

**This week's PubMed 10<sup>th</sup> – 16<sup>th</sup> September 2023: articles of interest n = 53**

### **CPR AND COVID-19**

1. Emerg Med J. 2023 Sep 13;emermed-2023-213529. doi: 10.1136/emered-2023-213529. Online ahead of print.

**Association of the COVID-19 pandemic with bystander cardiopulmonary resuscitation for out-of-hospital cardiac arrest in North Taiwan.**

Tai TL(1), Hsieh CY(2), Chen CH(1), Lai YN(3), Hsieh CC(3)(4)(5).

**NO ABSTRACT AVAILABLE**

### **CPR/MECHANICAL CHEST COMPRESSION**

No articles identified.

### **REGISTRIES, REVIEWS AND EDITORIALS**

1. Biomed Pharmacother. 2023 Sep 14;167:115492. doi: 10.1016/j.biopha.2023.115492. Online ahead of print.

**Contribution and therapeutic value of mitophagy in cerebral ischemia-reperfusion injury after cardiac arrest.**

Li Z(1), Xing J(2).

#### **ABSTRACT**

Cardiopulmonary resuscitation and related life support technologies have improved substantially in recent years; however, mortality and disability rates from cardiac arrest (CA) remain high and are closely associated with the high incidence of cerebral ischemia-reperfusion injury (CIRI), which is explained by a "double-hit" model (i.e., resulting from both ischemia and reperfusion). Mitochondria are important power plants in the cell and participate in various biochemical processes, such as cell differentiation and signaling in eukaryotes. Various mitochondrial processes, including energy metabolism, calcium homeostasis, free radical production, and apoptosis, are involved in several important stages of the progression and development of CIRI. Mitophagy is a key mechanism of the endogenous removal of damaged mitochondria to maintain organelle function and is a critical target for CIRI treatment after CA. Mitophagy also plays an essential role in attenuating ischemia-reperfusion in other organs, particularly during post-cardiac arrest myocardial dysfunction. Regulation of mitophagy may influence necroptosis (a programmed cell death pathway), which is the main endpoint of organ ischemia-reperfusion injury. In this review, we summarize the main signaling pathways related to mitophagy and their associated regulatory proteins. New therapeutic methods and drugs targeting mitophagy in ischemia-reperfusion animal models are also discussed. In-depth studies of the mechanisms underlying the regulation of mitophagy will enhance our understanding of the damage and repair processes in CIRI after CA, thereby contributing to the development of new therapeutic strategies.

2. Catheter Cardiovasc Interv. 2023 Sep 12. doi: 10.1002/ccd.30835. Online ahead of print.

**DRACULA-A mnemonic for unfavorable resuscitation features in cardiac arrest patients.**

Rab T(1).

**NO ABSTRACT AVAILABLE**

3. *Curr Opin Pediatr.* 2023 Oct 1;35(5):546-552. doi: 10.1097/MOP.0000000000001284. Epub 2023 Aug 8.

**The cardiac preparticipation sports evaluation.**

Donovan DJ(1), Nelson JE, Monaco MA.

**ABSTRACT**

**PURPOSE OF REVIEW:** Sudden cardiac death (SCD) is the leading cause of death in young athletes during sports participation. Preparticipation cardiovascular screening aims to identify those at an increased risk of SCD. This review aims to provide a background of SCD in young athletes, to discuss the various screening recommendations of major medical societies, and to review recent evidence and current practice. **RECENT FINDINGS:** Numerous studies have evaluated various preparticipation screening practices, particularly regarding the inclusion of ECG as part of an initial evaluation to identify conditions with an increased risk of SCD. Some analyses have shown ECG inclusion to provide increased screening sensitivity and specificity, though others have shown no benefit when compared with evaluation with history and physical examination alone. Furthermore, in countries for which more extensive screening protocols have been employed, postimplementation statistics have not shown a significant decrease in SCD. **SUMMARY:** SCD in young athletes primarily results from underlying cardiac disease. Various preparticipation screening recommendations exist globally, with the common goal of decreasing the rates of SCD by identifying youth at risk during sports participation. Current guidelines in the United States support universal preparticipation evaluation using history and physical examination, with cardiology referral if abnormalities are identified.

4. *J Hosp Palliat Nurs.* 2023 Sep 12. doi: 10.1097/NJH.0000000000000978. Online ahead of print.

**Demystifying Limited Code: Standardizing Resuscitation Options in a Large Health Care System.**

Sabolish R, Pennartz L.

**ABSTRACT**

Upon admission to an acute care hospital, patients and families are faced with determining their cardiopulmonary resuscitation status during conversation with providers. Medical providers are tasked with providing education and options in the context of the patient's acute and chronic conditions. Misconceptions are common in the general public, and providers may struggle with providing guidance in high-stress situations. Literature review revealed a lack of national consensus on code status definitions. Electronic health records may include multiple options for code status orders, which may lead to confusion for patients and medical staff, resulting in provision of potentially ineffective or undesired medical care. The following discussion will examine multiple cases in a large health care system and a novel way of standardizing resuscitation options using Havelock's change theory. This quality improvement project was approved by the institutional review board.

5. *JAMA Cardiol.* 2023 Sep 1;8(9):835-836. doi: 10.1001/jamacardio.2023.2277.

**Out-of-Hospital Cardiac Arrest-One Size Does Not Fit All.**

Pareek N(1)(2), Keeble TR(3)(4), Banerjee S(5).

**NO ABSTRACT AVAILABLE**

**IN-HOSPITAL CARDIAC ARREST**

1. *Resusc Plus.* 2023 Sep 6;16:100462. doi: 10.1016/j.resplu.2023.100462. eCollection 2023 Dec.

**External validation of GO-FAR 2 calculator for outcomes after in-hospital cardiac arrest with comparison to GO-FAR and trial of expanded applications.**

Maravelas R(1), Aydemir B(2), Vos D(2), Brauner D(2); Collaborators; Zamihovsky R(2), O'Sullivan K(3), Bell AF(2).

#### **ABSTRACT**

**AIM:** Externally validate the GO-FAR 2 tool for predicting survival with good neurologic function after in-hospital cardiac arrest with comparison to the original GO-FAR tool. Additionally, we collected qualitative descriptors and performed exploratory analyses with various levels of neurologic function and discharge destination. **METHODS:** Retrospective chart review of all patients who underwent in-hospital resuscitation after cardiac arrest during the calendar years 2016-2019 in our institution (n = 397). GO-FAR and GO-FAR 2 scores were calculated based on information available in the medical record at the time of hospital admission. Cerebral performance category (CPC) scores at the time of admission and discharge were assessed by chart review. **RESULTS:** The GO-FAR 2 score accurately predicted outcomes in our study population with a c-statistic of 0.625. The original GO-FAR score also had accurate calibration with a stronger c-statistic of 0.726. The GO-FAR score had decreased predictive value for lesser levels of neurologic function (c-statistic 0.56 for alive at discharge) and discharge destination (0.69). Descriptors of functional status by CPC score were collected. **CONCLUSION:** Our findings support the validity of the GO-FAR and GO-FAR 2 tools as published, but the c-statistics suggest modest predictive discrimination. We include functional descriptors of CPC outcomes to aid clinicians in using these tools. We propose that information about expected outcomes could be valuable in shared decision-making conversations.

#### **INJURIES AND CPR**

1. Resusc Plus. 2023 Sep 9;16:100465. doi: 10.1016/j.resplu.2023.100465. eCollection 2023 Dec. **Traumatic injuries after manual and automatic mechanical compression during cardiopulmonary resuscitation, a retrospective cohort study.**

Preda T(1)(2), Nafi M(2), Villa M(2), Cassina T(1)(2).

#### **ABSTRACT**

**INTRODUCTION:** Chest compressions during advanced cardiac life support is a life-saving, potential harmful procedure with high incidence of severe and life-threatening injuries. Previous studies suggest a possible correlation between the increased incidence of chest and/or abdominal trauma and the use of automatic mechanical compression devices. **METHODS:** An observational monocentric retrospective cohort study was conducted including all patients admitted to our Intensive Care Unit suffering from out-of-hospital cardiac arrest (OHCA) in Canton Ticino (Switzerland) from 2012 to 2021. The primary endpoint was to describe any resuscitation-related body injury. The secondary endpoints were to explore possible predictors of cardiopulmonary resuscitation (CPR) related injuries and their association with the 30-day mortality. **RESULTS:** We included 335 patients, 287 treated with manual chest compressions, 48 mechanically assisted. 55.5% of all resuscitated patients presented severe, or life-threatening lesions. Skeletal and thoracic injuries were the most frequent lesions followed by abdominal injuries. Mechanically assisted resuscitated patients presented higher risk of bleeding (OR 5.9; 95% CI 2.9-11.6) and increased CPR-related injuries (aOR 6.2; 95% CI 2.5-15.4) compared to standard manual chest compressions. In particular higher number of extra-thoracic and life-threatening lesions were described among the mechanical assisted CPR group. Patients with life-threatening had statistically significant higher mortality at 30-days compared to the severe and lesion's free cohort. **CONCLUSION:** Traumatic lesions occurred frequently after chest compression and their severity was associated with increased 30-day mortality. Mechanical devices, compared to manual chest compression, appear to be more harmful and may play a role in causing body lesions and hemorrhagic events.

## **CAUSE OF THE ARREST**

1. Eur Heart J Acute Cardiovasc Care. 2023 Sep 14:zuad105. doi: 10.1093/ehjacc/zuad105. Online ahead of print.

### **Air Pollution and out-of-hospital cardiac arrest risk.**

Moderato L(1), Aschieri D(1), Lazzeroni D(2), Rossi L(1), Biagi A(1), Binno SM(1), Monello A(1), Pelizzoni V(1), Sticozzi C(1), Zanni A(3), Capucci A(4), Nani S(5), Ardissino D(6), Nicolini F(5), Niccoli G(5).

#### **ABSTRACT**

**BACKGROUND:** Globally nearly 20% of cardiovascular disease deaths were attributable to air pollution. Out-of-hospital cardiac arrest (OHCA) represents a major public health problem, therefore, the identification of novel OHCA triggers is of crucial relevance. The aim of the study was to evaluate the association between air pollution (short-, mid- and long-term exposure) and out-of-hospital cardiac arrest (OHCA) risk, during a 7 years-period from a highly polluted urban area in northern of Italy, with a high density of automated external defibrillators (AEDs). **METHODS:** OHCA were prospectively collected from the "Progetto Vita Database" between 01/01/2010 to 31/12/2017; day-by-day air pollution levels were extracted from the Environmental Protection Agency (ARPA) stations. Electrocardiograms of OHCA interventions were collected from the AEDs data cards. Day-by-day particulate matter (PM) 2.5 and 10, ozone (O<sub>3</sub>), carbon monoxide (CO) and nitrogen dioxide (NO<sub>2</sub>) levels were measured. **RESULTS:** A total of 880 OHCA occurred in 748 days. A significantly increased in OHCA risk with the progressive increase in PM 2.5, PM 10, CO and NO<sub>2</sub> levels was found. After adjustment for temperature and seasons, a 9% and 12% increase of OHCA risk for each 10 µg/m<sup>3</sup> increase of PM 10 (p < 0.0001) and PM 2.5 (p < 0.0001) levels was found. Air pollutants levels were associated with both asystole and shockable rhythm risk while no correlation was found with pulseless electrical activity. **CONCLUSIONS:** Short-term and mid-term exposure to PM 2.5 and PM 10 is independently associated with the risk of OHCA due to asystole or shockable rhythm.

2. Resusc Plus. 2023 Sep 2;16:100464. doi: 10.1016/j.resplu.2023.100464. eCollection 2023 Dec.

### **Feasibility study of the Utstein Style For Drowning to aid data collection on the resuscitation of drowning victims.**

Thom O(1)(2), Roberts K(1)(2), Devine S(2), Leggat PA(2)(3), Franklin RC(2)(4).

#### **ABSTRACT**

**AIM:** The revised Utstein Style For Drowning (USFD) was published in 2015. Core data were considered feasible to be reported in most health systems worldwide. We aimed to determine the suitability of the USFD as a template for reporting data from drowning research. **METHOD:** Clinical records of 437 consecutive drowning presentations to the Sunshine Coast Hospital and Health Service Emergency Departments (ED) between 1/1/2015 and 31/12/2021 were examined for data availability to complete the USFD. The proportions of patients with each variable documented is reported. Time taken to record core and supplementary variables was recorded for 120 consecutive patients with severity of drowning Grade 1 or higher. **RESULTS:** There were 437 patients, including 227 (51.9%) aged less than 16 years. There were 253 (57.9%) males and 184 (42.1%) females. Sixty-one patients (13.9%) received cardiopulmonary resuscitation (CPR). There were nine (2.1%) deaths after presentation to the ED. Median time for data entry was 17 minutes for core variables and 6 min for supplementary. This increased to 29 + 6 minutes for patients in cardiac arrest. Sixteen (32.7%) of 49 core variables and four (13.3%) of 30 supplementary variables were documented 100% of the time. One (2.0%) core and seven (23.3%) supplementary variables were never documented.

Duration of submersion was documented in 100 (22.9%) patients. CONCLUSION: USFD is time consuming to complete. Data availability to enable completion of the USFD varies widely, even in a resource rich health system. These results should be considered in future revisions of the USFD.

## **END-TIDAL CO<sub>2</sub>**

1. Resuscitation. 2023 Sep 14:109970. doi: 10.1016/j.resuscitation.2023.109970. Online ahead of print.

### **Cardiovascular changes induced by targeted mild hypercapnia after out of hospital cardiac arrest. A sub-study of the TAME cardiac arrest trial.**

Baumann Melberg M(1), Flaa A(2), Øystein Andersen G(2), Sunde K(3), Bellomo R(4), Eastwood G(5), Mariero Olasveengen T(3), Qvigstad E(6).

#### **ABSTRACT**

AIM: Hypercapnia may elicit detrimental haemodynamic effects in critically ill patients. We aimed to investigate the consequences of targeted mild hypercapnia versus targeted normocapnia on pulmonary vascular resistance and right ventricular function in patients resuscitated from out-of-hospital cardiac arrest (OHCA). METHODS: Pre-planned, single-centre, prospective, sub-study of the Targeted Therapeutic Mild Hypercapnia After Resuscitated Cardiac Arrest (TAME) trial. Patients were randomised to mild hypercapnia (PaCO<sub>2</sub> = 6.7-7.3 kPa) or normocapnia (PaCO<sub>2</sub> = 4.7-6.0 kPa) for 24 hours. Haemodynamic assessment was performed with right heart catheterisation and serial blood-gas analyses every 4th hour for 48 hours. RESULTS: We studied 84 patients. Mean pH was 7.24 (95 % CI 7.22-7.30) and 7.32 (95 % CI 7.31-7.34) with hypercapnia and normocapnia, respectively (P-group <0.001). Pulmonary vascular resistance index (PVRI), pulmonary artery pulsatility index, and right atrial pressure did not differ between groups (P-group >0.05). Mean cardiac index was higher with mild hypercapnia (P-group <0.001): 2.0 (95 % CI 1.85-2.1) vs 1.6 (95 % CI 1.52-1.76) L/min/m<sup>2</sup>. Systemic vascular resistance index was 2579 dyne-sec/cm-5/ m<sup>2</sup> (95 % CI 2356-2830) with hypercapnia, and 3249 dyne-sec/cm-5/ m<sup>2</sup> (95 % CI 2930 - 3368) with normocapnia (P-group <0.001). Stroke volumes (P-group =0.013) and mixed venous oxygen saturation (P-group <0.001) were higher in the hypercapnic group. CONCLUSION: In resuscitated OHCA patients, targeting mild hypercapnia did not increase PVRI or worsen right ventricular function compared to normocapnia. Mild hypercapnia comparatively improved cardiac performance and mixed venous oxygen saturation.

## **ORGAN DONATION**

No articles identified.

## **FEEDBACK**

No articles identified.

## **DRUGS**

1. Cureus. 2023 Aug 10;15(8):e43252. doi: 10.7759/cureus.43252. eCollection 2023 Aug.

### **The Association Between Ventricular Fibrillation and Serum Catecholamine Levels.**

Oshima K(1), Sawada Y(1), Isshiki Y(1), Ichikawa Y(1), Fukushima K(1), Aramaki Y(1).

## **ABSTRACT**

Background and objective Epinephrine (Ep) is the first choice as a vasoconstrictor in cardiopulmonary resuscitation (CPR) for patients with cardiopulmonary arrest (CPA); however, the Ep concentration in the serum of CPA patients is still unclear. The aim of this study was to evaluate the association between serum Ep levels and achieving the return of spontaneous circulation (ROSC) in out-of-hospital cardiac arrest (OHCA) patients with ventricular fibrillation (VF). Methods This was a prospective, observational clinical study involving OHCA patients with VF transferred to our hospital from July 2014 to July 2017. The measurement of serum catecholamines [Ep, norepinephrine (Nep), and dopamine (DOA)] and vasopressin [antidiuretic hormone (ADH)] levels was performed with blood samples obtained immediately upon patients' arrival at our hospital. Patients were classified into two groups: the ROSC(+) group and ROSC(-) group; the serum concentrations of catecholamines and ADH were compared between these two groups. Results The serum Ep and Nep levels were lower in the ROSC(+) group than those in the ROSC(-) group and the difference was statistically significant. On the other hand, no significant differences were found in serum DOA and ADH levels between the two groups. Conclusions The results of this study suggest that an increment in serum Ep levels does not promote achieving ROSC in OHCA patients with VF.

2. Acta Pharm. 2023 Sep 14;73(3):325-339. doi: 10.2478/acph-2023-0022. Print 2023 Sep 1.

### **Is epinephrine still the drug of choice during cardiac arrest in the emergency department of the hospital? A meta-analysis.**

Hou M(1), Dong S(2), Kan Q(3), Ouyang M(4), Zhang Y(4).

## **ABSTRACT**

Epinephrine is the first-line emergency drug for cardiac arrest and anaphylactic reactions but is reported to be associated with many challenges resulting in its under- or improper utilization. Therefore, in this meta-analysis, the efficacy and safety of epinephrine as a first-line cardiac emergency drug for both out-of-hospital and in-hospital patients was assessed. Pertinent articles were searched in central databases like PubMed, Scopus, and Web of Science, using appropriate keywords as per the PRISMA guidelines. Retrospective and prospective studies were included according to the predefined PICOS criteria. RevMan and MedCalc software were used and statistical parameters such as odds ratio and risk ratio were calculated. Twelve clinical trials with a total of 208,690 cardiac arrest patients from 2000 to 2022 were included, in accordance with the chosen inclusion criteria. In the present meta-analysis, a high odds ratio (OR) value of 3.67 (95 % CI 2.32-5.81) with a tau<sup>2</sup> value of 0.64, a chi<sup>2</sup> value of 12,446.86, df value of 11, I<sup>2</sup> value of 100 %, Z-value 5.53, and a p-value < 0.00001 were reported. Similarly, the risk ratio of 1.89 (95 % CI 1.47-2.43) with a tau<sup>2</sup> value of 0.19, chi<sup>2</sup> value of 11,530.67, df value of 11, I<sup>2</sup> value of 100 %, Z-value of 4.95, and p-value < 0.000001. The present meta-analysis strongly prefers epinephrine injection as the first cardiac emergency drug for both out-of-hospital and in-hospital patients during cardiac arrest.

## **TRAUMA**

1. CJEM. 2023 Sep;25(9):724-727. doi: 10.1007/s43678-023-00541-y. Epub 2023 Jun 16.

### **Just the facts: traumatic cardiac arrest.**

Sowers N(1), Hung D(2).

**NO ABSTRACT AVAILABLE**

2. Injury. 2023 Sep 12:111033. doi: 10.1016/j.injury.2023.111033. Online ahead of print.

### **Who benefits from resuscitative thoracotomies following penetrating trauma: The patient or the learner?**

Atkins K(1), Schneider A(1), Gallaher J(1), Cairns B(1), Charles A(2).

#### **ABSTRACT**

**BACKGROUND:** Resuscitative thoracotomy (RT) is a salvage procedure following traumatic cardiac arrest. We aim to evaluate RT trends and outcomes in adults with cardiac arrest following penetrating trauma to determine the effect on mortality in this population. Further, we aim to estimate the effect of hospital teaching status on the performance of resuscitative thoracotomies and mortality. **METHODS:** We reviewed the National Trauma Data Bank (2017-2021) for adults ( $\geq 16$  years old) with penetrating trauma and prehospital cardiac arrest, stratified by the performance of a RT. We performed multivariable logistic regressions to estimate the effect of RT on mortality and the effect of hospital teaching status on the performance of resuscitative thoracotomies and mortality. **RESULTS:** 13,115 patients met our inclusion criteria. RT occurred in 12.7% ( $n = 1,664$ ) of patients. Rates of RT trended up over the study period. Crude mortality was similar in RT and Non-RT patients (95.6% vs. 94.5%,  $p = 0.07$ ). There was no statistically significant difference in the adjusted odds of mortality based on RT status (OR 0.82, 95%CI 0.56-1.21). University-teaching hospitals had an adjusted odds ratio of 1.68 (95% CI 1.31-2.17) for performing a RT than non-teaching hospitals. There was no difference in the adjusted odds of mortality in patients that underwent RT based on hospital teaching status. **CONCLUSION:** Despite up-trending rates, a resuscitative thoracotomy may not improve mortality in adults with penetrating, traumatic cardiac arrest. University teaching hospitals are nearly twice as likely to perform a RT than non-teaching hospitals, with no subsequent improvement in mortality.

#### **VENTILATION**

1. Resuscitation. 2023 Sep 12:109966. doi: 10.1016/j.resuscitation.2023.109966. Online ahead of print.

#### **The Effects of Mechanical Versus Bag-Valve Ventilation on Gas Exchange During Cardiopulmonary Resuscitation in Emergency Department Patients: A Randomized Controlled Trial (CPR-VENT).**

Tangpaisarn T(1), Tosibphanom J(2), Sata R(3), Kotruchin P(4), Drumheller B(5), Phungoen P(6).

#### **ABSTRACT**

**INTRODUCTION:** Effective ventilation is crucial for successful cardiopulmonary resuscitation (CPR). Previous studies indicate that higher arterial oxygen levels (PaO<sub>2</sub>) during CPR increase the chances of successful resuscitation. However, the advantages of mechanical ventilators over bag-valve ventilation for achieving optimal PaO<sub>2</sub> during CPR remain uncertain. **METHOD:** We conducted a randomized trial involving non-traumatic adult cardiac arrest patients who received CPR in the ED. After intubation, patients were randomly assigned to ventilate with a mechanical ventilator (MV) or bag valve ventilation (BV). In MV group, ventilation settings were: breath rate 10/minute, tidal volume 6-7 ml/kg, inspiratory time 1 second, positive end-expiratory pressure 0 cm water, inspiratory oxygen fraction (FiO<sub>2</sub>) 100%. The primary outcome was to compare the difference in PaO<sub>2</sub> from arterial blood gases (ABG) obtained 4-10 minutes later during CPR between both groups. **RESULTS:** Sixty patients were randomized (30 in each group). The study population consisted of: 57% male, median age 62 years, 37% received bystander CPR, and 20% had an initial shockable rhythm. Median time from arrest to intubation was 24 minutes. The median PaO<sub>2</sub> was not significantly different in the BV compared to MV [36.5 mmHg (14.0 - 70.0) vs. 29.0 mmHg (15.0-70.0),  $P = 0.879$ ]. Other ABG parameters and rates of return of spontaneous circulation and survival were not different. **CONCLUSIONS:** In ED patients with refractory cardiac arrest, arterial oxygen levels during CPR were comparable between patients ventilated with MV and BV. Mechanical ventilation is at least feasible and safe during CPR in intubated cardiac arrest patients.

2. Resuscitation. 2023 Sep 12;109965. doi: 10.1016/j.resuscitation.2023.109965. Online ahead of print.

**Ventilatory improvement with mechanical ventilator versus bag in non-traumatic out-of-hospital cardiac arrest: SYMEVECA study, phase 1.**

Hernández-Tejedor A, González Puebla V, Corral Torres E, Benito Sánchez A, Pinilla López R, Dolores Galán Calategui M.

**ABSTRACT**

AIM: To analyze differences in ventilatory parameters and outcome with different ventilatory methods during CPR. METHODS: Pragmatic prospective quasi-experimental study in out-of-hospital urban environment. Patients over 18 years of age in non-traumatic cardiac arrest, attended by an emergency medical service between April 2021 and September 2022, were included. Two groups were compared according to the ventilatory method: mechanical ventilator (IPPV, tidal volume 7 ml/kg, frequency 10-12 bpm) or manual resuscitator bag. The main variables of interest are those of gasometry performed 15 minutes after intubation or when spontaneous circulation is recovered and final outcome. Patients were followed up to hospital discharge. RESULTS: Of the 359 patients attended, 150 were included (71 in IPPV and 79 with a bag). In patients with arterial blood gases, pCO<sub>2</sub> was 67.8 ± 21.1 in the IPPV group vs 95.9 ± 39.0 mmHg in the bag group (p = 0.006) and pH was 7.00 ± 0.18 vs 6.92 ± 0.18 (p = 0.18). With a venous sample, the pCO<sub>2</sub> was 68.1 ± 18.9 vs 89.5 ± 26.5 mmHg (p < 0.001) and the pH was 7.03 ± 0.15 vs 6.94 ± 0.17 (p = 0.005), respectively. Survival with CPC 1-2 to hospital discharge was 15.6% with IPPV and 11.3% with bag (p = 0.44). CONCLUSION: The use of a mechanical ventilator in IPPV was associated with a better ventilatory status during CPR compared to the use of the bag, without conclusive data regarding its clinical repercussion with the sample collected.

3. BMJ Open. 2023 Sep 15;13(9):e074475. doi: 10.1136/bmjopen-2023-074475.

**Early restricted oxygen therapy after resuscitation from cardiac arrest (ER-OXYTRAC): protocol for a stepped-wedge cluster randomised controlled trial.**

Yamamoto R(1), Yamakawa K(2), Endo A(3), Homma K(4), Sato Y(5), Takemura R(5), Yamagiwa T(6), Shimizu K(7), Kaito D(4), Yagi M(8), Yonemura T(9), Shibusawa T(10), Suzuki G(11), Shoji T(12), Miura N(13), Takahashi J(14), Narita C(15), Kurata S(16), Minami K(17), Wada T(18), Fujinami Y(19), Tsubouchi Y(20), Natsukawa M(21), Nagayama J(22), Takayama W(23), Ishikura K(24), Yokokawa K(25), Fujita Y(26), Nakayama H(27), Tokuyama H(28), Shinada K(29), Taira T(30), Fukui S(31), Ushio N(2), Nakane M(32), Hoshiyama E(33), Tampo A(34), Sageshima H(35), Takami H(36), Iizuka S(37), Kikuchi H(38), Hagiwara J(39), Tagami T(40), Funato Y(41), Sasaki J(4)(42)(43), Er-Oxytrac SG(44).

**ABSTRACT**

INTRODUCTION: Cardiac arrest is a critical condition, and patients often experience postcardiac arrest syndrome (PCAS) even after the return of spontaneous circulation (ROSC). Administering a restricted amount of oxygen in the early phase after ROSC has been suggested as a potential therapy for PCAS; however, the optimal target for arterial partial pressure of oxygen or peripheral oxygen saturation (SpO<sub>2</sub>) to safely and effectively reduce oxygen remains unclear. Therefore, we aimed to validate the efficacy of restricted oxygen treatment with 94%-95% of the target SpO<sub>2</sub> during the initial 12 hours after ROSC for patients with PCAS. METHODS AND ANALYSIS: ER-OXYTRAC (early restricted oxygen therapy after resuscitation from cardiac arrest) is a nationwide, multicentre, pragmatic, single-blind, stepped-wedge cluster randomised controlled trial targeting cases of non-traumatic cardiac arrest. This study includes adult patients with out-of-hospital or in-hospital cardiac arrest who achieved ROSC in 39 tertiary centres across Japan, with a target sample size of 1000. Patients whose circulation has returned before hospital arrival and those with cardiac arrest due to intracranial disease or intoxication are excluded. Study participants are assigned to either the restricted oxygen (titration of a fraction of inspired oxygen with 94%-95% of the target SpO<sub>2</sub>) or the control (98%-100% of the target SpO<sub>2</sub>) group based on cluster randomisation per institution. The trial intervention continues until 12 hours after ROSC. Other treatments for PCAS, including oxygen



administration later than 12 hours, can be determined by the treating physicians. The primary outcome is favourable neurological function, defined as cerebral performance category 1-2 at 90 days after ROSC, to be compared using an intention-to-treat analysis.

### **CEREBRAL MONITORING**

1. PLoS One. 2023 Sep 15;18(9):e0290619. doi: 10.1371/journal.pone.0290619. eCollection 2023. **Neuroprognostication value of serum neurofilament light chain for out-of-hospital cardiac arrest: A systematic review and meta-analysis.**

Fu Y(1)(2), Fan XT(1)(2), Li H(1)(3), Zhang R(3), Zhang DD(4), Jiang H(5), Chen ZG(2), Zhang JT(3).

#### **ABSTRACT**

**BACKGROUND:** Neurofilament light chain (NfL) is a novel biomarker for the assessment of neurological function after cardiac arrest (CA). Although meta-analysis has confirmed its predictive value, it has not conducted a more detailed analysis of its research. We conducted a meta-analysis to evaluate the relationship between serum NfL level and neurological prognosis in patients with spontaneous circulation recovery after CA, and subgroup analysis was conducted according to sample collection time, time to assess neurological function, study design, whether TTM was received, the method of specimen determination, and the presence of neurological disease in patients. To analyze the influence of these factors on the predictive value of serum NfL. **METHODS:** Published Cochrane reviews and an updated, extended search of MEDLINE, Cochrane Library, Embase, Scopus, ClinicalKey, CINAHL, and Web of Science for relevant studies until March 2022 were assessed through inclusion and exclusion criteria. The standard mean difference and 95% confidence interval were calculated using the random-effects model or fixed-effects model to assess the association between one variable factor NfL level and the outcome of CA patients. Subgroup analysis according to sample collection time was performed. The prognosis analysis and publication bias were also assessed using Egger's and Begg's tests. **RESULTS:** Among 1209 related articles for screening, 6 studies (1360 patients) met the inclusion criteria and were selected for meta-analysis. The level of serum NfL in the good prognosis group (CPC1-2, CPC: cerebral performance category score) was significantly lower than that in the poor prognosis group (CPC3-5) SMD(standardized mean difference) = 0.553, 95%CI(confidence interval) = 0.418-0.687, I<sup>2</sup> = 65.5% P<0.05). And this relationship also exists at each sampling time point (NfL specimens were collected on admission: SMD:0.48,95%CI:0.24-0.73; Samples were collected 24 hours after CA: SMD:0.60,95%CI:0.32-0.88;Specimens were obtained 48 hours after CA: SMD:0.51, 95%CI:0.18-0.85;Specimens were obtained 72 hours after CA: SMD:0.59, 95%CI:0.38-0.81). **CONCLUSION:** NfL may play a potential neuroprognostication role in postcardiac arrest patients with spontaneous circulation, regardless of when the sample was collected after CA.

### **ULTRASOUND AND CPR**

No articles identified.

### **ORGANISATION AND TRAINING**

1. Resusc Plus. 2023 Sep 9;16:100467. doi: 10.1016/j.resplu.2023.100467. eCollection 2023 Dec.

**Basic life support training for people with disabilities. A scoping review.**

Berlanga-Macías C(1)(2), Barcala-Furelos R(3), Méndez-Seijo N(3), Peixoto-Pino L(4)(5), Martínez-Isasi S(5)(6)(7).

## **ABSTRACT**

**BACKGROUND:** The integration of populations with various types of disabilities into basic life support (BLS) training programs could contribute to a potential increase in trained laypersons with BLS knowledge and, consequently, in survival rates. The objective of this study was to analyze the distinct educational methods which exist today on BLS for people with some type of specific disability, and to evaluate their impact on the quality of BLS maneuvers. **METHODS:** A scoping review in which the different training strategies in BLS for people with distinctive disabilities were analyzed was carried out. Previous studies were sought and researched in MEDLINE, EMBASE, and the Cochrane Library from the beginning up to 4 August 2023. **RESULTS:** A total of 14 studies were thoroughly analyzed. The BLS training strategies for people with disabilities were classified according to the following criteria: objective (training, content validation or analysis of learning barriers), target population (visual, hearing, physical disabilities or Down syndrome), training resources (training with/without adaptation), contents (BLS and use of the automated external defibrillator) and evaluation instrument (i.e., the simulation test and knowledge questionnaire). The variety of BLS training programs for such population is limited. Likewise, people with different disabilities are able to effectively learn BLS maneuvers, although with mixed results, mainly in those regarding the CPR quality. **CONCLUSION:** People with visual, hearing disabilities or Down syndrome are able to effectively learn BLS maneuvers.

2. Resusc Plus. 2023 Sep 6;16:100466. doi: 10.1016/j.resplu.2023.100466. eCollection 2023 Dec.

### **A study protocol for a cluster-randomised controlled trial of smartphone-activated first responders with ultraportable defibrillators in out-of-hospital cardiac arrest: The First Responder Shock Trial (FIRST).**

Todd V(1)(2), Dicker B(1)(2), Okyere D(3)(4), Smith K(4)(5)(6), Smith T(1), Howie G(2)(1), Stub D(4), Ray M(3), Stewart R(7), Scott T(8), Swain A(9)(2), Heriot N(3), Brett A(1), Mahony E(3), Nehme Z(3)(4)(5).

## **ABSTRACT**

**OBJECTIVE:** To describe the First Responder Shock Trial (FIRST), which aims to determine whether equipping frequently responding, smartphone-activated (GoodSAM) first responders with an ultraportable AED can increase 30-day survival rates in OHCA. **METHODS:** The FIRST trial is an investigator-initiated, bi-national (Victoria, Australia and New Zealand), registry-nested cluster-randomised controlled trial where the unit of randomisation is the smartphone-activated (GoodSAM) first responder. High-frequency GoodSAM responders are randomised 1:1 to receive an ultraportable, single-use AED or standard alert procedures using the GoodSAM app. The primary outcome is survival to 30 days. The secondary outcome measures (shockable rhythm, return of spontaneous circulation, event survival, and time to first shock delivery) are routinely collected by OHCA registries in both regions. The trial was registered with the Australian New Zealand Clinical Trials Registry (ANZCTR) (Registration: ACTRN12622000448741) on 22 March 2022. **RESULTS:** The trial started in November 2022 and the last patient is expected to be enrolled in November 2024. We aim to detect a 7% increase in the proportion of 30-day survivors, from 9% in patients attended by control responders to 16% in patients attended by responders randomised to the ultraportable AED intervention arm. With 80% power, an alpha of 0.05, a cluster size of 1.5 and a coefficient of variation for cluster sizes of 1, the sample size required to detect this difference is 714 (357 per arm). **CONCLUSION:** The FIRST study will increase our understanding of the potential role of portable AED use by smartphone-activated community responders and their impact on survival outcomes.

3. Am Heart J. 2023 Sep 12:S0002-8703(23)00276-4. doi: 10.1016/j.ahj.2023.09.004. Online ahead of print.

### **A Cross-stakeholder Approach to Improving Out-of-Hospital Cardiac Arrest Survival.**

Guetterman TC(1), Forman J(2), Fouche S(3), Simpson K(4), Fetters MD(5), Nelson C(6), Mendel P(6), Hsu A(7), Flohr JA(3), Domeier R(8), Rahim R(9), Nallamotheu BK(10), Abir M(11).

#### **ABSTRACT**

**BACKGROUND:** Out-of-hospital cardiac arrest (OHCA) affects over 300,000 individuals per year in the U.S. with poor survival rates overall. A remarkable five-fold difference in survival-to-hospital discharge rates exist across U.S. communities. **METHOD:** We conducted a study using qualitative research methods comparing the system of care across sites in Michigan communities with varying OHCA survival outcomes, as measured by return to spontaneous circulation with pulse upon emergency department arrival. **RESULTS:** Major themes distinguishing higher performing sites were 1) working as a team, 2) devoting resources to coordination across agencies, and 3) developing a continuous quality improvement culture. These themes spanned the chain of survival framework for OHCA. By examining the unique processes, procedures, and characteristics of higher- relative to lower-performing sites, we gleaned lessons learned that appear to distinguish higher performers. The higher performing sites reported being the most collaborative, due in part to facilitation of system integration by progressive leadership that is willing to build bridges among stakeholders. **CONCLUSION:** Based on the distinguishing features of higher performing sites, we provide recommendations for toolkit development to improve survival in prehospital systems of care for OHCA.

4. JAMA Cardiol. 2023 Sep 13:e232934. doi: 10.1001/jamacardio.2023.2934. Online ahead of print.

### **Long-Term Quality of Life After Out-of-Hospital Cardiac Arrest.**

Yonis H(1)(2), Sørensen KK(1), Bøggild H(3), Ringgren KB(4)(5), Malta Hansen C(6)(7), Granger CB(8), Folke F(7)(9), Christensen HC(7), Jensen B(3), Andersen MP(1), Joshi VL(10)(11), Zwisler AD(10)(12), Torp-Pedersen C(1)(2), Kragholm K(13)(14).

#### **ABSTRACT**

**IMPORTANCE:** Allocating resources to increase survival after cardiac arrest requires survivors to have a good quality of life, but long-term data are lacking. **OBJECTIVE:** To determine the quality of life of survivors of out-of-hospital cardiac arrest from 2001 to 2019. **DESIGN, SETTING, AND PARTICIPANTS:** This survey study used the EuroQol Health Questionnaire, 12-Item Short Form Health Survey (SF-12), and Hospital Anxiety and Depression Scale (HADS) to assess the health-related quality of life of all adult survivors of out-of-hospital cardiac arrest included in the Danish Cardiac Arrest Registry between June 1, 2001, and August 31, 2019, who were alive in October 2020 (follow-up periods, 0-1, >1-2, >2-4, >4-6, >6-8, >8-10, >10-15, and >15-20 years since arrest). The survey was conducted from October 1, 2020, through May 31, 2021. **EXPOSURE:** All patients who experienced an out-of-hospital cardiac arrest. **MAIN OUTCOME AND MEASURES:** Self-reported health was measured using the EuroQol Health Questionnaire index (EQ index) score and EQ visual analog scale. Physical and mental health were measured using the SF-12, and anxiety and depression were measured using the HADS. Descriptive statistics were used for the analysis. **RESULTS:** Of 4545 survivors, 2552 (56.1%) completed the survey, with a median follow-up since their event of 5.5 years (IQR, 2.9-8.9 years). Age was comparable between responders and nonresponders (median [IQR], 67 [58-74] years vs 68 [56-78] years), and 2075 responders (81.3%) were men and 477 (18.7%) women (vs 1473 male [73.9%] and 520 female [26.1%] nonresponders). For the shortest follow-up (0-1 year) and longest follow-up (>15-20 years) groups, the median EQ index score was 0.9 (IQR, 0.7-1.0) and 0.9 (0.8-1.0), respectively. For all responders, the mean (SD) SF-12 physical health score was 43.3 (12.3) and SF-12 mental health score, 52.9 (8.3). All 3 scores were comparable to a general Danish reference population. Based on HADS scores, a low risk for anxiety was reported by 73.0% (54 of 74) of 0- to 1-year survivors vs 89.3% (100 of 112) of greater than 15- to 20-year survivors; for symptoms of

depression, these proportions were 79.7% (n = 59) and 87.5% (n = 98), respectively. Health-related quality of life was similar in survivor groups across all follow-up periods. **CONCLUSIONS AND RELEVANCE:** Among this survey study's responders, who comprised more than 50% of survivors of out-of-hospital cardiac arrest in Denmark, long-term health-related quality of life up to 20 years after their event was consistently high and comparable to that of the general population. These findings support resource allocation and efforts targeted to increasing survival after out-of-hospital cardiac arrest.

5. Resusc Plus. 2023 Sep 2;16:100456. doi: 10.1016/j.resplu.2023.100456. eCollection 2023 Dec.

**Frailty is a better predictor than age for shockable rhythm and survival in Out-of-Hospital cardiac arrest in over 16-year-olds.**

McPherson SJ(1)(2), Juniper M(1)(3), Smith N(1).

**ABSTRACT**

**OBJECTIVE:** To determine if the Clinical Frailty Scale (CFS) predicts out-of-hospital cardiac arrest (OHCA) outcomes better than age? **Design:** The analysed data was collected as part of a larger study run by NCEPOD on hospital admissions for OHCA in 2018. Study selection was OHCA in over 16-year-olds with restoration of spontaneous circulation (ROSC) for >20 mins and who were admitted to hospital, or who died in the emergency department. Patients from hospitals in England, Wales and Northern Ireland were identified using standard coding for cardiac arrest. CFS, age and gender were examined against two binary outcomes (non-shockable rhythm and survival). **RESULTS:** 304 patients with a known CFS, known original rhythm, and known outcome were included. Younger patients had lower CFSs, as a continuous variable (Pearson correlation coefficient 0.44, p-value < 0.001) and in CFS groupings of 1-3, 4-6, 7-9 (p-value < 0.001). CFSs were higher (p-values < 0.001) for both non-shockable rhythm and death (median CFS was 4 for death and 2 for survivors). Logistic regression analysis of continuous scale CFS showed the association with non-shockable rhythm remained when adjusted for age and sex (odds ratio [95% CI]; age adjustment 1.46 [1.28, 1.68] p-value < 0.001) and remained for survival when adjusted for age alone (odds ratio [95% CI]; 1.60 [1.36, 1.88] p-value < 0.001) and when adjusted for age, sex and initial rhythm combined (1.45 [1.21, 1.73] p-value < 0.001). 3.2% of patients had resuscitation against their advanced-care-directives. 12.9% (23/178) of hospitals had electronic systems which shared advance-care-directives with ambulance services and primary care. **CONCLUSION:** A higher CFS is a prognostic indicator in adult OHCA independent of age. Frail individuals have a lower likelihood of a shockable rhythm and poorer survival. Sensitive sharing of this information with patients when discussing advance-care-directives may enhance shared decision-making.

6. Medicine (Baltimore). 2023 Sep 15;102(37):e35057. doi: 10.1097/MD.00000000000035057.

**A model study for the classification of high-risk groups for cardiac arrest in general ward patients using simulation techniques.**

Song SY(1), Choi WK(2), Kwak S(3).

**ABSTRACT**

Currently, many hospitals use vital signs-based criteria such as modified early warning score (MEWS) and national early warning score (NEWS) to classify high-risk patients for cardiac arrest, but there are limitations in selecting high-risk patients with a possibility of cardiac arrest. The purpose of this study is to develop a cardiac arrest classification model to identify patients at high risk of cardiac arrest based on the patient family and past history, and blood test results after hospitalization, rather than vital signs. This study used electronic medical record (EMR) data from A university hospital, and patients in the high-risk group for cardiac arrest were defined as those who underwent cardio-pulmonary resuscitation (CPR) after cardiac arrest. Considering the use of the rapid response

team of A university hospital, patients hospitalized in intensive care units (ICU), emergency medicine departments, psychiatric departments, pediatric departments, cardiology departments, and palliative care wards were excluded. This study included 325,534 patients, of which 3291 low-risk and 382 high-risk patients were selected for study. Data were split into training and validation data sets and univariate analysis was performed for 13 candidate risk factors. Then, multivariate analysis was performed using a bivariate logistic regression model, and an optimal model was selected using simulation analysis. In the training data set, it was calculated as sensitivity 75.25%, precision 21.59%, specificity 66.89%, accuracy 67.79%, F1 score 33.56, area under curve (AUC) 71.1 (95% confidence interval [CI] = 68.9-73.1 P value=<.001). In the validation data set, sensitivity 73.37%, precision 25.81%, specificity 75.03%, accuracy 74.86%, F1 score 38.19, AUC 74.2 (95% CI = 72.1-76.2, P value=<.001) were calculated. A model for classifying the high-risk group of cardiac arrest should be developed from various perspectives. In the future, in order to classify patients with high risk of cardiac arrest, a prospective study on the combined use of the model developed by this study and NEWS or MEWS should be conducted.

7. *Obstet Gynecol.* 2023 Sep 14. doi: 10.1097/AOG.0000000000005349. Online ahead of print.

**Validation of a Simulation-Based Resuscitation Curriculum for Maternal Cardiac Arrest.**

Shields AD(1), Vidosh J, Thomson BA, Minard C, Annis-Brayne K, Kavanagh L, Roth CK, Lutgendorf MA, Rahm SJ, Becker LR, Mosesso VN, Schaeffer B, Gresens A, Epley S, Wagner R, Streitz MJ, Bhalala US, Melvin LM, Deering S, Nielsen PE.

**ABSTRACT**

**OBJECTIVE:** To assess the knowledge, skills, and self-efficacy of health care participants completing a simulation-based blended learning training curriculum on managing maternal medical emergencies and maternal cardiac arrest (Obstetric Life Support). **METHODS:** A formative assessment of the Obstetric Life Support curriculum was performed with a prehospital cohort comprising emergency medical services professionals and a hospital-based cohort comprising health care professionals who work primarily in hospital or urgent care settings and respond to maternal medical emergencies. The training consisted of self-guided precourse work and an instructor-led simulation course using a customized low-fidelity simulator. Baseline and postcourse assessments included multiple-choice cognitive test, self-efficacy questionnaire, and graded Megacode assessment of the team leader. Megacode scores and pass rates were analyzed descriptively. Pre- and post-self-confidence assessments were compared with an exact binomial test, and cognitive scores were compared with generalized linear mixed models. **RESULTS:** The training was offered to 88 participants between December 2019 and November 2021. Eighty-five participants consented to participation; 77 participants completed the training over eight sessions. At baseline, fewer than half of participants were able to achieve a passing score on the cognitive assessment as determined by the expert panel. After the course, mean cognitive assessment scores improved by 13 points, from 69.4% at baseline to 82.4% after the course (95% CI 10.9-15.1, P<.001). Megacode scores averaged 90.7±6.4%. The Megacode pass rate was 96.1%. There were significant improvements in participant self-efficacy, and the majority of participants (92.6%) agreed or strongly agreed that the course met its educational objectives. **CONCLUSION:** After completing a simulation-based blended learning program focused on managing maternal cardiac arrest using a customized low-fidelity simulator, most participants achieved a defensible passing Megacode score and significantly improved their knowledge, skills, and self-efficacy.

8. *Sci Rep.* 2023 Sep 12;13(1):15081. doi: 10.1038/s41598-023-41984-8.

**Red blood cell distribution width for the prediction of outcomes after cardiac arrest.**

Urban T(#)(1), Amacher SA(#)(1)(2), Becker C(1)(3), Gross S(1), Arpagaus A(1), Tisljar K(2), Sutter R(2)(4), Pargger H(2)(4), Marsch S(2)(4), Hunziker S(5)(6).

**ABSTRACT**

The red blood cell distribution width (RDW) is a routinely available blood marker that measures the variation of the size/volume of red blood cells. The aim of our study was to investigate the prognostic value of RDW in cardiac arrest patients and to assess whether RDW improves the prognostic value of three cardiac arrest-specific risk scores. Consecutive adult cardiac arrest patients admitted to the ICU of a Swiss university hospital were included. The primary outcome was poor neurological outcome at hospital discharge assessed by Cerebral Performance Category. Of 702 patients admitted to the ICU after cardiac arrest, 400 patients (57.0%) survived, of which 323 (80.8%) had a good neurological outcome. Higher mean RDW values showed an independent association with poor neurological outcomes at hospital discharge (adjusted OR 1.27, 95% CI 1.14 to 1.41;  $p < 0.001$ ). Adding the maximum RDW value to the OHCA- CAHP- and PROLOGUE cardiac arrest scores improved prognostic performance. Within this cohort of cardiac arrest patients, RDW was an independent outcome predictor and slightly improved three cardiac arrest-specific risk scores. RDW may therefore support clinical decision-making.

9. Resusc Plus. 2023 Sep 1;16:100461. doi: 10.1016/j.resplu.2023.100461. eCollection 2023 Dec.

**Findings from a decade of experience following implementation of a Rapid Response System into an Asian hospital.**

Tee A(1), Choo BP(2), Gokhale RS(3), Wang X(4), Mansor M(5), Oh HC(2), Jones D(6).

**ABSTRACT**

AIM: Rapid response systems (RRS) are present in many acute hospitals in western nations but are not widely adopted in Asia. The influence of healthcare culture and the effect of implementing an RRS over time are infrequently reported. We describe the introduction of a RRS into a Singaporean hospital and the barriers encountered. The efferent limb activation rates, cardiac arrest rates and unplanned intensive care unit (ICU) admissions are trended over eleven years. METHODS: We conducted a retrospective observational study using prospectively collected data derived from administrative and Medical Emergency Team (MET) databases. RESULTS: The RRS used a MET with a single parameter track and trigger and physician led efferent limb. Barriers encountered included clinical leadership buy-in, assembling and equipping the efferent team, maintaining a non-punitive mindset, improving accessibility to MET and communicating the impact of the MET. Over an 11-year period with 488,252 hospital admissions, MET activation rates increased from 1.6/1000 admissions (2009) to 14.1/1000 admissions (2019). Code blue activations and unplanned ICU admission rates decreased from 2.9 to 1.7 and from 8.8 to 2.0/1000 admissions, respectively over the 11 years. There were associations between increasing MET activation rate and reduction in code blue activations ( $p = 0.013$ ) and unplanned medical ICU admission rates ( $p = 0.001$ ). CONCLUSION: Implementing, sustaining and continued improvement of an RRS in Singapore is possible despite challenges encountered. With increasing activation rates over a decade, there were reductions in cardiac arrest rates and unplanned medical ICU admissions.

10. Perfusion. 2023 Sep 13:2676591231202679. doi: 10.1177/02676591231202679. Online ahead of print.

**Implications of pediatric extracorporeal cardiopulmonary resuscitation simulation for intensive care team confidence and coordination: A pilot study.**

Akinpelu T(1)(2), Shah NR(3), Weaver K(4), Muller N(4), McElroy J(4), Bhalala US(1)(3)(5).

**ABSTRACT**

**INTRODUCTION:** Extracorporeal cardiopulmonary resuscitation (ECPR) is associated with improved outcomes in select populations, however, crisis resource management (CRM) in this setting is logistically challenging. This study evaluates the impact of ECPR simulation on self-perceived confidence and collaboration of intensive care unit team members. **METHODS:** This is a prospective observational study analyzing data obtained between July 2018-December 2019. This study focused on non-surgical members of critical care team consisting of pediatric intensivists, resident physicians, registered nurses, respiratory therapists. Participants were expected to perform cardiopulmonary resuscitation (CPR) during the ECPR event, participate in code-team responsibilities and provide ancillary support during cannulation. Pre- and post-simulation surveys employed the Likert scale (1 = not at all confident, 5 = highly confident) to assess self-perceived scores in specified clinical competencies. **RESULTS:** Twenty-nine providers participated in the simulation; 38% had prior ECPR experience. Compared to mean pre-study Likert scores (2.4, 2.4, 2.5), post-simulation scores increased (4.2, 4.4, 4.3) when self-evaluating: confidence in assessing patients needing ECPR, confidence in participating in ECPR workflow and confidence in performing high-quality CPR, respectively. Post-simulation values of >3 were reported by 100% of participants in all domains ( $p < .0001$ ). All participants indicated the clinical scenario and procedural environment to be realistic and appropriately reflective of situational stress. Additionally, 100% of participants reported the simulation to improve perceived team communication and teamwork skills. **CONCLUSION:** This study demonstrated preliminary feasibility of pediatric ECPR simulation in enhancing independent provider confidence and team communication. This self-perceived improvement may establish a foundation for cohesive CRM, in preparation for a real life ECPR encounter.

## **POST-CARDIAC ARREST TREATMENTS**

1. Resusc Plus. 2023 Aug 31;16:100460. doi: 10.1016/j.resplu.2023.100460. eCollection 2023 Dec. **Long-term follow-up of cardiac arrest survivors: Protocol of the DESAC (Devenir des survivants d'Arrets Cardiaques) study, a French multicentric prospective cohort.**

Dumas F(1), Bougouin W(2)(3), Perier MC(3), Marin N(4), Goulenok C(2), Vieillard-Baron A(5), Diehl JL(6), Legriel S(7), Deye N(8), Cronier P(9), Ricôme S(10), Chemouni F(11), Mekontso Dessap A(12), Beganton F(3), Marijon E(3), Jouven X(3), Empana JP(3), Cariou A(3)(4).

### **ABSTRACT**

**BACKGROUND:** While the short-term prognosis of cardiac arrest patients - nearly 250,000 new cases per year in Europe - has been extensively studied, less is known regarding the mid and long-term outcome of survivors. **OBJECTIVE:** The aim of the DESAC study is to describe mid- and long-term survival rate and functional status of cardiac arrest survivors, and to assess the influence of pre and intra hospital therapeutic strategies on these two outcomes. **METHODS:** Between Jul 2015 and Oct 2018, adult patients over 18 years who were discharged alive from any intensive care units (public and private hospitals) in the Ile-de-France area (Paris and suburbs, France) after a non-traumatic cardiac arrest were screened for participation in this multicentric study. Survivors were included after they signed (or the proxies) an informed consent before discharge during initial hospitalisation. We calculated that including 600 patients in total would allow an 80% power to demonstrate a 2 years survival rate difference of 10% between patients who did and those who did not receive therapeutic hypothermia after resuscitation. Pre- and in-hospital data related to the circumstances surrounding the event and to the therapeutic interventions (such as cardio-pulmonary resuscitation, defibrillation, emergent coronary revascularization, neuroprotective therapeutics) were collected. After discharge, patients were interviewed at 3 months, 6 months and every year thereafter for a minimum follow-up of 26 months and a maximum follow-up of 48 months. Information on vital status, occurrence of cardiovascular events, medications and a comprehensive assessment of the functional status (qualitative of life as assessed by the Short-Form General Health Survey (SF36) scale,

activities of daily living (ADL) scale, neurological Cerebral Performance Categories (CPC) and Overall Performance Categories (OPC) scales, socio-professional activities) were collected at follow-up interviews. **DISCUSSION:** The DESAC study should provide important information regarding several dimensions of the mid and long-term prognosis of cardiac arrest survivors and on the benefit (and potentially harm) of early therapeutic strategies.

2. Intern Emerg Med. 2023 Sep 12. doi: 10.1007/s11739-023-03420-7. Online ahead of print.

**Cardiac arrest related lung edema: examining the role of downtimes in transpulmonary thermodilution analysis.**

Voigt I(1), Mighali M(2), Wieneke H(3)(4), Bruder O(3)(5).

**ABSTRACT**

Pulmonary edema and its association with low flow times has been observed in postcardiac arrest patients. However, diagnosis of distinct types of lung pathology is difficult. The aim of this study was to investigate pulmonary edema by transpulmonary thermodilution (TPTD) after out-of-hospital cardiac arrest (OHCA), and the correlation to downtimes. In this retrospective single-center study consecutive patients with return of spontaneous circulation (ROSC) following OHCA, age  $\geq 18$ , and applied TPTD were enrolled. According to downtimes, patients were divided into a short and a long no-flow-time group, and data of TPTD were analysed. We identified 45 patients ( $n = 25$  short no-flow time;  $n = 20$  long no-flow time) who met the inclusion criteria. 24 h after ROSC, the extra vascular lung water index (EVLWI) was found to be lower in the group with short no-flow time compared to the group with long no-flow time ( $10.7 \pm 3.5$  ml/kg vs.  $12.8 \pm 3.9$  ml/kg;  $p = 0.08$ ) and remained at a similar level 48 h ( $10.9 \pm 4.3$  ml/kg vs.  $12.9 \pm 4.9$  ml/kg;  $p = 0.25$ ) and 72 h ( $11.1 \pm 5.0$  ml/kg vs.  $13.9 \pm 7.7$  ml/kg;  $p = 0.27$ ) post-ROSC. We found a statistically significant and moderate correlation between no-flow duration and EVLWI 48 h ( $r = 0.51$ ;  $p = 0.002$ ) and 72 h ( $r = 0.54$ ;  $p = 0.004$ ) post-ROSC. Pulmonary vascular permeability index (PVPI) was not correlated with downtimes. Our observation underlines the presence of cardiac arrest-related lung edema by determination of EVLWI. The duration of no-flow times is a relevant factor for increased extravascular lung water index.

3. Shock. 2023 Sep 5. doi: 10.1097/SHK.0000000000002225. Online ahead of print.

**Predictive value of neutrophil extracellular traps components for 28-day all-cause mortality in patients with cardiac arrest: A pilot observational study.**

Li P(1), Liang S(2), Wang L(1), Guan X(1), Wang J, Gong P.

**ABSTRACT**

**BACKGROUND:** Ischemia-reperfusion after cardiac arrest activates peptidyl arginine deiminase and citrullinates histone H3 (CitH3), which leads to the formation of neutrophil extracellular traps (NETs). This study attempted to determine the alterations in NET components in post-cardiac arrest patients as well as analyze the association of NETs with 28-day all-cause mortality. **METHODS:** In this study, 95 patients with return of spontaneous circulation (ROSC) after cardiac arrest were included. They were categorized into the survivor group ( $n = 32$ ) and the nonsurvivor group ( $n = 63$ ) according to their 28-day survival statuses. The control group comprised 20 healthy individuals. The blood samples were collected from the patients on Days 1, 3, and 7 after ROSC and from the control subjects at the time of enrollment. The serum cell-free DNA (cfDNA) level was determined using the fluorescent labeling method, and the serum concentrations of NETs components, including CitH3, myeloperoxidase (MPO), neutrophil elastase (NE), and nucleosomes, were estimated using the enzyme-linked immunosorbent assay. **RESULTS:** Compared with the control group, the serum NET components were significantly increased in the patients 1 week after ROSC (all  $P < 0.05$ ). These components were significantly higher in the nonsurvivor group than in the survivor group (all  $P < 0.05$ ). Spearman's correlational analysis revealed that the components were positively correlated with APACHE II scores (both  $P < 0.05$ ). Binary logistic regression analysis indicated that serum cfDNA, CitH3, and nucleosomes on Days 1 and 3 after ROSC were independent predictors of 28-day all-cause



mortality. Furthermore, these parameters on Day 1 after ROSC had the biggest areas under the ROC curves (0.876, 0.862, and 0.861, respectively). CONCLUSIONS: Elevated serum levels of cfDNA, CitH3, MPO, NE, and nucleosomes were positively correlated with disease severity after ROSC. However, only serum CitH3, cfDNA, and nucleosomes on Day 1 after ROSC showed a good predictive value for 28-day all-cause mortality.

### **TARGETED TEMPERATURE MANAGEMENT**

1. Inn Med (Heidelb). 2023 Sep 13. doi: 10.1007/s00108-023-01582-2. Online ahead of print.

#### **[Procedure after successful cardiopulmonary resuscitation-Cooling or no more cooling?].**

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

Roedl K(1), Wolfrum S(2), Kluge S(3).

#### **ABSTRACT**

Approximately 84 out of 100,000 inhabitants in Europe suffer from an out of hospital cardiac arrest (OHCA) each year. The mortality after cardiac arrest (CA) is high and is particularly determined by the predominant cardiogenic shock condition and hypoxic ischemic encephalopathy. For almost two decades hypothermic temperature control was the only neuroprotective intervention recommended in guidelines for postresuscitation care; however, recently published studies failed to demonstrate any improvement in the neurological outcome with hypothermia in comparison to strict normothermia in postresuscitation treatment. According to the European Resuscitation Council (ERC) and European Society of Intensive Care Medicine (ESICM) guidelines published in 2022, unconscious adults after CA should be treated with temperature management and avoidance of fever; however, many questions remain open regarding the optimal target temperature, the cooling methods and the optimal duration. Despite these currently unanswered questions, a structured and high-quality postresuscitation care that includes a targeted temperature management should continue to be provided for all patients in the postresuscitation phase, independent of the selected target temperature. Furthermore, fever avoidance remains an important component of postresuscitation care.

### **ELECTROPHYSIOLOGY AND DEFIBRILLATION**

1. Prehosp Emerg Care. 2023 Sep 11:1-23. doi: 10.1080/10903127.2023.2258192. Online ahead of print.

#### **Dynamic Course of Clinical State Transitions in Patients Undergoing Advanced Life Support after Out-of-Hospital Cardiac Arrest.**

Sanson G(1), Antonaglia V(2), Buttignon G(3), Caggegi GD(4), Pegani C(4), Peratoner A(4).

#### **ABSTRACT**

OBJECTIVES: Studies of out-of-hospital cardiac arrest generally document the presenting (pulseless electrical activity [PEA], ventricular fibrillation/tachycardia (VF/VT), asystole), and the final states (resuming stable spontaneous circulation [s-ROSC], being declared dead). Only a few studies described the transitions between clinical states during advanced life support (ALS). The aim of this study was to describe and analyze the dynamics of state transitions during ALS. METHODS: A retrospective analysis of 464 OHCA events was conducted. Any observed state and its corresponding changing time were documented through continuous electrocardiographic and trans-thoracic impedance recording. RESULTS: When achieved, most s-ROSCs were obtained by 30 minutes, regardless of the presenting state. After this time point, the persistence of any transient state was associated with a great probability of being declared dead. The most probable change for VF/VT or

PEA at any time was the transition to asystole (36.4% and 34.4%, respectively); patients in asystole at any time had a 70% probability of death. Patients achieving s-ROSC mostly came from a VF/VT state. In most cases, the presenting rhythm tended to persist over time during ALS. Asystole was the most stable state; a higher degree of instability was observed when the presenting rhythms were VF/VT or PEA. Transient ROSC episodes occurred mainly as the first transition after the presenting state, especially for initial PEA. CONCLUSIONS: An understanding of the dynamic course of clinical state transitions during ALS may allow treatment strategies to be tailored in patients affected by OHCA.

2. medRxiv. 2023 Aug 28:2023.08.28.23294672. doi: 10.1101/2023.08.28.23294672. Preprint.

**The International Cardiac Arrest Research (I-CARE) Consortium Electroencephalography Database.**

Amorim E, Zheng WL, Ghassemi MM, Aghaeeval M, Kandhare P, Karukonda V, Lee JW, Herman ST, Sivaraju A, Gaspard N, Hofmeijer J, van Putten MJAM, Sameni R, Reyna MA, Clifford GD, Westover MB.

**ABSTRACT**

**OBJECTIVE:** To develop a harmonized multicenter clinical and electroencephalography (EEG) database for acute hypoxic-ischemic brain injury research involving patients with cardiac arrest. **DESIGN:** Multicenter cohort, partly prospective and partly retrospective. **SETTING:** Seven academic or teaching hospitals from the U.S. and Europe. **PATIENTS:** Individuals aged 16 or older who were comatose after return of spontaneous circulation following a cardiac arrest who had continuous EEG monitoring were included. **INTERVENTIONS:** not applicable. **MEASUREMENTS AND MAIN RESULTS:** Clinical and EEG data were harmonized and stored in a common Waveform Database (WFDB)-compatible format. Automated spike frequency, background continuity, and artifact detection on EEG were calculated with 10 second resolution and summarized hourly. Neurological outcome was determined at 3-6 months using the best Cerebral Performance Category (CPC) scale. This database includes clinical and 56,676 hours (3.9 TB) of continuous EEG data for 1,020 patients. Most patients died (N=603, 59%), 48 (5%) had severe neurological disability (CPC 3 or 4), and 369 (36%) had good functional recovery (CPC 1-2). There is significant variability in mean EEG recording duration depending on the neurological outcome (range 53-102h for CPC 1 and CPC 4, respectively). Epileptiform activity averaging 1 Hz or more in frequency for at least one hour was seen in 258 (25%) patients (19% for CPC 1-2 and 29% for CPC 3-5). Burst suppression was observed for at least one hour in 207 (56%) and 635 (97%) patients with CPC 1-2 and CPC 3-5, respectively. **CONCLUSIONS:** The International Cardiac Arrest Research (I-CARE) consortium database provides a comprehensive real-world clinical and EEG dataset for neurophysiology research of comatose patients after cardiac arrest. This dataset covers the spectrum of abnormal EEG patterns after cardiac arrest, including epileptiform patterns and those in the ictal-interictal continuum.

3. Neurohospitalist. 2023 Oct;13(4):371-375. doi: 10.1177/19418744231174950. Epub 2023 May 12.

**Continuous EEG Characteristics in Critically ill Patients Presenting With Seizures Prior to Death From Cardiac Arrest.**

Wang T(1), Raman VK(2), Motamedi GK(1).

**ABSTRACT**

**Background:** There have been limited reports about brain activity during cardiac arrest. Here we report 4 patients presenting with seizure who had cardiac arrest leading to their deaths while being on continuous video-EEG (cVEEG) monitoring and one-lead cardiac telemetry. **Purpose:** We illustrate characteristic stepwise EEG and EKG changes in these critically ill patients prior to their death. **Research Design/Study Sample:** All patients showed progressive broad spectrum of cardiac arrhythmias at or before the beginning of EEG suppression while there were no such changes seen in

a control group of 4 randomly selected patients without cardiac arrest who had seizure on presentation and underwent cVEEG monitoring. Data Collection and Results: There was a progressive decline in EEG potentials associated with decreasing heart rate starting from the posterior region, more pronounced on the left, progressing to complete unilateral deactivation of the left fronto-central head regions while the right-sided networks became hyperactive before bilateral deactivation by the time of asystole. Conclusions: This case series provides a rare opportunity to compare EEG and EKG changes in patients who died while being on continuous EEG and EKG monitoring from hours to minutes prior to cardiac arrest and death.

4. J Emerg Med. 2023 Sep;65(3):e180-e187. doi: 10.1016/j.jemermed.2023.05.015. Epub 2023 Jun 7.

**Cardiac Rhythm Changes During Transfer from the Emergency Medical Service to the Emergency Department: A Retrospective Tertiary Single-Center Analysis on Prevalence and Outcomes.**

Mandigers L(1), Rietdijk WJR(2), den Uil CA(3), de Graaf EY(4), Strnisa S(4), Verdonschot RJCG(5).

**ABSTRACT**

**BACKGROUND:** Out-of-hospital cardiac arrest (OHCA) is a leading cause of death worldwide. Cardiac rhythms of OHCA patients can change during transportation and transfer from emergency medical services (EMS) to the emergency department (ED). **OBJECTIVE:** Our objective was to study the prevalence of cardiac rhythm changes during transfer from the EMS to the ED in OHCA patients and the possible association with clinical outcomes. **METHODS:** We retrospectively studied adult OHCA patients admitted to the ED between January 2017 and December 2019. The primary outcome was the incidence of cardiac rhythm changes during transfer from EMS to the ED. Secondary outcomes were: ED survival, intensive care unit survival, hospital survival, and maximum Glasgow Coma Scale score during admission. **RESULTS:** We included 625 patients, of whom there were 49 (7.8%) in the rhythm change group and 576 in the no rhythm change group. ED survival was significantly lower in the rhythm change group (26.5%) vs. the no rhythm change group (78.5%,  $p < 0.01$ ). **CONCLUSION:** Cardiac rhythm changes can occur in OHCA patients during transfer from EMS to the ED. Our results showed some evidence that these changes are associated with a lower ED survival.

**PEDIATRICS AND CHILDREN**

1. Resuscitation. 2023 Sep 14:109967. doi: 10.1016/j.resuscitation.2023.109967. Online ahead of print.

**Sudden pediatric cardiac arrest with catecholaminergic polymorphic ventricular tachycardia: when epinephrin should be avoided.**

Mortamet G(1), Maisonneuve E(2), Wroblewski I(2), Douchin S(3), Massardier C(3).

**NO ABSTRACT AVAILABLE**

2. Crit Care. 2023 Sep 7;27(1):349. doi: 10.1186/s13054-023-04630-3.

**Out-of-hospital cardiac arrest in children: an epidemiological study based on the German Resuscitation Registry identifying modifiable factors for return of spontaneous circulation.**

Katzenschlager S(1), Kelpanides IK(2)(3), Ristau P(4), Huck M(5), Seewald S(4)(6), Brenner S(7), Hoffmann F(8), Wnent J(4)(6)(9), Kramer-Johansen J(3)(4)(10), Tjelmeland IBM(3)(4)(10), Weigand MA(5), Gräsner JT(4)(6), Popp E(5).

**ABSTRACT**

**AIM:** This work provides an epidemiological overview of out-of-hospital cardiac arrest (OHCA) in children in Germany between 2007 and 2021. We wanted to identify modifiable factors associated with survival. **METHODS:** Data from the German Resuscitation Registry (GRR) were used, and we included patients registered between 1st January 2007 and 31st December 2021. We included

children aged between > 7 days and 17 years, where cardiopulmonary resuscitation (CPR) was started, and treatment was continued by emergency medical services (EMS). Incidences and descriptive analyses are presented for the overall cohort and each age group. Multivariate binary logistic regression was performed on the whole cohort to determine the influence of (1) CPR with/without ventilation started by bystander, (2) OHCA witnessed status and (3) night-time on the outcome hospital admission with return of spontaneous circulation (ROSC). RESULTS: OHCA in children aged < 1 year had the highest incidence of the same age group, with 23.42 per 100 000. Overall, hypoxia was the leading presumed cause of OHCA, whereas trauma and drowning accounted for a high proportion in children aged > 1 year. Bystander-witnessed OHCA and bystander CPR rate were highest in children aged 1-4 years, with 43.9% and 62.3%, respectively. In reference to EMS-started CPR, bystander CPR with ventilation were associated with an increased odds ratio for ROSC at hospital admission after adjusting for age, sex, year of OHCA and location of OHCA. CONCLUSION: This study provides an epidemiological overview of OHCA in children in Germany and identifies bystander CPR with ventilation as one primary factor for survival.

### **EXTRACORPOREAL LIFE SUPPORT**

1. *Medicine (Baltimore)*. 2023 Sep 15;102(37):e34680. doi: 10.1097/MD.00000000000034680.

#### **Venoarterial extracorporeal membrane oxygenation for group B streptococcal toxic shock syndrome: A case report and literature review.**

Iwasaki N(1), Sekino M(1), Tominaga T(2), Tanaka T(3), Araki H(1), Yano R(1), Matsumoto S(1), Ichinomiya T(1), Higashijima U(1), Nonaka T(2), Izumikawa K(3), Hara T(1).

#### **ABSTRACT**

**RATIONALE:** Streptococcal toxic shock syndrome (STSS) rapidly leads to refractory shock and multiple organ failure. The mortality rate among patients with STSS is 40%; however, most deaths occur within a few days of onset. Venoarterial extracorporeal membrane oxygenation (VA-ECMO) may help avoid acute death in adult patients with STSS. However, the effectiveness of VA-ECMO is unclear. In this study, we report a case of group B STSS, which was successfully treated with VA-ECMO despite cardiopulmonary arrest (CPA) owing to rapidly progressive refractory shock. **PATIENT CONCERNS:** A 60-year-old woman was hospitalized because of diarrhea and electrolyte abnormalities owing to chemoradiation therapy for rectal cancer. A sudden deterioration of her condition led to CPA. Conventional cardiopulmonary resuscitation was immediately performed but was ineffective. Therefore, VA-ECMO was initiated. Contrast-enhanced computed tomography revealed duodenal perforation. Hence, septic shock owing to peritonitis was diagnosed, and emergency surgery was performed under VA-ECMO. However, the patient had progressive multiple organ failure and required organ support therapy in the intensive care unit (ICU). **DIAGNOSES:** On day 2 in the ICU, blood and ascites fluid culture tests revealed beta-hemolytic streptococci, and the patient was finally diagnosed as having STSS caused by *Streptococcus agalactiae*. **INTERVENTIONS:** Clindamycin was added to meropenem, vancomycin, and micafungin, which had been administered since the sudden deterioration. In addition, VA-ECMO, mechanical ventilation, blood purification therapy, and treatment for disseminated intravascular coagulation were continued. **OUTCOMES:** Thereafter, hemodynamics improved rapidly, and the patient was weaned off VA-ECMO on day 5 of ICU admission. She was transferred to a general ward on day 22 in the ICU. **LESSONS:** In patients with fatal STSS and rapid progressive refractory shock or CPA, VA-ECMO may help to avoid acute death and improve prognosis by ameliorating tissue oxygenation and providing extra time to treat invasive streptococcal infection.

2. *Ann Thorac Surg*. 2023 Sep 11:S0003-4975(23)00935-9. doi: 10.1016/j.athoracsur.2023.09.003. Online ahead of print.

### **Cardiac Arrest With or Without Need for Extracorporeal Life Support After Congenital Cardiac Surgery.**

Bencie N(1), Savorgnan F(2), Binsalamah Z(3), Resheidat A(4), Vener DF(4), Faraoni D(5).

#### **ABSTRACT**

**BACKGROUND:** Postoperative cardiorespiratory arrest (CA) with or without need for extracorporeal cardiopulmonary resuscitation (ECPR) are among the most significant complications in the early postoperative period of pediatric cardiac surgery. The objective of this study was to develop and validate a predictive model of postoperative CA with or without ECPR. **METHODS:** In this retrospective cohort study, we reviewed data from patients who underwent cardiac surgery with cardiopulmonary bypass (CPB) between July 20, 2020 and December 31, 2021. Variables included demographic data, presence of preoperative risk factors, STAT mortality categories, perioperative data, residual lesion score (RLS), and vasoactive-inotropic scores (VIS). We used multivariable logistic regression analysis to develop a predictive model. **RESULTS:** The incidence of CA with or without ECPR was 4.4% (n=24/544). Patients who experienced postoperative CA with or without ECPR were younger (age: 130 days (54-816.5) vs 626 days (127.5-2497.5) P <0.050), required longer CPB (253 min (154-332.5) vs 130 min (87-186) P <0.010) and cross clamp times (116.5 min (75.5-143.5) vs. 64 min (30-111), P < 0.020). 37.5% of patients with an outcome had at least 1 preoperative risk factor (vs. 16.9%, P <0.010). Our multivariable logistic regression determined that the presence of at least 1 preoperative risk factor (P=0.009), CPB duration (P=0.003), intraoperative RLS (P=0.009), and post-surgery VIS (P=0.010) were predictors of the incidence of CA with or without ECPR. **CONCLUSIONS:** We developed a predictive model of postoperative CA with or without ECPR after congenital cardiac surgery. Our model performed better than the individual scores and risk factors.

3. Emerg Med J. 2023 Sep 12:emermed-2023-213292. doi: 10.1136/emermed-2023-213292. Online ahead of print.

### **Hospital-administered ECPR for out-of-hospital cardiac arrest: an observational cohort study.**

Puolakka T(1), Salo A(2), Varpula M(3), Nurmi J(2), Skrifvars MB(2)(4), Wilkman E(5), Lemström K(4)(6), Kuisma M(2).

#### **ABSTRACT**

**BACKGROUND:** Extracorporeal cardiopulmonary resuscitation (ECPR) is a treatment method for refractory out-of-hospital cardiac arrest (OHCA) requiring a complex chain of care. **METHODS:** All cases of OHCA between 1 January 2016 and 31 December 2021 in the Helsinki University Hospital catchment area in which the ECPR protocol was activated were included in the study. The protocol involved patient transport from the emergency site with ongoing mechanical cardiopulmonary resuscitation (CPR) directly to the cardiac catheterisation laboratory where the implementation of extracorporeal membrane oxygenation (ECMO) was considered. Cases of hypothermic cardiac arrest were excluded. The main outcomes were the number of ECPR protocol activations, duration of prehospital and in-hospital time intervals, and whether the ECPR candidates were treated using ECMO or not. **RESULTS:** The prehospital ECPR protocol was activated in 73 cases of normothermic OHCA. The mean patient age (SD) was 54 ( $\pm$ 11) years and 67 (91.8%) of them were male. The arrest was witnessed in 67 (91.8%) and initial rhythm was shockable in 61 (83.6%) cases. The median ambulance response time (IQR) was 9 (7-11) min. All patients received mechanical CPR, epinephrine and/or amiodarone. Seventy (95.9%) patients were endotracheally intubated. The median (IQR) highest prehospital end-tidal CO<sub>2</sub> was 5.5 (4.0-6.9) kPa. A total of 37 (50.7%) patients were treated with venoarterial ECMO within a median (IQR) of 84 (71-105) min after the arrest. Thirteen (35.1%) of them survived to discharge and 11 (29.7%) with a cerebral performance category (CPC) 1-2. In those ECPR candidates who did not receive ECMO, 8 (22.2%) received permanent return of spontaneous circulation during transport or immediately after hospital arrival and 6 (16.7%) survived to discharge with a CPC 1-2. **CONCLUSIONS:** Half of the ECPR protocol activations did not lead to ECMO treatment. However, every fourth ECPR candidate and every third patient who received ECMO-facilitated resuscitation at the hospital survived with a good neurological outcome.

4. Pacing Clin Electrophysiol. 2023 Sep 12. doi: 10.1111/pace.14820. Online ahead of print.

**Extracorporeal cardiopulmonary resuscitation for out-of-hospital cardiac arrest: A meta-analysis of randomized controlled trials.**

Cheema HA(1), Shafiee A(2)(3), Jafarabady K(3), Seighali N(3), Shahid A(1), Ahmad A(4), Ahmad I(5), Ahmad S(6), Pahuja M(7), Dani SS(8).

**ABSTRACT**

INTRODUCTION: Extracorporeal cardiopulmonary resuscitation (ECPR) is a resuscitation method for patients with refractory out-of-hospital cardiac arrest (OHCA). However, evidence from randomized controlled trials (RCTs) is lacking. METHODS: We searched several electronic databases until March 2023 for RCTs comparing ECPR with conventional CPR in OHCA patients. RevMan 5.4 was used to pool risk ratios (RR) with 95% confidence intervals (CIs). RESULTS: A total of four RCTs were included. The results of our meta-analysis showed no statistically significant benefit of ECPR regarding mid-term survival (RR 1.21; 95% CI 0.64 to 2.28; I2 = 48%; p = .55). We found a significant improvement with ECPR in mid-term favorable neurological outcome (RR 1.59; 95% CI 1.09 to 2.33; I2 = 0%; p = .02). There was no significant difference between ECPR and conventional CPR in long-term survival (RR 1.32; 95% CI 0.18 to 9.50; I2 = 64%; p = .79), and long-term favorable neurological outcome (RR 1.47; 95% CI 0.89 to 2.43; I2 = 25%; p = .13). There was an increased incidence of adverse events in the ECPR group (RR 3.22; 95% CI 1.18 to 8.80; I2 = 63%; p = .02). CONCLUSION: ECPR in OHCA patients was not associated with improved survival or long-term favorable neurological outcome but did improve favorable neurological outcome in the mid-term. However, these results are likely underpowered due to the small number of available RCTs. Large-scale confirmatory RCTs are needed to provide definitive conclusions.

5. Inn Med (Heidelb). 2023 Sep 15. doi: 10.1007/s00108-023-01587-x. Online ahead of print.

**[Extracorporeal cardiopulmonary resuscitation-When the heart no longer functions].**

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

Supady A(1), Wengenmayer T(2).

**ABSTRACT**

Extracorporeal cardiopulmonary resuscitation (ECPR) is an option for restoring blood circulation in patients with refractory circulatory failure. While conventional resuscitation measures are being continued, venoarterial extracorporeal membrane oxygenation (VA ECMO) is established in patients with cardiac arrest. This bypass can compensate for the functions of the heart and lungs until recovery of organ function. The benefit of ECPR compared to conventional resuscitation appears to be evident, especially after a prolonged resuscitation period; however, in three prospective randomized controlled studies an advantage has not yet been conclusively proven for widespread use in clinical routine. ECPR systems are complex and resource-intensive and should therefore be limited to specialized centers where sufficient numbers of patients are treated to ensure a high level of expertise in the teams.

6. Quant Imaging Med Surg. 2023 Sep 1;13(9):6205-6214. doi: 10.21037/qims-23-430. Epub 2023 Aug 1.

**Both decreased and increased grey-to-white matter attenuation ratio in the putamen and caudate on early head computed tomography differentiate patients with favorable and unfavorable outcomes after prolonged cardiac arrest-secondary analysis of the Prague OHCA study.**

Hrdlicka J(1), Smalcova J(2), Bircakova B(1), Lambert L(1), Belohlavek J(2)(2), Burgetova A(2)(1).

**ABSTRACT**

BACKGROUND: Neurological damage remains the leading cause of death in cardiac arrest victims with early neuroprognostication being the cornerstone of the decision-making process to continue or discontinue advanced treatments. In this study, we aimed to find markers of favorable and unfavorable outcome on early brain computed tomography (CT) in patients after prolonged out-of-

hospital cardiac arrest (OHCA) treated both by conventional and extracorporeal cardiopulmonary resuscitation (ECPR). **METHODS:** In a secondary analysis of the Prague OHCA study, patients who underwent brain CT within 36 hours after cardiac arrest were identified. Qualitative findings (brain edema, hemorrhage) and quantitative measurements [attenuation of grey matter structures and grey-to-white matter attenuation ratio (GWR)] between patients with cerebral performance category (CPC) of 1-2 (favorable outcome) and 3-5 (unfavorable outcome) within 180 days after the event were compared. **RESULTS:** In 45 eligible patients, intracranial edema (n=16, 50%) was present in patients with CPC 3-5 only (n=32, 71%). Attenuation of brain structures and GWR did not differ between patients with favorable and unfavorable outcomes. However, the GWR in the caudate and putamen of most CPC 1-2 patients was within a narrow range of values (1.18 to 1.30 and 1.20 to 1.33) that separated patients with CPC 1-2 from CPC 3-5 with a sensitivity of 78% and 66% a specificity of 85% and 100%, and area under the curve (AUC) of 0.86 (P=0.0001) and 0.77 (P=0.0053), respectively. Patients treated by ECPR had lower attenuation in the centrum semiovale ( $28.3 \pm 2.7$ ) compared to those who were not ( $31.0 \pm 2.8$ , P=0.003). The most common causes of death in CPC 3-5 patients were brain death in 13 (41%) patients, multiorgan failure in 12 (38%), and cardiac rearrest in 4 (13%). **CONCLUSIONS:** Both decreased and increased grey-to-white matter differentiation in the putamen and caudate on early non-contrast brain CT after prolonged OHCA indicate poor neurological outcome within 180 days after cardiac arrest.

7. Crit Care. 2023 Sep 12;27(1):351. doi: 10.1186/s13054-023-04636-x.

**Outcome assessment for out-of-hospital cardiac arrest patients in Singapore and Japan with initial shockable rhythm.**

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), Irisawa T(11), Yamada T(12), Nishimura T(13), Kiguchi T(14), Kishimoto M(15), Matsuyama T(16), Nishioka N(17), Kiyohara K(18), Kitamura T(19), Iwami T(17), Ong MEH(20)(3).

**ABSTRACT**

**BACKGROUND:** Singapore and Osaka in Japan have comparable population sizes and prehospital management; however, the frequency of ECPR differs greatly for out-of-hospital cardiac arrest (OHCA) patients with initial shockable rhythm. Given this disparity, we hypothesized that the outcomes among the OHCA patients with initial shockable rhythm in Singapore were different from those in Osaka. The aim of this study was to evaluate the outcomes of OHCA patients with initial shockable rhythm in Singapore compared to the expected outcomes derived from Osaka data using machine learning-based prediction models. **METHODS:** This was a secondary analysis of two OHCA databases: the Singapore PAROS database (SG-PAROS) and the Osaka-CRITICAL database from Osaka, Japan. This study included adult (18-74 years) OHCA patients with initial shockable rhythm. A machine learning-based prediction model was derived and validated using data from the Osaka-CRITICAL database (derivation data 2012-2017, validation data 2018-2019), and applied to the SG-PAROS database (2010-2016 data), to predict the risk-adjusted probability of favorable neurological outcomes. The observed and expected outcomes were compared using the observed-expected ratio (OE ratio) with 95% confidence intervals (CI). **RESULTS:** From the SG-PAROS database, 1,789 patients were included in the analysis. For OHCA patients who achieved return of spontaneous circulation (ROSC) on hospital arrival, the observed favorable neurological outcome was at the same level as expected (OE ratio: 0.905 [95%CI: 0.784-1.036]). On the other hand, for those who had continued cardiac arrest on hospital arrival, the outcomes were lower than expected (shockable rhythm on hospital arrival, OE ratio: 0.369 [95%CI: 0.258-0.499], and nonshockable rhythm, OE ratio: 0.137 [95%CI: 0.065-0.235]). **CONCLUSION:** This observational study found that the outcomes for patients with initial shockable rhythm but who did not obtain ROSC on hospital arrival in Singapore were lower than expected from Osaka. We hypothesize this is mainly due to differences in the use of ECPR.

8. Resusc Plus. 2023 Sep 9;16:100468. doi: 10.1016/j.resplu.2023.100468. eCollection 2023 Dec.

**Neurologic outcome and location of cardiac arrest in out-of-hospital cardiac arrest patients who underwent extracorporeal cardiopulmonary resuscitation: A multicentre retrospective cohort in Japan.**

Shirakawa K(1), Matsuoka Y(1)(2), Yamamoto Y(2), Inoue A(3), Takahashi R(3), Yamada Y(2), Ariyoshi K(1), Hifumi T(4), Sakamoto T(5), Kuroda Y(6); SAVE-J II study group.

**ABSTRACT**

AIM: We examined the association between the location of cardiac arrest and outcomes of patients with out-of-hospital cardiac arrest (OHCA) who underwent extracorporeal cardiopulmonary resuscitation (ECPR). METHODS: This was a secondary analysis of SAVE-J II, a multicentre retrospective registry with 36 participating institutions across Japan, which enrolled adult patients with OHCA who underwent ECPR. The outcomes of interest were favourable neurologic outcome at discharge. We compared the outcome between OHCA cases that occurred at residential and public locations, using a multilevel logistic regression model allowing for the random effect of each hospital. RESULTS: Among 1,744 enrolled OHCA, 809 and 935 occurred at residential (house: 603; apartment: 206) and public (street: 260; workplace: 210; others: 465) locations, respectively. The proportion of favourable neurologic outcomes was lower in OHCA at residential locations than those at public locations (88/781 (11.3%) vs. 131/891 (14.7%); adjusted odds ratio, 0.72 [95% confidence interval, 0.53-0.99]). However, subgroup analyses for patients with EMS aged <65 years call to hospital arrival within 30 minutes or during daytime revealed less difference between residential and public locations. CONCLUSION: When cardiac arrests occurred at residential locations, lower proportions of favourable neurologic outcomes were exhibited among patients with OHCA who underwent ECPR. However, the event's location may not affect the prognosis among appropriate and select cases when transported within a limited timeframe.

**EXPERIMENTAL RESEARCH**

1. PLoS One. 2023 Sep 15;18(9):e0291598. doi: 10.1371/journal.pone.0291598. eCollection 2023.

**Nicotinamide restores tissue NAD<sup>+</sup> and improves survival in rodent models of cardiac arrest.**

Zhu X(1), Li J(1), Wang H(1), Gasior FM(2), Lee C(1), Lin S(1), Justice CN(1)(2), O'Donnell JM(2), Vanden Hoek TL(1).

**ABSTRACT**

Metabolic suppression in the ischemic heart is characterized by reduced levels of NAD<sup>+</sup> and ATP. Since NAD<sup>+</sup> is required for most metabolic processes that generate ATP, we hypothesized that nicotinamide restores ischemic tissue NAD<sup>+</sup> and improves cardiac function in cardiomyocytes and isolated hearts, and enhances survival in a mouse model of cardiac arrest. Mouse cardiomyocytes were exposed to 30 min simulated ischemia and 90 min reperfusion. NAD<sup>+</sup> content dropped 40% by the end of ischemia compared to pre-ischemia. Treatment with 100 μM nicotinamide (NAM) at the start of reperfusion completely restored the cellular level of NAD<sup>+</sup> at 15 min of reperfusion. This rescue of NAD<sup>+</sup> depletion was associated with improved contractile recovery as early as 10 min post-reperfusion. In a mouse model of cardiac arrest, 100 mg/kg NAM administered IV immediately after cardiopulmonary resuscitation resulted in 100% survival at 4 h as compared to 50% in the saline group. In an isolated rat heart model, the effect of NAM on cardiac function was measured for 20 min following 18 min global ischemia. Rate pressure product was reduced by 26% in the control group following arrest. Cardiac contractile function was completely recovered with NAM treatment given at the start of reperfusion. NAM restored tissue NAD<sup>+</sup> and enhanced production of lactate and ATP, while reducing glucose diversion to sorbitol in the heart. We conclude that NAM can rapidly



restore cardiac NAD<sup>+</sup> following ischemia and enhance glycolysis and contractile recovery, with improved survival in a mouse model of cardiac arrest.

2. Resuscitation. 2023 Sep 14:109969. doi: 10.1016/j.resuscitation.2023.109969. Online ahead of print.

**Effect of first epinephrine administration time on cerebral perfusion pressure and cortical cerebral blood flow in a porcine cardiac arrest model.**

Hyun Choi D(1), Jeong Hong K(2), Hong Kim K(3), Do Shin S(4), Jun Song K(5), Kim Y(6), Ha Joo Y(7), Ho Park J(8), Sun Ro Y(9), Jeong Kang H(10).

**ABSTRACT**

**OBJECTIVE:** The optimal time for epinephrine administration and its effects on cerebral blood flow (CBF) and microcirculation remain controversial. This study aimed to assess the effect of the first administration of epinephrine on cerebral perfusion pressure (CePP) and cortical CBF in porcine cardiac arrest model. **METHODS:** After 4 min of untreated ventricular fibrillation, eight of 24 swine were randomly assigned to the early, intermediate, and late groups. In each group, epinephrine was administered intravenously at 5, 10, and 15 min after cardiac arrest induction. CePP was calculated as the difference between the mean arterial pressure and intracranial pressure. Cortical CBF was measured using a laser Doppler flow probe. The outcomes were CePP and cortical CBF measured continuously during cardiopulmonary resuscitation (CPR). Mean CePP and cortical CBF were compared using analysis of variance and a linear mixed model. **RESULTS:** The mean CePP was significantly different between the groups at 6-11 min after cardiac arrest induction. The mean CePP in the early group was significantly higher than that in the intermediate group at 8-10 min and that in the late group at 6-9 min and 10-11 min. The mean cortical CBF was significantly different between the groups at 9-11 min. The mean cortical CBF was significantly higher in the early group than in the intermediate and late group at 9-10 min. **CONCLUSION:** Early administration of epinephrine was associated with improved CePP and cortical CBF compared to intermediate or late administration during the early period of CPR.

3. Biochem Biophys Rep. 2023 Sep 6;35:101543. doi: 10.1016/j.bbrep.2023.101543. eCollection 2023 Sep.

**Alterations of the gut microbial community structure modulates the Th17 cells response in a rat model of asphyxial cardiac arrest.**

Yuan Q(1), Sun L(1), Ma G(1), Shen H(2), Wang S(1), Guo F(1), Sun X(1), Gao C(1).

**ABSTRACT**

Th17 cells triggered inflammation is a critical element in cerebral ischemic injury, and the gut microbiota intricately impacts T lymphocytes. Nevertheless, it remains unclear whether the gut microbiota involves in cardiac arrest/cardiopulmonary resuscitation (CA/CPR) induced-brain injury through Th17 cells. The present study investigated the interaction between gut microbiota and Th17 cells in a rat model. We observed that CA/CPR induced the alterations of the gut microbial community structure, and elevated the level of IL-17 in the serum, and a slight infiltration of Th17 cells into the brain. The Th17 cells were increased significantly in the peripheral blood, 28.33 ± 6.18% of these Th17 cells were derived from the Peyer's patches of small intestine. Furthermore, fecal microbiota transplantation (FMT) from rats with CA/CPR induced Th17 cell response, promoting hippocampal cell apoptosis and declining learning ability and memory in

recipient rats. Taken together, CA/CPR-induced alterations of the gut microbial community structure stimulated Th17 cell response which aggravated brain injury.

4. Clin Hemorheol Microcirc. 2023 Sep 2. doi: 10.3233/CH-231768. Online ahead of print.

**Protection of the endothelium and endothelial glycocalyx by hydrogen against ischaemia-reperfusion injury in a porcine model of cardiac arrest.**

Astapenko D(1)(2)(3), Hyspler R(2)(4), Tich A(4), Tomasova A(2)(4), Navratil P(2)(5), Zrzavecky M(2), Byreddy B(2), Sedlacek P(2), Radochova V(6), Skulec R(1)(2)(7)(8)(9), Hahn RG(10), Lehmann C(11)(12)(13)(14), Malbrain MLNG(15)(16)(17), Cerny V(1)(2)(3)(7)(8)(11)(18)(19)(20).

**ABSTRACT**

**BACKGROUND:** Hydrogen is a potent antioxidant agent that can easily be administered by inhalation. The aim of the study was to evaluate whether hydrogen protects the endothelial glycocalyx layer after successful cardiopulmonary resuscitation (CPR). **METHODS:** Fourteen anesthetized pigs underwent CPR after induced ventricular fibrillation. During CPR and return of spontaneous circulation, 2% hydrogen gas was administered to seven pigs (hydrogen group) and seven constituted a control group. Biochemistry and sublingual microcirculation were assessed at baseline, during CPR, at the 15th, 30th, 60th, 120th minute. **RESULTS:** All seven subjects from the hydrogen group and six subjects in the control group were successfully resuscitated after 6-10 minutes. At baseline, there were no statistically significant differences in examined variables. After the CPR, blood pH, base excess, and lactate showed significantly smaller deterioration in the hydrogen group than in the control group. By contrast, plasma syndecan-1 and the measured variables obtained via sublingual microcirculation did not change after the CPR; and were virtually identical between the two groups. **CONCLUSION:** In pigs, hydrogen gas inhalation during CPR and post-resuscitation care was associated with less pronounced metabolic acidosis compared to controls. However, we could not find evidence of injury to the endothelium or glycocalyx in any studied groups.

**CASE REPORTS**

1. Medicine (Baltimore). 2023 Sep 15;102(37):e35227. doi: 10.1097/MD.00000000000035227.

**Gas embolism during surgical hysteroscopy leading to cardiac arrest and refractory hypokalemia: A case report and review of literature.**

Xu R(1), Zhou X(2), Wang L(3), Cao Y(2).

**ABSTRACT**

**RATIONALE:** One of the catastrophic complications of surgical hysteroscopy is venous gas embolism (VGE), and this event could cause morbidity and in serious cases may even lead to death. However, in cases of VGE accompanied by refractory hypokalemia is rare and can significantly increase the difficulty of treatment and resuscitation. Here, we successfully treated a patient with fatal VGE during surgical hysteroscopy, accompanied by difficult resuscitation with refractory hypokalemia. **PATIENT CONCERNS:** We report a rare case of sudden cardiac arrest due to VGE during surgical hysteroscopy, followed by difficult resuscitation with refractory hypokalemia. **DIAGNOSIS:** VGE was diagnosed by a sudden decrease in EtCO<sub>2</sub>, a loud mill wheel murmur in the thoracic area, and a small number of air bubbles evacuated from the internal jugular catheter. And refractory hypokalemia was diagnosed by serum potassium levels dropping frequently to as low as 2.0 mmol/L within 36 hours of resuscitation after cardiac arrest. **INTERVENTIONS:** Our vigilant anesthesiologist noticed the early sign of VGE with a sudden drop in EtCO<sub>2</sub>, and as the cardiac arrest occurred, interventional maneuvers were implemented quickly including termination of the surgical procedure, adjustment of the patient's position, cardiac resuscitation, continuous chest compression, and correction of electrolyte disturbances, particularly refractory hypokalemia during

the early stage of resuscitation. **OUTCOMES:** The patient regained consciousness 4 days after the cardiac arrest and was discharged 1 month later without any neurological deficits. **LESSONS:** As a relatively simple procedure, surgical hysteroscopy may have catastrophic complications. This case demonstrates the full course of fatal gas embolism and difficult resuscitation during hysteroscopic surgery, and emphasizes the importance of early detection, prompt intervention, and timely correction of electrolyte disturbances, such as refractory hypokalemia.

2. Am J Ther. 2023 Sep-Oct 01;30(5):e426-e432. doi: 10.1097/MJT.0000000000001571. Epub 2022 Dec 26.

**High-Dose Insulin for Hyperkalemic Cardiac Arrest.**

Shikhooun MA(1), Abdulhadi LA(2), Yafes WM(3), Saleh MR(4), Corsentino SA(5), Pantin EJ(6).

**ABSTRACT**

Hyperkalemic cardiac arrest diagnosis can be elusive and management difficult as the cardiac rhythm restoration is often not achieved until the potassium level decreases to a relatively normal level for the patient who suffers the arrest. Current treatment modalities can take hours to achieve this goal. We describe two patients who survived a witnessed hyperkalemic cardiac arrest after being managed with conventional advanced cardiac life support and unconventionally high doses of intravenous insulin.