(3), Kaizer A(6), Duval S(7), Debaty G(8), Lurie K(2).
ABSTRACT
AIM: To determine if controlled head and thorax elevation, active compression-decompression cardiopulmonary resuscitation (CPR), and an impedance threshold device combined, termed automated head-up positioning CPR (AHUP-CPR), should be initiated early, as a basic (BLS) intervention, or later, as an advanced (ALS) intervention, in a severe porcine model of cardiac arrest. METHODS: Yorkshire pigs (n = 22) weighing ~40 kg were anesthetized and ventilated. After 15 minutes of untreated ventricular fibrillation, pigs were randomized to AHUP-CPR for 25 minutes (BLS group) or conventional CPR for 10 minutes, followed by 15 minutes of AHUP-CPR (ALS group). Thereafter, epinephrine, amiodarone, and defibrillation were administered. Neurologic function, the primary endpoint, was assessed 24-hours later with a Neurological Deficit Score (NDS, 0 = normal and 260 = worst deficit score or death). Secondary outcomes included return of spontaneous circulation (ROSC), cumulative survival, hemodynamics and epinephrine responsivity. Data, expressed as mean ± standard deviation, were compared using Fisher's Exact, log-rank, Mann-Whitney U and unpaired t-tests. RESULTS: ROSC was achieved in 10/11 pigs with early AHUP-CPR versus 6/11 with delayed AHUP-CPR (p = 0.14), and cumulative 24-hour survival was 45.5% versus 9.1%, respectively (p < 0.02). The NDS was 203 ± 80 with early AHUP-CPR versus 259 ± 3 with delayed AHUP-CPR (p = 0.035). ETCO2, rSO2, and responsiveness to epinephrine were significantly higher in the early versus delayed AHUP-CPR. CONCLUSION: When delivered early rather than late, AHUP-CPR resulted in significantly increased hemodynamics, 24-hour survival, and improved neurological function in pigs after prolonged cardiac arrest. Based on these findings, AHUP-CPR should be considered a BLS intervention.

CASE REPORTS

[Case of Hematemesis Cardiopulmonary Arrest after Chemotherapy for Advanced Gastric Cancer].
[Article in Japanese]

Nakamoto M(1), Teruya J, Miyahira A, Kinoshita K, Kimura K, Akamatsu M, Nozato E.

ABSTRACT
The case is of a 66-year-old woman who visited a general practitioner with a chief complaint of cough. She was referred to the Internal Medicine Department of our hospital because an abnormal shadow was found in her chest X-ray examination. A CT scan suspected her to have a metastatic lung tumor, and gastric cancer was diagnosed on primary site search. The patient was started on G-SOX therapy. After 2 courses, she experienced massive hematemesis and was referred to the hospital. A CT scan revealed arterial bleeding into the stomach. She went into cardiac arrest shortly afterward, and cardiopulmonary resuscitation was started. Hemostasis was obtained by interventional radiology(IVR). Upper gastrointestinal endoscopy performed after hemostasis showed the tumor to be necrotic and shrunk. Bleeding from advanced gastric cancer is common; however, bleeding due to the effects of chemotherapy have been reported. We report a case of massive bleeding and cardiopulmonary arrest during chemotherapy.

Concomitant hypokalemia and hypocalcemia: a very rare but life-threating combination of reversible causes of cardiac arrest - an unusual first manifestation of coeliac disease.

Silvestri I(1), Merigo G(2), Bonetti C(3), Guerra MB(4), Pignatelli S(5), Stirparo G(6), Ristagno G(7).

ABSTRACT
The causes of cardiac arrest are extremely heterogeneous. Among these, both hypokalemia and hypocalcemia are known reversible factors that can lead to cardiac arrest. In this report, we present a unique case report of a patient with previously undiagnosed coeliac disease who experienced cardiac arrest due a combination of hypokalemia and hypocalcemia resulting from malabsorption. A 66-year-old male presented to the emergency department with symptoms of malaise, weakness, weight loss, and persistent diarrhea. The patient exhibited characteristic signs of hypokalemia and hypocalcemia, including fasciculations, weakness, and swelling. An electrocardiogram showed a normal rhythm, and blood tests confirmed the electrolyte imbalances. Despite initial treatment, the patient experienced sudden cardiac arrest. Prompt resuscitation efforts were successful in restoring spontaneous circulation. However, recurrent episodes of ventricular arrhythmias and cardiac arrest occurred. Large doses of intravenous potassium chloride, in conjunction with magnesium, were needed prior to restore electrolyte balance. The concomitant severe hypocalcemia required caution calcium supplementation, to avoid further decreases in serum potassium levels. Appropriate ion replacements ultimately led to successful resuscitation with good functional recovery. During the hospital stay, the patient was diagnosed with coeliac disease. This case is noteworthy for its uniqueness, as there are no documented instances in the scientific literature linking cardiac arrest directly to coeliac disease. It is important to emphasize the need for investigating potential reversible causes of cardiac arrest, such as hypokalemia and hypocalcemia, and implementing appropriate interventions to address these factors.

Survived sudden cardiac death in a patient with arrhythmic mitral valve prolapse syndrome: a case report.

Kreimer F(1), Mügge A(2), Gotzmann M(2).
NO ABSTRACT AVAILABLE

Successful Therapeutic Hypothermia in a Patient with Drug-Induced J Waves and Cardiac Arrest: A Case Report.

Sato J(1), Yagi T(2), Shimada E(2), Kobori M(2), Watanabe K(2), Kuwana T(1), Chiba N(1), Saito T(1), Kinoshita K(1).

ABSTRACT

A 50-year-old man was admitted to our hospital with hypotension and bradycardia after receiving high doses of atenolol, amlodipine, and etizolam. He had a drug-induced J wave on electrocardiography and subsequently underwent cardiac arrest. The patient was successfully rescued by venoarterial extracorporeal membrane oxygenation (VA-ECMO) and a good neurological outcome was achieved with therapeutic hypothermia (TH). In patients with J waves, TH is thought to increase the J waves and cause fatal arrhythmias, but in this case, rapid cooling with VA-ECMO allowed the patient to successfully complete TH.