

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

1. Notf Rett Med. 2021 Aug 24:1-6. doi: 10.1007/s10049-021-00932-7. Online ahead of print.

**[Out-of-hospital cardiac arrest during lockdown].** [Article in German]

Grübl T(1)(2), Plöger B(1), Sassen MC(1)(3), Jerrentrup A(1), Schieffer B(1)(4), Betz S(1).

#### **ABSTRACT**

**BACKGROUND:** Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has spread worldwide. Consequences of infection prevention measures during such contagion events can cause disadvantages especially for patients in out-of-hospital cardiac arrest (OHCA). **METHODS:** Retrospective analysis of OHCA in one county from January-May in 2018, 2019 and 2020, with the first appearance of the SARS-CoV-2 pandemic in 2020 and a high incidence of the influenza virus in 2018. **RESULTS:** A total of 497 OHCA were investigated (2018 n = 173; 2019 n = 149; 2020 n = 175). In this study, a constant resuscitation incidence (85-99 resuscitations/100,000 population/year) and locally typical patients (mean 70 years, 66% male; median PES 3) were found. There were no statistically significant differences in the initial situation of the patients (number of observed OHCA, frequency of lay resuscitations, suspected causes of OHCA, initial ECG rhythm) and the treatment course (frequency of return of spontaneous circulation [ROSC]/hospital admission/survival to hospital discharge, neurological outcome). None of the OHCA patients in 2020 tested positive for SARS-CoV-2 and 3 patients in 2018 tested positive for the influenza virus. **DISCUSSION:** The lockdown during the first wave of SARS-CoV-2 pandemic does not seem to have affected the outcome of OHCA patients without coronavirus disease 2019 (COVID-19) in the end.

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

1. Resuscitation. 2021 Aug 27:S0300-9572(21)00337-3. doi: 10.1016/j.resuscitation.2021.08.036.

Online ahead of print.

**Chest compression release and recoil dynamics in prolonged manual cardiopulmonary resuscitation.**

Knox Russell J(1), Leturiondo M(2), González-Otero DM(3), Julio Gutiérrez J(2), Ramzan Daya M(4), Ruiz de Gauna S(2).

#### **ABSTRACT**

**AIM:** of the study Characterize release and recoil dynamics in chest compressions during prolonged cardiopulmonary resuscitation (CPR) efforts, which are increasingly prevalent. **METHODS:** Force and depth of chest compressions, and their rates of change, were calculated from records extracted from CPR monitors used during prolonged resuscitation efforts for out-of-hospital cardiac arrest and tracked over time. Metrics were normalized to the median of the first 100 compressions. Kruskal-Wallis ANOVA and Jonckheere-Terpstra trend analyses were used for differences and trends. Averages are reported as median (interquartile range). Correlations among metrics are reported as coefficients of determination. **RESULTS:** In 471 cases of adult subjects receiving at least 1000 compressions, peak depths varied modestly over the course of extended resuscitation efforts, staying within a narrow range without a trend over the course of resuscitation efforts. Increases in recoil velocity and decreases in recoil interval also remained within limited ranges (5%, 6% variation respectively). By contrast, force waveforms changed substantially. Peak force decreased monotonically reaching a 38% decrease for compression numbers > 3500, similar to a decrease in

release rate (39%) and an increase in release interval (39%). CONCLUSION: Depth waveforms change markedly less than do force waveforms over the course of prolonged CPR. With the benefit of feedback, CPR providers effectively adjust the application of force to compensate for changes in chest stiffness, documented previously. Despite slowing release and quickening recoil, interference between release of force and recoil of depth appears limited. Spontaneous chest recoil is well preserved in prolonged duration manual CPR.

## **REGISTRIES, REVIEWS AND EDITORIALS**

1. BMJ Open. 2021 Sep 2;11(9):e047251. doi: 10.1136/bmjopen-2020-047251.

### **Effectiveness of rehabilitation interventions on the secondary consequences of surviving a cardiac arrest: a systematic review and meta-analysis.**

Joshi VL(1), Christensen J(2), Lejsgaard E(3), Taylor RS(4), Zwisler AD(3), Tang LH(5)(6).

#### **ABSTRACT**

AIM: The aim of this systematic review was to assess the effectiveness of rehabilitation interventions on the secondary physical, neurological and psychological consequences of cardiac arrest (CA) for adult survivors. METHODS: A literature search of electronic databases (MEDLINE, Allied and Complementary Medicine Database, Cumulative Index to Nursing and Allied Health Literature, Excerpta Medica database, Psychological Information Database, Web of Science and Cochrane Central Register of Controlled trials) was conducted for randomised controlled trials (RCTs) and observational studies up to 18 April 2021. The primary outcome was health-related quality of life (HRQoL) and main secondary outcome was neurological function with additional secondary outcomes being survival, rehospitalisation, safety (serious and non-serious adverse events), psychological well-being, fatigue, exercise capacity and physical capacity. Two authors independently screened studies for eligibility, extracted data and assessed risk of bias. RESULTS: Three RCTs and 11 observational studies were included (total 721 participants). Study duration ranged from 8 weeks to 2 years. Pooled data from two RCTs showed low-quality evidence for no effect on physical HRQoL (standardised mean difference (SMD) 0.19, (95% CI: -0.09 to 0.47)) and no effect on mental HRQoL (SMD 0.27 (95% CI: -0.01 to 0.55)). Regarding secondary outcomes, very low-quality evidence was found for improvement in neurological function associated with inpatient rehabilitation for CA survivors with acquired brain injury (SMD 0.71, (95% CI: 0.45 to 0.96)) from five observational studies. Two small observational studies found exercise-based rehabilitation interventions to be safe for CA survivors, reporting no serious or non-serious events. CONCLUSIONS: Given the overall low quality of evidence, this review cannot determine the effectiveness of rehabilitation interventions for CA survivors on HRQoL, neurological function or other included outcomes, and recommend further high-quality studies be conducted. In the interim, existing clinical guidelines on rehabilitation provision after CA should be followed to meet the high burden of secondary consequences suffered by CA survivors.

2. Crit Care. 2021 Aug 31;25(1):312. doi: 10.1186/s13054-021-03678-3.

### **Monitoring and modifying brain oxygenation in patients at risk of hypoxic ischaemic brain injury after cardiac arrest.**

Skrifvars MB(1), Sekhon M(2), Åneman EA(3)(4)(5)(6)(7).

#### **ABSTRACT**

This article is one of ten reviews selected from the Annual Update in Intensive Care and Emergency Medicine 2021. Other selected articles can be found online at <https://www.biomedcentral.com/collections/annualupdate2021> . Further information about the Annual Update in Intensive Care and Emergency Medicine is available from <https://link.springer.com/bookseries/8901> .

## **IN-HOSPITAL CARDIAC ARREST**

1. Resuscitation. 2021 Aug 26:S0300-9572(21)00335-X. doi: 10.1016/j.resuscitation.2021.08.034. Online ahead of print.

### **Sex differences in the association of comorbidity with shockable initial rhythm in out-of-hospital cardiac arrest.**

van Dongen LH(1), Oving I(1), Dijkema PW(1), Beesems SG(1), Blom MT(1), Tan HL(2).

#### **ABSTRACT**

**BACKGROUND:** Lower survival chances after out-of-hospital cardiac arrest (OHCA) in women is associated with lower odds of a shockable initial rhythm (SIR). We hypothesized that sex differences in the prevalence of SIR are due to sex differences in comorbidities. We aimed to establish to what extent sex differences in the cumulative comorbidity burden, measured using the Charlson Comorbidity Index (CCI), or in individual comorbidities, account for the lower proportion of SIR in women. **METHODS:** The association between CCI or its constituent comorbidities, and presence of SIR was studied using data (2010-2014) from a Dutch community-based OHCA registry, and included 2510 OHCA patients aged  $\geq 18$ y with presumed cardiac cause. **RESULTS:** The mean age was  $67.8 \pm 13.8$ y, 71% were men. Women were more often in high CCI categories than men. However, moderate or high disease burden was associated with lower odds of SIR compared to no disease burden only in men (OR 99%CI 0.73 [0.53-1.00] and OR 0.54 [0.37-0.80] P-trend $<0.001$ ), but not in women (1.00 [0.58-1.72] and 1.02 [0.57-1.84 P-trend 0.93). Adding CCI to a multivariable model did not alter the OR of sex with SIR. Of the individual comorbidities, only previous myocardial infarction was both differently distributed between sexes (men 22.7% vs. women 13.1%,  $p<0.001$ ) and associated with odds of SIR (higher in both sexes). Adding this variable to the model changed the association of sex with initial rhythm from 0.49 (0.38-0.64) to 0.53 (0.41-0.69) **CONCLUSION:** Sex differences in comorbidities explained lower odds of SIR in women only modestly: differences in previous myocardial infarction contributed little, and cumulative comorbidity not at all.

2. Aust Crit Care. 2021 Aug 25:S1036-7314(21)00112-0. doi: 10.1016/j.aucc.2021.07.002. Online ahead of print.

### **Functional outcomes following an in-hospital cardiac arrest: A retrospective cohort study.**

Doherty ZB(1), Fletcher JA(2), Fuzzard KL(2), Leach MJ(3), O'Sullivan BG(4), Panozzo LE(5), Pound GM(6), Saka E(7), Kippen RJ(8).

#### **ABSTRACT**

**BACKGROUND/PURPOSE:** Whilst much is known about the survival outcomes of patients that suffer an in-hospital cardiac arrest (IHCA) in Australia very little is known about the functional outcomes of survivors. This study aimed to describe the functional outcomes of a cohort of patients that suffered an in-hospital cardiac arrest (IHCA) and survived to hospital discharge in a regional Australian hospital. **METHODS:** This is a single-centre retrospective observational cohort study conducted in a regional Australian hospital. All adult patients that had an IHCA in the study hospital between 1 Jan 2017 and 31 Dec 2019 and survived to hospital discharge were included in the study. Functional outcomes were reported using the Modified Rankin Scale (mRS), a six-point scale for which increasing scores represent increasing disability. Scores were assigned through a retrospective review of medical notes. **RESULTS:** Overall, 102 adult patients had an IHCA during the study period, of whom 50 survived to hospital discharge. The median age of survivors was 68 years, and a third had a shockable initial arrest rhythm. Of survivors, 47 were able to be assigned both mRS scores. At discharge, 81% of patients achieved a favourable functional outcome (mRS 0-3 or equivalent function at discharge equal to admission). **CONCLUSIONS:** Most survivors to hospital discharge following an IHCA have a favourable functional outcome and are discharged home. Although these results are promising, larger studies across multiple hospitals are required to further inform what is known about functional outcomes in Australian IHCA survivors.

## **INJURIES AND CPR**

No articles identified.

## **CAUSE OF THE ARREST**

1. Scand J Trauma Resusc Emerg Med. 2021 Aug 30;29(1):128. doi: 10.1186/s13049-021-00943-w.  
**Point-of-care testing in out-of-hospital cardiac arrest: a retrospective analysis of relevance and consequences.**

Gruebl T(1)(2), Ploeger B(3), Wranze-Bielefeld E(4), Mueller M(5), Schmidbauer W(6), Kill C(7), Betz S(3).

### **ABSTRACT**

**BACKGROUND:** Metabolic and electrolyte imbalances are some of the reversible causes of cardiac arrest and can be diagnosed even in the pre-hospital setting with a mobile analyser for point-of-care testing (POCT). **METHODS:** We conducted a retrospective observational study, which included analysing all pre-hospital resuscitations in the study region between October 2015 and December 2016. A mobile POCT analyser (Alere epoc®) was available at the scene of each resuscitation. We analysed the frequency of use of POCT, the incidence of pathological findings, the specific interventions based on POCT as well as every patient's eventual outcome. **RESULTS:** N = 263 pre-hospital resuscitations were included and in n = 98 of them, the POCT analyser was used. Of these measurements, 64% were performed using venous blood and 36% using arterial blood. The results of POCT showed that 63% of tested patients had severe metabolic acidosis ( $\text{pH} < 7.2 + \text{BE} < 5 \text{ mmol/l}$ ). Of these patients, 82% received buffering treatment with sodium bicarbonate. Potassium levels were markedly divergent normal ( $> 6.0 \text{ mmol/l} / < 2.5 \text{ mmol/l}$ ) in 17% of tested patients and 14% of them received a potassium infusion. On average, the pre-hospital treatment time between arrival of the first emergency medical responders and the beginning of transport was 54 ( $\pm 20$ ) min without POCT and 60 ( $\pm 17$ ) min with POCT ( $p = 0.07$ ). Overall, 21% of patients survived to hospital discharge (POCT 30% vs no POCT 16%,  $p = 0.01$ ,  $\Phi = 0.16$ ). **CONCLUSIONS:** Using a POCT analyser in pre-hospital resuscitation allows rapid detection of pathological acid-base imbalances and potassium concentrations and often leads to specific interventions on scene and could improve the probability of survival.

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

No articles identified.

## **ORGAN DONATION**

1. Resuscitation. 2021 Sep 1:S0300-9572(21)00345-2. doi: 10.1016/j.resuscitation.2021.08.043.  
Online ahead of print.

**Organ donation after resuscitation: towards a regionalization of cardiac arrest centers?**

Benghanem S(1), Cariou A(2).

**NO ABSTRACT AVAILABLE**

## **FEEDBACK**

No articles identified.

## **DRUGS**

No articles identified.

## **TRAUMA**

1. Resuscitation. 2021 Sep 1:S0300-9572(21)00346-4. doi: 10.1016/j.resuscitation.2021.03.040.

Online ahead of print.

### **Is there any reason for prone cardiopulmonary resuscitation in avalanche victims?**

Wallner B(1), Strapazzon G(2), Brugger H(3).

**NO ABSTRACT AVAILABLE**

## **VENTILATION**

1. J Am Heart Assoc. 2021 Aug 28:e021679. doi: 10.1161/JAHA.121.021679. Online ahead of print.

### **Timing of Prehospital Advanced Airway Management for Adult Patients With Out-of-Hospital Cardiac Arrest: A Nationwide Cohort Study in Japan.**

Okubo M(1), Komukai S(2), Izawa J(3), Gibo K(4), Kiyohara K(5), Matsuyama T(6), Iwami T(7), Callaway CW(1), Kitamura T(8).

#### **ABSTRACT**

**Background** The timing of advanced airway management (AAM) on patient outcomes after out-of-hospital cardiac arrest has not been fully investigated. We evaluated the association between the timing of prehospital AAM and 1-month survival. **Methods and Results** We conducted a secondary analysis of a prospective, nationwide, population-based out-of-hospital cardiac arrest registry in Japan. We included emergency medical services-treated adult ( $\geq 18$  years) out-of-hospital cardiac arrests from 2014 through 2017, stratified into initial shockable or nonshockable rhythms. Patients who received AAM at any minute after emergency medical services-initiated cardiopulmonary resuscitation underwent risk-set matching with patients who were at risk of receiving AAM within the same minute using time-dependent propensity scores. Eleven thousand three hundred six patients with AAM in shockable and 163 796 with AAM in nonshockable cohorts, respectively, underwent risk-set matching. For shockable rhythms, the risk ratios (95% CIs) of AAM on 1-month survival were 1.01 (0.89-1.15) between 0 and 5 minutes, 1.06 (0.98-1.15) between 5 and 10 minutes, 0.99 (0.87-1.12) between 10 and 15 minutes, 0.74 (0.59-0.92) between 15 and 20 minutes, 0.61 (0.37-1.00) between 20 and 25 minutes, and 0.73 (0.26-2.07) between 25 and 30 minutes after emergency medical services-initiated cardiopulmonary resuscitation. For nonshockable rhythms, the risk ratios of AAM were 1.12 (1.00-1.27) between 0 and 5 minutes, 1.34 (1.25-1.44) between 5 and 10 minutes, 1.39 (1.26-1.54) between 10 and 15 minutes, 1.20 (0.99-1.45) between 15 and 20 minutes, 1.18 (0.80-1.73) between 20 and 25 minutes, 0.63 (0.29-1.38) between 25 and 30 minutes, and 0.44 (0.11-1.69) after 30 minutes. **Conclusions** In this observational study, the timing of AAM was not statistically associated with improved 1-month survival for shockable rhythms, but AAM within 15 minutes after emergency medical services-initiated cardiopulmonary resuscitation was associated with improved 1-month survival for nonshockable rhythms.

## **CEREBRAL MONITORING**

1. Lancet. 2021 Aug 26:S0140-6736(21)00953-3. doi: 10.1016/S0140-6736(21)00953-3. Online ahead of print.

### **Brain injury after cardiac arrest.**

Perkins GD(1), Callaway CW(2), Haywood K(3), Neumar RW(4), Lilja G(5), Rowland MJ(6), Sawyer KN(2), Skrifvars MB(7), Nolan JP(8).

#### **ABSTRACT**

As more people are surviving cardiac arrest, focus needs to shift towards improving neurological outcomes and quality of life in survivors. Brain injury after resuscitation, a common sequela following cardiac arrest, ranges in severity from mild impairment to devastating brain injury and brainstem death. Effective strategies to minimise brain injury after resuscitation include early intervention with cardiopulmonary resuscitation and defibrillation, restoration of normal physiology, and targeted temperature management. It is important to identify people who might have a poor outcome, to enable informed choices about continuation or withdrawal of life-sustaining treatments. Multimodal prediction guidelines seek to avoid premature withdrawal in those who might survive with a good neurological outcome, or prolonging treatment that might result in survival with severe disability. Approximately one in three admitted to intensive care will survive, many of whom will need intensive, tailored rehabilitation after discharge to have the best outcomes.

2. Resuscitation. 2021 Sep 1:S0300-9572(21)00344-0. doi: 10.1016/j.resuscitation.2021.08.042.

Online ahead of print.

### **Neurological outcome in adult out-of-hospital cardiac arrest - not all doom and gloom!**

Mckenzie N(1), Ball S(2), Bailey P(2), Finn L(3), Arendts G(4), Celenza A(5), Fatovich D(6), Jenkins I(7), Mukherjee A(8), Smedley B(9), Ghedina N(10), Bray J(11), Ho KM(12), Dobb G(13), Finn J(14).

#### **ABSTRACT**

AIMS: To describe neurological and functional outcomes among out-of-hospital cardiac arrest (OHCA) patients who survived to hospital discharge; to determine the association between neurological outcome at hospital discharge and 12-month survival. METHODS: Our cohort comprised adult OHCA patients ( $\geq 18$  years) attended by St John WA (SJWA) paramedics in Perth, Western Australia (WA), who survived to hospital discharge, between 1st January 2004 and 31st December 2019. Neurological and functional status at hospital discharge (and before the arrest) was determined by medical record review using the five-point 'Cerebral Performance Category (CPC)' and 'Overall Performance Category (OPC)' scores. Adjusted multivariable logistic regression analysis was used to estimate the association of CPC score at hospital discharge with 12-month survival, adjusted for prognostic variables. RESULTS: Over the study period, SJWA attended 23,712 OHCA. Resuscitation was attempted in 43.4% of cases (n=10,299) with 2171 subsequent admissions, 99.4% (n=2158) of these were admitted to a study hospital. Of the 1062 hospital survivors, 71.3% (n=757) were CPC1 (highest category of neurological performance), 21.4% (n=227) CPC2, 6.3% (n=67) CPC3 and 1.0% (n=11) CPC4. OPC scores followed a similar distribution. Of the 1,011 WA residents who survived to hospital discharge, 92.3% (n=933) survived to 12-months. A CPC1-2 at hospital discharge was significantly associated with 12-month survival (adjusted odds ratio 3.28, 95% confidence interval 1.69-6.39). CONCLUSION: Whilst overall survival is low, most survivors of OHCA have a good neurological outcome at hospital discharge and are alive at 12-months.

3. Ir J Med Sci. 2021 Aug 30. doi: 10.1007/s11845-021-02745-6. Online ahead of print.

### **Clinical value of miR-191-5p in predicting the neurological outcome after out-of-hospital cardiac arrest.**

Yu J(1), Zhou A(2), Li Y(3).

## ABSTRACT

**BACKGROUND:** The diagnostic and prognostic value of microRNAs (miRNA) in human disease has been confirmed in a number of clinical studies. **AIMS:** The purpose of this study was to investigate the predictive value of miR-191-5p in the neurological outcome of patients recovering from out-of-hospital cardiac arrest (OHCA). **METHODS:** A total of 260 patients undergoing the target temperature management trial were analyzed. The expression level of serum miR-191-5p was detected by qRT-PCR at 48 h after return of spontaneous circulation (ROSC). ROC curve was established to evaluate the ability of miR-191-5p as a biomarker for predicting adverse neurological outcomes after OHCA. Kaplan-Meier curve and Cox regression analysis were used for survival analysis. **RESULTS:** One hundred eighteen patients (45%) had poor neurological outcomes at 6 months. The expression level of serum miR-191-5p in patients with poor neurological outcomes was significantly lower than that in patients with good neurological prognosis ( $P < 0.001$ ) and was not associated with TTM trial. The AUC, sensitivity, and specificity of the ROC curve were 0.899, 84.7%, and 82.4%, respectively, suggesting that the level of miR-191-5p had the ability to predict neurological outcome. By the end of the experiment, 88 patients (34%) were dead. Results of survival analysis showed that lower miR-191-5p expression level was significantly associated with lower survival rate (HR: 0.344, 95% CI = 0.208-0.567,  $P < 0.001$ ). **CONCLUSIONS:** The level of miR-191-5p was down-regulated in patients with poor neurological outcomes, and it could be used as a promising novel biomarker for prediction of neurological outcome and survival after OHCA.

4. J Intensive Care Med. 2021 Aug 30;8850666211034728. doi: 10.1177/08850666211034728.

Online ahead of print.

### **Brain Natriuretic Peptide as a Marker of Adverse Neurological Outcomes Among Survivors of Cardiac Arrest.**

Dutta A(1), Alirhayim Z(2), Masmoudi Y(3), Azizian J(3), McDonald L(4), Jogu HR(3), Qureshi WT(5), Majeed N(6).

## ABSTRACT

**BACKGROUND:** Neurological prognosis after cardiac arrest remains ill-defined. Plasma brain natriuretic peptide (BNP) may relate to poor neurological prognosis in brain-injury patients, though it has not been well studied in survivors of cardiac arrest. **METHODS:** We performed a retrospective review and examined the association of BNP with mortality and neurological outcomes at discharge in a cohort of cardiac arrest survivors enrolled from January 2012 to December 2016 at the Wake Forest Baptist Hospital, in North Carolina. Cerebral performance category (CPC) and modified Rankin scales were calculated from the chart based on neurological evaluation performed at the time of discharge. The cohort was subdivided into quartiles based on their BNP levels after which multivariable adjusted logistic regression models were applied to assess for an association between BNP and poor neurological outcomes as defined by a CPC of 3 to 4 and a modified Rankin scale of 4 to 5. **RESULTS:** Of the 657 patients included in the study, 254 patients survived until discharge. Among these, poor neurological status was observed in 101 (39.8%) patients that had a CPC score of 3 to 4 and 97 patients (38.2%) that had a modified Rankin scale of 4 to 5. Mean BNP levels were higher in patients with poor neurological status compared to those with good neurological status at discharge ( $P = .03$  for CPC 3-4 and  $P = .02$  for modified Rankin score 4-5). BNP levels however, did not vary significantly between patients that survived and those that expired ( $P = .22$ ). BNP did emerge as a significant discriminator between patients with severe neurological disability at discharge when compared to those without. The area under the curve for BNP predicting a modified Rankin score of 4 to 5 was 0.800 (95% confidence interval [CI] 0.756-0.844,  $P < .001$ ) and for predicting CPC 3 to 4 was 0.797 (95% CI 0.756-0.838,  $P < .001$ ). BNP was able to significantly improve the net reclassification index and integrated discriminatory increment ( $P < .05$ ). BNP was not associated with

long-term all-cause mortality ( $P > .05$ ). **CONCLUSIONS:** In survivors of either inpatient or out-of-hospital cardiac arrest, increased BNP levels measured at the time of arrest predicted severe neurological disability at discharge. We did not observe an independent association between BNP levels and long-term all-cause mortality. BNP may be a useful biomarker for predicting adverse neurological outcomes in survivors of cardiac arrest.

### **ULTRASOUND AND CPR**

No articles identified.

### **ORGANISATION AND TRAINING**

1. Indian Heart J. 2021 Jul-Aug;73(4):446-450. doi: 10.1016/j.ihj.2021.02.004. Epub 2021 Feb 17.

#### **Study of pre-hospital care of out of hospital cardiac arrest victims and their outcome in a tertiary care hospital in India.**

Bhat R(1), Ravindra P(2), Sahu AK(3), Mathew R(4), Wilson W(5).

#### **ABSTRACT**

**BACKGROUND:** India does not have a formal cardiac arrest registry or a centralized emergency medical system. In this study, we aimed to assess the prehospital care received by the patients with OHCA and predict the factors that could influence their outcome. **METHODS:** Out-of-hospital cardiac arrest patients presenting to the emergency department in a tertiary care centre were included in the study. Prehospital care was assessed in terms of bystander cardiopulmonary resuscitation (CPR), mode of transport, resuscitation in ambulance. OHCA outcomes like Return of spontaneous circulation (ROSC), survival to hospital discharge and favourable neurological outcome at discharge were assessed. **RESULTS:** Among 205 patients, the majority were male (71.2%) and were above 60 years of age (49.3%); Predominantly non-traumatic (82.4%). 30.7% of the patients had sustained cardiac arrest in transit to the hospital. 41.5% of patients reached hospital by means other than ambulance. Only 9.8% patients had received bystander CPR. Only 12.5% ambulances had BLS trained personnel. AED was used only in 1% of patients. The initial rhythm at presentation to the hospital was non-shockable (96.5%). Return of spontaneous circulation (ROSC) was achieved in 17 (8.3%) patients, of which only 3 (1.4%) patients survived till discharge. The initial shockable rhythm was a significant predictor of ROSC (OR 18.97 95%CI 3.83-93.89;  $p < 0.001$ ) and survival to discharge (OR 42.67; 95%CI 7.69-234.32;  $p < 0.001$ ). **CONCLUSION:** The outcome of OHCA in India is dismal. The pre-hospital care received by the OHCA victim needs attention. Low by-stander CPR rate, under-utilised and under-equipped EMS system are the challenges.

2. Resusc Plus. 2021 Aug 19;7:100157. doi: 10.1016/j.resplu.2021.100157. eCollection 2021 Sep.

#### **Cardiopulmonary resuscitation retention training for hospital nurses by a self-learner skill station or the traditional instructor led course: A randomised controlled trial.**

Sand K(1)(2)(3), Guldal AU(4), Myklebust TÅ(3), Hoff DAL(1)(2)(3), Juvkam PC(5), Hole T(1)(2).

#### **ABSTRACT**

**INTRODUCTION:** Intrahospital cardiac arrest has a steep mortality and high-quality cardiopulmonary resuscitation (CPR) is essential for favourable outcome. Instructor led (IL) CPR training is resource demanding and instructor free, feedback providing CPR skill stations (SS) could provide a means to enable the needed frequent retraining. The main objective of this study was to test the hypothesis that there was no difference between IL and SS training. **METHODS:** A total of 129 hospital nurses were randomised to CPR retraining in three groups; skill station with retraining at 2 months (SS-R),

skill station without retraining (SS) and instructor led training (IL). Participants were tested at baseline, 2 and 8 months. The skill station groups were combined (c-SS) for analysis at baseline and 2 months when comparing to IL. RESULTS: Baseline characteristics for the three groups differed significantly, however c-SS and IL groups performed equally at baseline and testing at 2 months. At 8 months the SS group performed 71% correct ventilations compared to 54% in the IL group ( $p = 0.04$ ), but CPR quality was otherwise equal. Longitudinal analysis showed SS-R performed 3.4 mm deeper compressions at final evaluation compared to baseline ( $p = 0.02$ ) and 2.8 mm deeper compared to 2-month test ( $p = 0.02$ ). No effects of retraining at 2 months could be detected at final comparison of SS-R and SS groups. CONCLUSION: CPR training using a skill station led to equal performance at 2 and 8 months compared to instructor led training. Feedback-providing skill stations could be a feasible tool for required frequent retraining.

3. Am J Emerg Med. 2021 Aug;46:456-461. doi: 10.1016/j.ajem.2020.10.054. Epub 2020 Oct 27.

**Association between prehospital prognostic factors and out-of-hospital cardiac arrest: Effect of rural-urban disparities.**

Hsu YC(1), Wu WT(2), Huang JB(1), Lee KH(3), Cheng FJ(4).

**ABSTRACT**

BACKGROUND: Out-of-hospital cardiac arrest (OHCA) is associated with a poor prognosis and a highly variable survival rate. Few studies have focused on outcomes in rural and urban groups while also evaluating underlying diseases and prehospital factors for OHCA. OBJECTIVE: To investigate the relationship between the patient's underlying disease and outcomes of OHCA in urban areas versus those in rural areas. METHODS: We reviewed the emergency medical service (EMS) database for information on OHCA patients treated between January 2015 and December 2019, and collected data on pre-hospital factors, underlying diseases, and outcomes of OHCA. Univariate and multivariate logistic regression analyses were used to evaluate the prognostic factors for OHCA. RESULTS: Data from 4225 OHCA were analysed. EMS response time was shorter and the rate of attendance by EMS paramedics was higher in urban areas ( $p < 0.001$  for both). Urban area was a prognostic factor for >24-h survival (odds ratio [OR] = 1.437, 95% confidence interval [CI]: 1.179-1.761). Age (OR = 0.986, 95% CI: 0.979-0.993). EMS response time (OR = 0.854, 95% CI: 0.811-0.898), cardiac arrest location (OR = 2.187, 95% CI: 1.707-2.795), attendance by paramedics (OR = 1.867, 95% CI: 1.483-2.347), and prehospital defibrillation (OR = 2.771, 95% CI: 2.154-3.556) were independent risk factors for survival to hospital discharge, although the influence of an urban area was not significant (OR = 1.211, 95% CI: 0.918-1.584). CONCLUSIONS: Compared with rural areas, OHCA in urban areas are associated with a higher 24-h survival rate. Shorter EMS response time and a higher probability of being attended by paramedics were noted in urban areas. Although shorter EMS response time, younger age, public location, defibrillation by an automated external defibrillator, and attendance by Emergency Medical Technician-paramedics were associated with a higher rate of survival to hospital discharge, urban area was not an independent prognostic factor for survival to hospital discharge in OHCA patients.

4. Resuscitation. 2021 Aug 27:S0300-9572(21)00333-6. doi: 10.1016/j.resuscitation.2021.08.032.

Online ahead of print.

**Early recognition of a caller's emotion in out-of-hospital cardiac arrest dispatching: An artificial intelligence approach.**

Chin KC(1), Hsieh TC(2), Chiang WC(3), Chien YC(4), Sun JT(5), Lin HY(6), Hsieh MJ(6), Yang CW(7), Chen AY(2), Huei-Ming Ma M(3).

**ABSTRACT**

AIM: This study aimed to develop an AI model for detecting a caller's emotional state during out-of-hospital cardiac arrest calls by processing audio recordings of dispatch communications. METHODS: Audio recordings of 337 out-of-hospital cardiac arrest calls from March-April 2011 were retrieved. The callers' emotional state was classified based on the emotional content and cooperative scores. Mel-frequency cepstral coefficients extracted essential information from the voice signals. A support vector machine was utilised for the automatic judgement, and repeated random sub-sampling cross validation (RRS-CV) was applied to evaluate robustness. The results from the artificial intelligence classifier were compared with the consensus of expert reviewers. RESULTS: The audio recordings were classified into five emotional content and cooperative score levels. The proposed model had an average positive predictive value of 72.97%, a negative predictive value of 93.47%, sensitivity of 38.76%, and specificity of 98.29%. If only the first 10 seconds of the recordings were considered, it had an average positive predictive value of 84.62%, a negative predictive value of 93.57%, sensitivity of 52.38%, and specificity of 98.64%. The artificial intelligence model's performance maintained preferable results for emotionally stable cases. CONCLUSION: Artificial intelligence models can possibly facilitate the judgement of callers' emotional states during dispatch conversations. This model has the potential to be utilised in practice, by pre-screening emotionally stable callers, thus allowing dispatchers to focus on cases that are judged to be emotionally unstable. Further research and validation are required to improve the model's performance and make it suitable for the general population.

5. JAMA Netw Open. 2021 Aug 2;4(8):e2123007. doi: 10.1001/jamanetworkopen.2021.23007.

**Effect of a Mobile App on Prehospital Medication Errors During Simulated Pediatric Resuscitation: A Randomized Clinical Trial.**

Siebert JN(1)(2), Bloudeau L(3), Combescure C(4), Haddad K(1), Hugon F(1), Suppan L(2)(5), Rodieux F(2)(6), Lovis C(2)(7), Gervaix A(1)(2), Ehrler F(2)(7), Manzano S(1)(2); Pediatric Accurate Medication in Emergency Situations (PedAMINES) Prehospital Group.

**ABSTRACT**

IMPORTANCE: Medication errors are a leading cause of injury and avoidable harm, affecting millions of people worldwide each year. Children are particularly susceptible to medication errors, but innovative interventions for the prevention of these errors in prehospital emergency care are lacking. OBJECTIVE: To assess the efficacy of an evidence-based mobile app in reducing the occurrence of medication errors compared with conventional preparation methods during simulated pediatric out-of-hospital cardiac arrest scenarios. DESIGN, SETTING, AND PARTICIPANTS: This nationwide, open-label, multicenter, randomized clinical trial was conducted at 14 emergency medical services centers in Switzerland from September 3, 2019, to January 21, 2020. The participants were 150 advanced paramedics with drug preparation autonomy. Each participant was exposed to a 20-minute, standardized, fully video-recorded, realistic pediatric out-of-hospital cardiac arrest cardiopulmonary resuscitation scenario concerning an 18-month-old child. Participants were tested on sequential preparations of 4 intravenous emergency drugs of varying degrees of preparation difficulty (epinephrine, midazolam, 10% dextrose, and sodium bicarbonate). INTERVENTION: Participants were randomized (1:1 ratio) to the support of an app designed to assist with pediatric drug preparation (intervention; n = 74) or to follow conventional drug preparation methods without assistance (control; n = 76). MAIN OUTCOMES AND MEASURES: The primary outcome was the rate of medication errors, defined as a failure in drug preparation according to predefined, expert consensus-based criteria. Logistic regression models with mixed effects were used to assess the effect of the app on binary outcomes. Secondary outcomes included times to drug preparation and delivery, assessed with linear regression models with mixed effects. RESULTS: In total, 150 advanced paramedics (mean [SD] age, 35.6 [7.2] years; 101 men [67.3%]; mean [SD] time

since paramedic certification, 8.0 [6.2] years) participated in the study and completed 600 drug preparations. Of 304 preparations delivered using the conventional method, 191 (62.8%; 95% CI, 57.1%-68.3%) were associated with medication errors compared with 17 of 296 preparations delivered using the app (5.7%; 95% CI, 3.4%-9.0%). When accounting for repeated measures, with the app, the proportion of medication errors decreased in absolute terms by 66.5% (95% CI, 32.6%-83.8%;  $P < .001$ ), the mean time to drug preparation decreased by 40 seconds (95% CI, 23-57 seconds;  $P < .001$ ), and the mean time to drug delivery decreased by 47 seconds (95% CI, 27-66 seconds;  $P < .001$ ). The risk of medication errors varied across drugs with conventional methods (19.7%-100%) when compared with the app (4.1%-6.8%). **CONCLUSIONS AND RELEVANCE:** Compared with conventional methods, the use of a mobile app significantly decreased the rate of medication errors and time to drug delivery for emergency drug preparation in a prehospital setting. Dedicated mobile apps have the potential to improve medication safety and change practices in pediatric emergency medicine.

6. Resusc Plus. 2021 Aug 17;7:100152. doi: 10.1016/j.resplu.2021.100152. eCollection 2021 Sep.

**The use of a cognitive aid app supports guideline-conforming cardiopulmonary resuscitations: A randomized study in a high-fidelity simulation.**

Grundgeiger T(1), Hahn F(2), Wurmb T(2), Meybohm P(2), Happel O(2).

**ABSTRACT**

**AIM:** Cardiac arrests require fast, well-timed, and well-coordinated interventions delivered by several staff members. We evaluated a cognitive aid that works as an attentional aid to support specifically the timing and coordination of these interventions. We report the results of an experimental, simulation-based evaluation of the tablet-based cognitive aid in performing guideline-conforming cardiopulmonary resuscitation. **METHODS:** In a parallel group design, emergency teams (one qualified emergency physician as team leader and one qualified nurse) were randomly assigned to the cognitive aid application (CA App) group or the no application (No App) group and then participated in a simulated scenario of a cardiac arrest. The primary outcome was a cardiopulmonary resuscitation performance score ranging from zero to two for each team based on the videotaped scenarios in relation to twelve performance variables derived from the European Resuscitation Guidelines. As a secondary outcome, we measured the participants' subjective workload. **RESULTS:** A total of 67 teams participated. The CA App group ( $n = 32$  teams) showed significantly better cardiopulmonary resuscitation performance than the No App group ( $n = 31$  teams; mean difference = 0.23, 95 %CI = 0.08 to 0.38,  $p = 0.002$ ,  $d = 0.83$ ). The CA App group team leaders indicated significantly less mental and physical demand and less effort to achieve their performance compared to the No App group team leaders. **CONCLUSIONS:** Among well-trained in-hospital emergency teams, the cognitive aid could improve cardiopulmonary resuscitation coordination performance and decrease mental workload.

7. Ann Med Surg (Lond). 2021 Aug 17;69:102600. doi: 10.1016/j.amsu.2021.102600. eCollection 2021 Sep.

**Cardiopulmonary resuscitation: Knowledge and Attitude of doctors from Lahore.**

Iqbal A(1), Nisar I(1), Arshad I(1), Butt UI(1)(2), Umar M(1)(2), Ayyaz M(3), Farooka MW(1)(2).

**ABSTRACT**

**OBJECTIVE:** The objective of study was to assess the knowledge and attitude of doctors from Lahore regarding CPR as per American Heart Association (AHA) guidelines. **METHODS:** The researchers visited various hospitals and filled e-questionnaires by interviewing respondents. The study was conducted at Jinnah Hospital Lahore, Mayo Hospital Lahore, Punjab Institute of Cardiology Lahore, Sir Ganga Ram Hospital Lahore, Services Hospital Lahore and Mid City Hospital. Data were analyzed

using statistical package for social sciences (SPSS) 23 version. Knowledge was assessed based on the scores, with those scoring 10 or more being considered to have good knowledge while those having score less than 10 were considered to have poor knowledge. P values < 0.05 were considered statistically significant. RESULTS: Out of 792 participants, 68 refused to take part in the study. The total respondents were 724 with the response rate of 91%. The knowledge regarding cardiopulmonary resuscitation of 601(83%) respondents was poor with only 123(17%) doctors having good knowledge. The doctors who received formal CPR training had better knowledge (20.17%) than the doctors who didn't get any training regarding CPR (4.69%). Anesthesiologists scored better among all specialties. The overall attitude of the doctors towards CPR was positive with 93.8% of the respondents willing to do CPR. CONCLUSION: The overall knowledge of the doctors regarding CPR is not satisfactory. A practical and functional approach is needed to improve this situation. However, the attitude of the doctors towards CPR is positive.

8. Resuscitation. 2021 Aug 31;167:91-92. doi: 10.1016/j.resuscitation.2021.08.012. Online ahead of print.

**Corrigendum to "European Resuscitation Council Guidelines 2021: Cardiac arrest in special circumstances" [Resuscitation 161 (2021) 152-219].**

Lott C(1), Truhlář A(2), Alfonso A(3), Barelli A(4), González-Salvado V(5), Hinkelbein J(6), Nolan JP(7), Paal P(8), Perkins GD(9), Thies KC(10), Yeung J(9), Zideman DA(11), Soar J(12); ERC Special Circumstances Writing Group Collaborators.

**NO ABSTRACT AVAILABLE**

9. Aust Crit Care. 2021 Aug 26:S1036-7314(21)00111-9. doi: 10.1016/j.aucc.2021.07.001. Online ahead of print.

**Time out! Pauses during advanced life support in high-fidelity simulation: A cross-sectional study.**

Márquez-Hernández VV(1), Gutiérrez-Puertas L(2), García-Viola A(3), Garrido-Molina JM(3), Gutiérrez-Puertas V(3), Rodríguez-García MC(1), Aguilera-Manrique G(1).

**ABSTRACT**

BACKGROUND: Prolonged preshock pauses are associated with negative effects on patient outcomes and survival. A greater understanding of these pauses may help to improve the quality of advanced life support (ALS) and clinical outcomes. OBJECTIVE: The objective of this study was to identify the pauses that occur during ALS situations in high-fidelity simulation scenarios and the frequency and duration of these pauses. METHODS: One hundred forty-two nursing students participated in this cross-sectional study, involving high-fidelity simulation scenario of cardiorespiratory arrest in a simulated hospital room. Pauses were assessed using an observation checklist. RESULTS: Students performed the scenario in an average time of 8.32 (standard deviation = 1.13) minutes. Pauses between chest compressions were longer than recommended (mean = 0.36, standard deviation = 1.14). A strong positive correlation was found between the identification of the arrhythmia and the initiation of countershock ( $r_s = 0.613$ ,  $p < 0.001$ ). CONCLUSIONS: Nursing students generally performed ALS within the time limits recommended by resuscitation guidelines. Early identification of shockable rhythms may lead to early nurse-initiated defibrillation. Strategies to speed up the identification of arrhythmias should be put in place to minimise preshock pauses and improve ALS outcomes.

## **POST-CARDIAC ARREST TREATMENTS**

1. J Cardiol. 2021 Aug 29:S0914-5087(21)00219-7. doi: 10.1016/j.jjcc.2021.08.016. Online ahead of print.

## **Non-ST elevation myocardial infarction and cardiac arrest: The United States Nationwide Emergency Department Sample.**

Mir T(1), Qureshi WT(2), Uddin M(1), Shafi O(3), Sheikh M(4), Kakouros N(5).

### **ABSTRACT**

**BACKGROUND:** Literature regarding outcomes of cardiac arrest with associated NSTEMI is limited. We aim to study the predictors and survival outcomes of cardiac arrest patients presenting to the emergency department who were diagnosed with non-ST elevated myocardial infarction (NSTEMI). **METHODS:** Data from the nationwide emergency department sample (NEDS) that constitutes 20% sample of hospital-owned emergency departments in the United States was analyzed for the cardiac arrest related visits from 2009-2018. Cardiac arrest was defined by the ICD codes. **RESULTS:** Out of 3,235,555 cardiac arrests (mean age  $64.0 \pm 19.5$  years, 40.7% females) there were 163,970 (5.1%) patients diagnosed with NSTEMI during the years 2009-2018. Among cardiac arrest patients, the survival for NSTEMI patients was higher than patients without NSTEMI (46.7% vs. 22.7%). These patients were more likely to be males and elderly. Among the predictors for NSTEMI cardiac arrests, hypertension (OR 1.12,  $p < 0.001$ ), peripheral vascular disease (OR 1.16,  $p < 0.001$ ), prior-coronary artery bypass graft (OR 1.20,  $p < 0.001$ ) were the predominant ones. Cardiovascular interventions were more common in NSTEMI cardiac arrests and were associated with lower mortality rates ( $p < 0.001$ ). However, trend for coronary interventions remained steady over study years. We observed an increase in prevalence of NSTEMI cardiac arrests with a worsening trend in survival from 2009-2018. **CONCLUSIONS:** NSTEMI was not uncommon in patients with cardiac arrest. NSTEMI cardiac arrest had a better prognosis than patients without NSTEMI. Cardiovascular interventions might have survival benefits. More research is required to identify NSTEMI in cardiac arrest patients and further evaluate the effect of cardiovascular interventions on survival.

2. N Engl J Med. 2021 Aug 29. doi: 10.1056/NEJMoa2101909. Online ahead of print.

### **Angiography after Out-of-Hospital Cardiac Arrest without ST-Segment Elevation.**

Desch S(1), Freund A(1), Akin I(1), Behnes M(1), Preusch MR(1), Zelniker TA(1), Skurk C(1), Landmesser U(1), Graf T(1), Eitel I(1), Fuernau G(1), Haake H(1), Nordbeck P(1), Hammer F(1), Felix SB(1), Hassager C(1), Engström T(1), Fichtlscherer S(1), Ledwoch J(1), Lenk K(1), Joner M(1), Steiner S(1), Liebetau C(1), Voigt I(1), Zeymer U(1), Brand M(1), Schmitz R(1), Horstkotte J(1), Jacobshagen C(1), Pöss J(1), Abdel-Wahab M(1), Lurz P(1), Jobs A(1), de Waha-Thiele S(1), Olbrich D(1), Sandig F(1), König IR(1), Brett S(1), Vens M(1), Klinge K(1), Thiele H(1); TOMAHAWK Investigators.

### **ABSTRACT**

**BACKGROUND:** Myocardial infarction is a frequent cause of out-of-hospital cardiac arrest. However, the benefits of early coronary angiography and revascularization in resuscitated patients without electrocardiographic evidence of ST-segment elevation are unclear. **METHODS:** In this multicenter trial, we randomly assigned 554 patients with successfully resuscitated out-of-hospital cardiac arrest of possible coronary origin to undergo either immediate coronary angiography (immediate-angiography group) or initial intensive care assessment with delayed or selective angiography (delayed-angiography group). All the patients had no evidence of ST-segment elevation on postresuscitation electrocardiography. The primary end point was death from any cause at 30 days. Secondary end points included a composite of death from any cause or severe neurologic deficit at 30 days. **RESULTS:** A total of 530 of 554 patients (95.7%) were included in the primary analysis. At 30 days, 143 of 265 patients (54.0%) in the immediate-angiography group and 122 of 265 patients (46.0%) in the delayed-angiography group had died (hazard ratio, 1.28; 95% confidence interval [CI], 1.00 to 1.63;  $P = 0.06$ ). The composite of death or severe neurologic deficit occurred more frequently in the immediate-angiography group (in 164 of 255 patients [64.3%]) than in the delayed-angiography group (in 138 of 248 patients [55.6%]), for a relative risk of 1.16 (95% CI, 1.00 to 1.34). Values for peak troponin release and for the incidence of moderate or severe bleeding, stroke, and renal-replacement therapy were similar in the two groups. **CONCLUSIONS:** Among patients with

resuscitated out-of-hospital cardiac arrest without ST-segment elevation, a strategy of performing immediate angiography provided no benefit over a delayed or selective strategy with respect to the 30-day risk of death from any cause.

### **TARGETED TEMPERATURE MANAGEMENT**

1. Resuscitation. 2021 Aug 27:S0300-9572(21)00338-5. doi: 10.1016/j.resuscitation.2021.08.037. Online ahead of print.

#### **Increasing mean arterial pressure or cardiac output in comatose out-of-hospital cardiac arrest patients undergoing targeted temperature management: effects on cerebral tissue oxygenation and systemic hemodynamics.**

Grand J(1), Wiberg S(2), Kjaergaard J(2), Wanscher M(3), Hassager C(2).

#### **ABSTRACT**

**INTRODUCTION:** Few data exist on the effects of increasing norepinephrine doses or increasing arterial CO<sub>2</sub> (PaCO<sub>2</sub>) on hemodynamics and cerebral oxygenation in comatose out-of-hospital cardiac arrest (OHCA) patients. **METHODS:** We prospectively studied 10 resuscitated OHCA-patients undergoing targeted temperature management (36°C). The trial consisted of 5 phases with 20 minutes steady state in-between: Phase 1-4 were increasing doses of norepinephrine to reach targets of mean arterial pressure (MAP). First 65, second 75, third 85, fourth 65 mmHg again. In the fifth phase, MAP was constant while PaCO<sub>2</sub> was increased to 6.5-7.3 kPa to increase cardiac output. Primary outcome was cerebral near-infrared spectroscopy (NIRS). Secondary outcomes were hemodynamic variables from Swan-Ganz catheters and blood samples from the radial artery and jugular bulb. **RESULTS:** To reach a MAP at 85 mmHg, norepinephrine was increased from 0.11±0.02 to 0.18±0.02 µg/kg/min (P < 0.001). Norepinephrine up-titration significantly increased systemic vascular resistance (SVR) and pulmonary vascular resistance, without affecting cardiac output, heart rate or cerebral oxygenation. Increasing PaCO<sub>2</sub>, resulted in a significant increase in cardiac output and cerebral NIRS, but arterial-venous cerebral oxygen-uptake decreased. Norepinephrine demand to keep MAP at 65 mmHg was unaffected by increasing PaCO<sub>2</sub>. **CONCLUSIONS:** A short-term increase in MAP with norepinephrine in resuscitated comatose cardiac arrest-patients is associated with increased SVR and pulmonary vascular resistance without affecting cardiac output or cerebral NIRS. Increased cardiac output caused by an increase in PaCO<sub>2</sub> increased cerebral NIRS, but not cerebral oxygen uptake.

2. Resuscitation. 2021 Aug 30:S0300-9572(21)00341-5. doi: 10.1016/j.resuscitation.2021.08.040. Online ahead of print.

#### **Targeted Temperature Management in Adult Cardiac Arrest: Systematic Review and Meta-Analysis.**

Granfeldt A(1), Holmberg MJ(2), Nolan JP(3), Soar J(4), Andersen LW(5).

#### **ABSTRACT**

**AIM:** To perform a systematic review and meta-analysis on targeted temperature management in adult cardiac arrest patients. **METHODS:** PubMed, Embase, and the Cochrane Central Register of Controlled Trials were searched on June 17, 2021 for clinical trials. The population included adult patients with cardiac arrest. The review included all aspects of targeted temperature management including timing, temperature, duration, method of induction and maintenance, and rewarming. Two investigators reviewed trials for relevance, extracted data, and assessed risk of bias. Data were pooled using random-effects models. Certainty of evidence was evaluated using GRADE. **RESULTS:** The systematic search identified 32 trials. Risk of bias was assessed as intermediate for most of the outcomes. For targeted temperature management with a target of 32-34°C vs. normothermia (which

often required active cooling), 9 trials were identified, with six trials included in meta-analyses. Targeted temperature management with a target of 32-34°C did not result in an improvement in survival (risk ratio: 1.08 [95%CI: 0.89, 1.30]) or favorable neurologic outcome (risk ratio: 1.21 [95%CI: 0.91, 1.61]) at 90 to 180 days after the cardiac arrest (low certainty of evidence). Three trials assessed different hypothermic temperature targets and found no difference in outcomes (low certainty of evidence). Ten trials were identified comparing prehospital cooling vs. no prehospital cooling with no improvement in survival (risk ratio: 1.01 [95%CI: 0.92, 1.11]) or favorable neurologic outcome (risk ratio: 1.00 [95%CI: 0.90, 1.11]) at hospital discharge (moderate certainty of evidence). **CONCLUSIONS:** Among adult patients with cardiac arrest, the use of targeted temperature management at 32-34°C, when compared to normothermia, did not result in improved outcomes in this meta-analysis. There was no effect of initiating targeted temperature management prior to hospital arrival. These findings warrant an update of international cardiac arrest guidelines.

## **ELECTROPHYSIOLOGY AND DEFIBRILLATION**

1. Europace. 2021 Sep 1:euab192. doi: 10.1093/europace/euab192. Online ahead of print.

### **Using a smartwatch electrocardiogram to detect abnormalities associated with sudden cardiac arrest in young adults.**

Nasarre M(1), Strik M(1)(2), Daniel Ramirez F(1)(2)(3), Buliard S(1), Marchand H(1), Abu-Alrub S(1)(2), Ploux S(1)(2), Haïssaguerre M(1)(2), Bordachar P(1)(2).

#### **ABSTRACT**

**AIMS:** Smartwatch electrocardiograms (ECGs) could facilitate the detection of sudden cardiac arrest (SCA)-associated abnormalities. We evaluated the feasibility of using smartwatch-derived ECGs for detecting SCA-associated abnormalities in young adults and its agreement with 12-lead ECGs.

**METHODS AND RESULTS:** Twelve-lead and Apple Watch ECGs were registered in 155 healthy volunteers and 67 patients aged 18-45 years with diagnosis and ECG signs of long-QT syndrome (n = 10), Brugada syndrome (n = 12), ventricular pre-excitation (n = 19), hypertrophic cardiomyopathy (HCM, n = 13), and arrhythmogenic right ventricular dysplasia/cardiomyopathy (ARVC/D, n = 13). Cardiologists separately analysed 12-lead ECGs and the smartwatch ECGs taken from the left wrist (AW-I) and then from chest positions V1, V3, and V6 (AW-4). Compared with AW-I, AW-4 improved the classification of ECGs as 'abnormal', increasing the sensitivity from 64% to 89% (P < 0.01). Pre-excitation was detected in most cases using AW-I (sensitivity 89%) and in all cases using AW-4 (sensitivity 100%, P = 0.48 compared with AW-I, specificity 100% for both). Brugada was missed using AW-I but was detected in 11/12 patients using AW-4 (sensitivity 92%, specificity 100%, P = 0.003). Long QT was detected in 8/10 cases using AW-I (sensitivity 80%, specificity 100%) and in 9 patients using AW-4 (sensitivity 90%, specificity 100%, P > 0.99). Hypertrophic cardiomyopathy was correctly suspected using AW-I and AW-4 (sensitivity 92% and 85%, specificity 85%, and 100%, P > 0.99). AW-I was mostly (62%) considered normal in ARVC/D whereas AW-4 was useful in suspecting ARVC/D (100% sensitivity, 99% specificity, P = 0.004). **CONCLUSIONS:** Detection of SCA-associated ECG abnormalities (pre-excitation, Brugada patterns, long QT, and signs suggestive of HCM and ARVC/D) is possible with an ECG smartwatch.

## **PEDIATRICS AND CHILDREN**

1. J Am Coll Cardiol. 2021 Sep 7;78(10):1042-1052. doi: 10.1016/j.jacc.2021.06.042.

### **Compression-Only Versus Rescue-Breathing Cardiopulmonary Resuscitation After Pediatric Out-of-Hospital Cardiac Arrest.**

Naim MY(1), Griffis HM(2), Berg RA(3), Bradley RN(4), Burke RV(5), Markenson D(6), McNally BF(7), Nadkarni VM(3), Song L(2), Vellano K(7), Vetter V(8), Rossano JW(9).'

#### **ABSTRACT**

**BACKGROUND:** There are conflicting data regarding the benefit of compression-only bystander cardiopulmonary resuscitation (CO-CPR) compared with CPR with rescue breathing (RB-CPR) after pediatric out-of-hospital cardiac arrest (OHCA). **OBJECTIVES:** This study sought to test the hypothesis that RB-CPR is associated with improved neurologically favorable survival compared with CO-CPR following pediatric OHCA, and to characterize age-stratified outcomes with CPR type compared with no bystander CPR (NO-CPR). **METHODS:** Analysis of the CARES registry (Cardiac Arrest Registry to Enhance Survival) for nontraumatic pediatric OHCA (patients aged  $\leq 18$  years) from 2013-2019 was performed. Age groups included infants ( $< 1$  year), children (1 to 11 years), and adolescents ( $\geq 12$  years). The primary outcome was neurologically favorable survival at hospital discharge. **RESULTS:** Of 13,060 pediatric OHCA, 46.5% received bystander CPR. CO-CPR was the most common bystander CPR type. In the overall cohort, neurologically favorable survival was associated with RB-CPR (adjusted OR: 2.16; 95% CI: 1.78-2.62) and CO-CPR (adjusted OR: 1.61; 95% CI: 1.34-1.94) compared with NO-CPR. RB-CPR was associated with a higher odds of neurologically favorable survival compared with CO-CPR (adjusted OR: 1.36; 95% CI: 1.10-1.68). In age-stratified analysis, RB-CPR was associated with better neurologically favorable survival versus NO-CPR in all age groups. CO-CPR was associated with better neurologically favorable survival compared with NO-CPR in children and adolescents, but not in infants. **CONCLUSIONS:** CO-CPR was the most common type of bystander CPR in pediatric OHCA. RB-CPR was associated with better outcomes compared with CO-CPR. These results support present guidelines for RB-CPR as the preferred CPR modality for pediatric OHCA.

2. Simul Healthc. 2021 Aug 31. doi: 10.1097/SIH.0000000000000599. Online ahead of print.

#### **Healthcare Provider Characteristics and Cardiopulmonary Resuscitation Quality During Infant Resuscitation: A Simulation Study.**

Khatab M(1), Frisell K, MacKinnon R, Chang T, Raymond T, Lofton L, Tofil N, Forrester K, Gohel C, Aitken D, Scalzo A, Moore-Clingenpeel M, Auerbach M; INSPIRE (International Network for Simulation-based Pediatric Innovation, Research and Education) Network QCPR Leaderboard Investigators.

#### **ABSTRACT**

**INTRODUCTION:** Healthcare providers' anthropometric characteristics can adversely affect adult cardiopulmonary resuscitation (CPR) performance quality. However, their effects on infant CPR are unknown. We aimed to determine any relationships between healthcare provider characteristics (anthropomorphic, demographics, training, occupational data) and simulated infant CPR performance at multiple international sites. Our secondary aim was to examine provider's CPR performance degradation. **METHODS:** Providers from 4 international hospitals performed 2 minutes of single-rescuer simulated infant CPR using 2015 American Heart Association Basic Life Support criteria with guidance from a real-time visual performance feedback device. Providers' characteristics were collected, and the simulator collected compression and ventilation data. Multivariate analyses examined the entire 2 minutes and performance degradation. **RESULTS:** Data from 127 participants were analyzed. Although median values for all compression variables (depth, rate, lean) and ventilation volume were within guideline target ranges, when looking at individuals, only 52% chest compressions and 20% ventilations adhered to the American Heart Association guidelines. Age was found to be independently associated with ventilation volume (direct-relationship), and height was associated with chest compression lean (shorter participant-deeper lean). No significant differences were noted based on sex or body mass index. Neonatal intensive care unit participants were noted to perform shallower chest compressions ( $P < 0.001$ ). Overall,

there was minimal evidence of performance degradation over 2 minutes. **CONCLUSIONS:** Isolated provider characteristics were noted among a diverse cohort of healthcare providers that may affect the CPR quality on a simulated infant. Understanding the relationships between provider characteristics and CPR quality could inform future infant CPR guidelines customized for the provider and not just the patient.

3. J Am Coll Cardiol. 2021 Sep 7;78(10):1053-1055. doi: 10.1016/j.jacc.2021.07.029.

**Chest Compression-Only Cardiopulmonary Resuscitation in Pediatric Out-of-Hospital Cardiac Arrest: (Don't) Take My Breath Away.**

Ong GY(1).

**NO ABSTRACT AVAILABLE**

4. Pediatr Qual Saf. 2021 Aug 26;6(5):e455. doi: 10.1097/pq9.000000000000455. eCollection 2021 Sep-Oct.

**Contextual Factors Affecting Implementation of In-hospital Pediatric CPR Quality Improvement Interventions in a Resuscitation Collaborative.**

Dewan M(1)(2)(3), Parsons A(2), Tegtmeyer K(1)(2), Wenger J(4), Niles D(5), Raymond T(6), Cheng A(6), Skellett S(7), Roberts J(4), Jani P(8), Nadkarni V(5), Wolfe H(5).

**ABSTRACT**

**INTRODUCTION:** Pediatric quality improvement (QI) collaboratives are multisite clinical networks that support cooperative learning. Our goal is to identify the contextual facilitators and barriers to implementing QI resuscitation interventions within a multicenter resuscitation collaborative.

**METHODS:** A mixed-methods evaluation of the contextual facilitators and barriers to implementation of a resuscitation QI bundle. We administered a quantitative questionnaire, the Model for Understanding Success in Quality (MUSIQ), to the Pediatric Resuscitation Quality (pediRES-Q) Collaborative. Its primary goal is to optimize the care of children who experience in-hospital cardiac arrest through a resuscitation QI bundle. We also conducted semistructured phone interviews with site primary investigators adapted from the Consolidated Framework for Implementation Research qualitative interview guide. **RESULTS:** All 13 actively participating US sites completed the MUSIQ questionnaire. Total MUSIQ scores ranged from 86.0 to 140.5 (median of 118.7, interquartile range 103.6-124.5). Evaluation of the QI team subsection noted a mean score of 5.5 for low implementers and 6.1 for high implementers ( $P = 0.02$ ). We conducted 8 interviews with the local QI team leadership. Contextual facilitators included a unified institutional approach to QI, a fail forward climate, leadership support, strong microculture, knowledge of other organizations, and prioritization of goals. Contextual barriers included low team tenure, no specific allocation of resources, lack of formalized QI training, and lack of support and buy-in by leaders and staff.

**CONCLUSIONS:** Using mixed methods, we identified an association between the local QI team's strength and the successful implementation of the QI interventions.

**EXTRACORPOREAL LIFE SUPPORT**

1. Perfusion. 2021 Sep 2:2676591211041229. doi: 10.1177/02676591211041229. Online ahead of print.

**Outcomes of extracorporeal membrane oxygenation and cardiopulmonary bypass in children after drowning-related resuscitation.**

Gottschalk U(1), Köhne M(2), Holst T(2), Hüners I(2), von Stumm M(3), Müller G(1), Stark V(1), van Rùth V(2), Kozlik-Feldmann R(1), Singer D(4), Sachweh JS(2), Biermann D(2).

**ABSTRACT**

Drowning is one of the leading causes of accidental deaths in children worldwide. However, the use of long-term extracorporeal life support (ECLS) in this setting is not widely established, and rewarming is often achieved by short-term cardiopulmonary bypass (CPB) treatment. Thus, we sought to add our experience with this means of support as a bridge-to-recovery or to-decision. This retrospective single-center study analyzes the outcome of 11 children (median 23 months, minimum-maximum 3 months-6.5 years) who experienced drowning and subsequent cardiopulmonary resuscitation (CPR) between 2005 and 2016 and who were supported by veno-arterial extracorporeal membrane oxygenation (ECMO), CPB, or first CPB then ECMO. All but one incident took place in sweet water. Submersion time ranged between 10 and 50 minutes (median 23 minutes), water temperature between 2°C and 28°C (median 14°C), and body core temperature upon arrival in the emergency department between 20°C and 34°C (median 25°C). Nine patients underwent ongoing CPR from the scene until ECMO or CPB initiation in the operating room. The duration of ECMO or CPB before successful weaning/therapy withdrawal ranged between 2 and 322 hours (median 19 hours). A total of four patients (36%) survived neurologically mildly or not affected after 4 years of follow-up. The data indicate that survival is likely related to a shorter submersion time and lower water temperature. Resuscitation of pediatric patients after drowning has a poor outcome. However, ECMO or CPB might promote recovery in selected cases or serve as a bridge-to-decision tool.

## **EXPERIMENTAL RESEARCH**

1. Biomed Pharmacother. 2021 Aug 30;143:112093. doi: 10.1016/j.biopha.2021.112093. Online ahead of print.

### **Effects of NLRP3 inflammasome blockade on postresuscitation cerebral function in a rat model of cardiopulmonary resuscitation.**

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#### **ABSTRACT**

Cardiac arrest (CA) remains a major public health issue. Inflammatory responses with overproduction of interleukin-1 $\beta$  regulated by NLRP3 inflammasome activation play a crucial role in cerebral ischemia/reperfusion injury. We investigated the effects of the selective NLRP3-inflammasome inhibitor MCC950 on post-resuscitation cerebral function and neurologic outcome in a rat model of cardiac arrest. Thirty-six male rats were randomized into the MCC950 group, the control group, or the sham group (N = 12 of each group). Each group was divided into a 6 h non-survival subgroup (N = 6) and a 24 h survival subgroup (N = 6). Ventricular fibrillation (VF) was electrically induced and untreated for 6 min, followed by 8 min of precordial compressions and mechanical ventilation. Resuscitation was attempted with a 4J defibrillation. Either MCC950 (10 mg/kg) or vehicle was injected intraperitoneally immediately after the return of spontaneous circulation (ROSC). Rats in the sham group underwent the same surgical procedures without VF and CPR. Brain edema, cerebral microcirculation, plasma interleukin 1 $\beta$  (IL-1 $\beta$ ), and neuron-specific enolase (NSE) concentration were measured at 6 h post-ROSC of non-survival subgroups, while 24 h survival rate, neurological deficits were measured at 24 h post-ROSC of survival subgroups. Post-resuscitation brain edema was significantly reduced in animals treated with MCC950 ( $p < 0.05$ ). Cerebral perfused vessel density (PVD) and microcirculatory flow index (MFI) values were significantly higher in the MCC950 group compared with the control group ( $p < 0.05$ ). The plasma concentrations of IL-1 $\beta$  and NSE were significantly decreased in animals treated with MCC950 compared with the control group ( $p < 0.05$ ). 24 h-survival rate and neurological deficits score (NDS) was also significantly improved in the MCC950 group compared with the control group ( $p < 0.05$ ).

NLRP3 inflammasome blockade with MCC950 at ROSC reduces the circulatory level of IL-1 $\beta$ , preserves cerebral microcirculation, mitigates cerebral edema, improves the 24 h-survival rate, and neurological deficits.

2. Biomed Pharmacother. 2021 Aug 30;142:111935. doi: 10.1016/j.biopha.2021.111935. Online ahead of print.

**High-resolution respirometry for evaluation of mitochondrial function on brain and heart homogenates in a rat model of cardiac arrest and cardiopulmonary resuscitation.**

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**ABSTRACT**

The physiology and pathophysiology process of mitochondrial function following cardiac arrest remains poorly understood. We aimed to assess mitochondrial respiratory function on the heart and brain homogenates from cardiac arrest rats. The expression level of SIRT1/PGC-1 $\alpha$  pathway was measured by immunoblotting. 30 rats were assigned to the CA group and the sham group. Rats of CA were subjected to 6 min of untreated ventricular fibrillation (VF) followed by 8 min of cardiopulmonary resuscitation (CPR). Mitochondrial respiratory function was compromised following CA and I/R injury, as indicated by CIL ( $451.46 \pm 71.48$  vs.  $909.91 \pm 5.51$  pmol/min\*mg for the heart and  $464.14 \pm 8.22$  vs.  $570.53 \pm 56.33$  pmol/min\*mg for the brain), CI ( $564.04 \pm 64.34$  vs.  $2729.52 \pm 347.39$  pmol/min\*mg for the heart and  $726.07 \pm 85.78$  vs.  $1762.82 \pm 262.04$  pmol/min\*mg for the brain), RCR ( $1.88 \pm 0.46$  vs.  $3.57 \pm 0.38$  for the heart and  $2.05 \pm 0.19$  vs.  $3.49 \pm 0.19$ , for the brain) and OXPHOS coupling efficiency ( $0.45 \pm 0.11$  vs.  $0.72 \pm 0.03$  for the heart and  $0.52 \pm 0.05$  vs.  $0.71 \pm 0.01$  for the brain). However, routine respiration was lower in the heart and comparable in the brain after CA. CIV did not change in the heart but was enhanced in the brain. Furthermore, both SIRT1 and PGC-1 $\alpha$  were downregulated concurrently in the heart and brain. The mitochondrial respiratory function was compromised following CA and I/R injury, and the major affected respiratory state is complex I-linked respiration. Furthermore, the heart and the brain respond differently to the global I/R injury after CA in mitochondrial respiratory function. Inhibition of the SIRT1/PGC-1 $\alpha$  pathway may be a major contributor to the impaired mitochondrial respiratory function.

**CASE REPORTS**

1. Intern Med. 2021 Aug 31. doi: 10.2169/internalmedicine.7612-21. Online ahead of print.

**Cardiac Arrest in a 33-year-old Marathon Runner with Anomalous Right Coronary Artery Originating from the Pulmonary Artery.**

Ohashi K(1), Itagaki R(2), Mukaida T(1), Miyazaki K(3), Ohashi K(3), Kawada M(4), Abe D(1).

**ABSTRACT**

A 33-year-old marathon runner presented with anomalous right coronary artery originating from the pulmonary artery after being admitted for cardiac arrest. Surgical re-implantation of the right coronary artery to the aortic root to re-establish right coronary ostial circulation was successful. The patient resumed exercise and required no further medical therapy.

2. Unfallchirurg. 2021 Sep;124(9):774-778. doi: 10.1007/s00113-020-00950-z. Epub 2021 Jan 12.

**[Improvement in breathing mechanics by plate osteosynthesis of the ribs after cardiac massage : Case report and review of the literature]. [Article in German]**

Abshagen KF(1), Stolberg-Stolberg J(2), Luyen JP(2), Riesenbeck O(2), Everding J(2), Freise H(3), Raschke MJ(2).

**ABSTRACT**

This article reports the case of a 69-year-old patient with multiple rib fractures and sternal fracture after repetitive cardiopulmonary resuscitation (CPR). Because of secondary respiratory failure due to an unstable thorax, rib fixation was performed 10 days after CPR. Subsequently, ventilation improved resulting in successful extubation 4 days after rib plating. A review of the literature revealed only five documented cases of rib osteosynthesis after CPR. Although flail chest occurs in up to 15% of patients after CPR, there is little evidence of the effect of rib fixation. The benefit of this procedure after chest trauma is reduced pain, shortened intensive care unit stay, lower rates of ventilation-associated pneumonia and lower costs for the healthcare system. Further clinical research is needed and interdisciplinary treatment should be kept in mind when dealing with patients resuscitated with prolonged mechanical ventilation.