## RCP I COMPRESSIONS TORÀCIQUES MECÀNIQUES

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## REGISTRES REVISIONS I EDITORIALS

**Update of a Systematic Review of Autoresuscitation After Cardiac Arrest.**
Hornby L(1)(2), Dhanani S(1)(3), Shemie SD(1)(4).
**Erratum in**
Update of a Systematic Review of Autoresuscitation after Cardiac Arrest: Erratum. [Crit Care Med. 2019]
**Abstract**
OBJECTIVES: There has been a growth in publications focusing on the phenomena of autoresuscitation in recent years. In 2010, we systematically reviewed the medical literature with the primary objective of summarizing the evidence on the timing of autoresuscitation. Healthcare professionals have continued to voice concerns regarding the potential for autoresuscitation. With this in mind, the objective of this brief report is to update the results of our original review of autoresuscitation. DATA SOURCES: We applied the same search strategy described in our original article to update our findings to include articles published from January 2009 to September 2016. STUDY SELECTION AND DATA EXTRACTION: We screened an additional 1,859 citations, after duplicates were removed, and then assessed 46 full-text articles for eligibility, from which 15 studies were included for data extraction. DATA SYNTHESIS: During the time period of this review, there have been 1) 10 additional adult and three pediatric case reports of autoresuscitation in patients after cessation of cardiopulmonary resuscitation; in those cases with continuous monitoring and confirmation of circulation, the longest events are reported to be 10 and 2 minutes, respectively for adults and children; 2) six adults (4%, total n = 162) with autoresuscitation events reported from two observational studies and one chart review of patients undergoing withdrawal of life-sustaining therapy; the longest time reported to be 89 seconds with electrocardiogram and invasive arterial blood pressure monitoring and 3 minutes with electrocardiogram monitoring only; 3) 12 pediatric patients studied with vital sign monitoring during withdrawal of life-sustaining therapy without any reports of autoresuscitation. CONCLUSIONS: Although case reports of autoresuscitation are hampered by variability in observation and monitoring techniques, autoresuscitation has now been reported in adults and children, and there appears to be a distinction in timing between failed cardiopulmonary resuscitation and withdrawal of life-sustaining therapy. Although additional prospective studies are required to clarify the frequency and predisposing factors associated with this phenomenon, clinical decision-making regarding patient management under uncertainty is required nonetheless. Both adult and pediatric healthcare professionals should be aware of the possibility of autoresuscitation and monitor their patients accordingly before diagnosing death.

**In pursuit of equity: shedding light on gender differences in post-arrest care treatment of out-of-hospital cardiac arrest.**
Blewer AL(1), Ong Eng Hock M(2).
**NO ABSTRACT AVAILABLE**

## ACR INTRAHOSPITALÀRIA

**Nursing roles for in-hospital cardiac arrest response: higher versus lower performing hospitals.**
Guetterman TC(1)(2), Kellenberg JE(3), Krein SL(3)(4), Harrod M(5), Lehrich JL(6), Iwashyna TJ(3)(5), Kronick SL(7), Girotra S(8), Chan PS(9), Nallamothu BK(3).
**Abstract**
BACKGROUND: Good outcomes for in-hospital cardiac arrest (IHCA) depend on a skilled resuscitation team, prompt initiation of high-quality cardiopulmonary resuscitation and defibrillation, and organisational structures to support IHCA response. We examined the role of nurses in resuscitation, contrasting higher versus lower performing hospitals in IHCA survival. METHODS: We conducted a descriptive qualitative study

at nine hospitals in the American Heart Association's Get With The Guidelines-Resuscitation registry, purposefully sampling hospitals that varied in geography, academic status, and risk-standardised IHCA survival. We conducted 158 semistructured interviews with nurses, physicians, respiratory therapists, pharmacists, quality improvement staff, and administrators. Qualitative thematic text analysis followed by type-building text analysis identified distinct nursing roles in IHCA care and support for roles. RESULTS: Nurses played three major roles in IHCA response: bedside first responder, resuscitation team member, and clinical or administrative leader. We found distinctions between higher and lower performing hospitals in support for nurses. Higher performing hospitals emphasised training and competency of nurses at all levels; provided organisational flexibility and responsiveness with nursing roles; and empowered nurses to operate at a higher scope of clinical practice (eg, bedside defibrillation). Higher performing hospitals promoted nurses as leaders-administrators supporting nurses in resuscitation care at the institution, resuscitation team leaders during resuscitation and clinical champions for resuscitation care. Lower performing hospitals had more restrictive nurse roles with less emphasis on systematically identifying improvement needs. CONCLUSION: Hospitals that excelled in IHCA survival emphasised mentoring and empowering front-line nurses and ensured clinical competency and adequate nursing training for IHCA care. Though not proof of causation, nurses appear to be critical to effective IHCA response, and how to support their role to optimise outcomes warrants further investigation.

**Nurse Vigilance: A Three-Part Simulation Course to Decrease Cardiopulmonary Arrests Outside Intensive Care Units.**
Zinkan JL(1), Rutledge C, Norwood C, Wise KM, Gaither S, Cameron B, Tofil NM, Raju SKS.
**Abstract**
Early recognition of and prompt intervention for the deteriorating pediatric patient remains paramount in preventing cardiac arrests from occurring outside intensive care units. To decrease these events, we developed a three-part simulation-based blended learning course consisting of a computer-based training module, a simulation scenario, and follow-up in situ scenarios for inpatient nurses. After initiation of the course, our facility has seen a decrease in the number of codes outside critical care areas.

## LESIONS PER RCP

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## CAUSES DE L'ACR

**A laboratory-derived early warning score for the prediction of in-hospital mortality, ICU admission, Medical Emergency Team activation and Cardiac Arrest in general medical wards.**
Ratnayake H(1), Johnson D(2), Martensson J(3), Lam Q(4), Bellomo R(5)(6).
**Abstract**
AIM: To assess whether a laboratory based admission score can predict in hospital mortality, ICU admission, Medical Emergency Team (MET) activation or cardiac arrest in a cohort of Australian general medical patients admitted via the emergency department. METHODS: We performed a retrospective observational study of all general medical admissions to hospital via the emergency department in 2015. Admission pathology was used to calculate a risk score. In-patient outcomes of death, ICU transfer, MET Call activation or cardiac arrest were collected from hospital records. RESULTS: We studied 2942 admissions derived from 2521 patients, with a median age of 81 years. There were 143 in-patient deaths, 82 ICU admissions, 277 MET Calls and 14 cardiac arrest calls. The laboratory-based admission score had an area under the receiver operating characteristic curve (AUC-ROC) of 0.76 (95%CI: 0.72-0.80) for inpatient death, an AUC-ROC of 0.79 (95%CI: 0.66-0.93) for inpatient cardiac arrest, an AUC-ROC of 0.64 (95%CI:0.58-0.70) for ICU transfer and an AUC-ROC of 0.59 (95%CI:0.55-0.62) for MET Call activation. When patients aged over 75 were analysed separately, the AUC-ROC for prediction of in-patient death was 0.74 (95%CI: 0.70-0.78) and increased to 0.86 (95%CI: 0.73-0.98) for the prediction of in-patient cardiac arrest. CONCLUSION: A simple laboratory derived score obtained at patient admission is a fair to good predictor of subsequent in-patient death or cardiac arrest in

general medical patients and in the older patient cohort. Prospective interventional studies are required to ascertain the clinical utility of this admission score.

## END-TIDAL CO$_2$

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## DONACIÓ D'ÒRGANS

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## FEEDBACK

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## FÀRMACS

**1.** Scand J Trauma Resusc Emerg Med. 2019 Aug 16;27(1):74. doi:10.1186/s13049-019-0657-8.
**Epinephrine during resuscitation of traumatic cardiac arrest and increased mortality: a post hoc analysis of prospective observational study.**
Yamamoto R(1), Suzuki M(2), Hayashida K(3), Yoshizawa J(3), Sakurai A(4), Kitamura N(5), Tagami T(6), Nakada TA(7), Takeda M(8), Sasaki J(3); SOS-KANTO 2012 Study Group.
**Abstract**
BACKGROUND: The beneficial effect of epinephrine during resuscitation from out-of-hospital cardiac arrest (OHCA) has been inconclusive, and potential harm has been suggested, particularly in trauma victims. Although no significant improvement in neurological outcomes has been found among resuscitated patients using epinephrine, including trauma patients, the use of epinephrine is recommended in the Advanced Trauma Life Support protocol. Given that the use of vasopressors was reported to be associated with increased mortality in patients with massive bleeding, the undesirable effects of epinephrine during the resuscitation of traumatic OHCA should be elucidated. We hypothesized that resuscitation with epinephrine would increase mortality in patients with OHCA following trauma. METHODS: This study is a post-hoc analysis of a prospective, multicenter, observational study on patients with OHCA between January 2012 and March 2013. We included adult patients with traumatic OHCA who were aged ≥15 years and excluded those with missing survival data. Patient data were divided into epinephrine or no-epinephrine groups based on the use of epinephrine during resuscitation at the hospital. Propensity scores were developed to estimate the probability of being assigned to the epinephrine group using multivariate logistic regression analyses adjusted for known survival predictors. The primary outcome was survival 7 days after injury, which was compared among the two groups after propensity score matching. RESULTS: Of the 1125 adults with traumatic OHCA during the study period, 1030 patients were included in this study. Among them, 822 (79.8%) were resuscitated using epinephrine, and 1.1% (9/822) in the epinephrine group and 5.3% (11/208) in the no-epinephrine group survived 7 days after injury. The use of epinephrine was significantly associated with decreased 7-day survival (odds ratio = 0.20; 95% CI = 0.08-0.48; P < 0.01), and this result was confirmed by propensity score-matching analysis, in which 178 matched pairs were examined (adjusted odds ratio = 0.11; 95% CI = 0.01-0.85; P = 0.02). CONCLUSIONS: The relationship between the use of epinephrine during resuscitation and decreased 7-day survival was found in patients with OHCA following trauma, and the propensity score-matched analyses validated the results. Resuscitation without epinephrine in traumatic OHCA should be further studied in a randomised controlled trial.

## TRAUMA

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## VENTILACIÓ

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**MONITORATGE CEREBRAL**

**1.** Am J Emerg Med. 2018 Dec;36(12):2236-2241. doi: 10.1016/j.ajem.2018.04.016. Epub 2018 Apr 9.
**Effect of regional cerebral oximetry to estimate neurologic prognostic outcomes in patients administered targeted temperature management.**

Sarıtaş A(1), Çinleti BA(2), Zincircioğlu Ç(3), Uzun U(3), Köse I(3), Şenoğlu N(3).

**Abstract**

PURPOSE: The aim of our study is to research the role and efficacy of cerebral oximetry in predicting neurologic prognosis when applied during TTM to patients experiencing coma after CA. METHODS: This study was performed on surviving adult comatose patients after CA treated with TTM. The average scores of $rSO_2$ was measured at 6h intervals for the first 2days and once a day for the following 3days with a NIRS device during TTM. The CPC scale was used to define the neurologic outcomes of patients. We compared the correlations of $rSO_2$ values between good (CPC 1-2) and poor (CPC 3-5) neurologic outcomes in CA patients. RESULTS: There was no statistically significant difference identified between the prognosis groups in terms of $rSO_2$, CPR durations, hemoglobin values and admission body temperature (p>0.05). When the variation in $rSO_2$ values over time is investigated, though there was no significant difference between the good and poor prognosis groups, it appeared to fall in the first 6h in both prognosis groups. The median NT-proBNP and lactate values were observed to be higher in the poor prognosis group. CONCLUSION: There is no significant correlation between $rSO_2$ values and neurologic outcomes. Multimodal monitoring methods may be useful and further studies with a larger patient population are necessary in this area.

**2.** Medicine (Baltimore). 2019 Aug;98(34):e16930. doi: 10.1097/MD.0000000000016930.
**Predictive performance of plasma neutrophil gelatinase-associated lipocalin for neurologic outcomes in out-of-hospital cardiac arrest patients treated with targeted temperature management: A prospective observational study.**

Lee JH(1)(2), Park I(1), You JS(1), Kim MJ(1), Lee HS(3), Park YS(1), Park HC(4), Chung SP(1).

**Abstract**

Few studies have demonstrated the prognostic potential of neutrophil gelatinase-associated lipocalin (NGAL) in post-cardiac arrest patients. This study evaluated the usefulness of plasma NGAL in predicting neurologic outcome and mortality in out-of-hospital cardiac arrest (OHCA) patients treated with targeted temperature management (TTM). A prospective observational study was conducted between October 2013 and April 2016 at a single tertiary hospital. We enrolled 75 patients treated with TTM and collected their demographic data, cardiopulmonary resuscitation-related information, data on plasma NGAL concentration, and prognostic test results. Plasma NGAL was measured at 4 hours after return of spontaneous circulation (ROSC). The primary endpoint was the neurologic outcome at discharge and the secondary outcome was 28-day mortality. Neurologic outcomes were analyzed using a stepwise multivariate logistic regression while 28-day mortality was analyzed using a stepwise Cox regression. The predictive performance of plasma NGAL for neurologic outcome was measured by the area under the receiver operating characteristic curve and the predictability of 28-day mortality was measured using Harrell C-index. We also compared the predictive performance of plasma NGAL to that of other traditional prognostic modalities for outcome variables. Thirty patients (40%) had good neurologic outcomes and 53 (70.7%) survived for more than 28 days. Plasma NGAL in patients with good neurologic outcomes was 122.7±146.7 ng/ml, which was significantly lower than that in the poor neurologic outcome group (307.5±269.6 ng/ml; P<.001). The probability of a poor neurologic outcome was more than 3.3-fold in the NGAL >124.3 ng/ml group (odds ratio, 3.321; 95% confidence interval [CI], 1.265-8.721]). Plasma NGAL in the survived group was significantly lower than that in the non-survived group (172.7±191.6 vs 379.9±297.8 ng/ml; P=.005). Plasma NGAL was significantly correlated with 28-day mortality (hazard ratio 1.003, 95% CI 1.001-1.004; P<.001). The predictive performance of plasma NGAL was not inferior to that of other prognostic modalities except electroencephalography. Plasma NGAL is valuable for predicting the neurologic outcome and 28-day mortality of patients with OHCA at an early stage after ROSC.This study was registered at ClinicalTrials.gov on November 19, 2013 (Identifier: NCT01987466).

**3.** Resuscitation. 2019 Aug 15;143:42-49. doi: 10.1016/j.resuscitation.2019.08.014. [Epub ahead of print]
**Modulating effects of immediate neuroprognosis on early coronary angiography and targeted temperature management following out-of-hospital cardiac arrest: A retrospective cohort study.**

Wang CH(1), Tsai MS(2), Chang WT(2), Yu PH(3), Wu YW(4), Huang CH(2), Chen WJ(5).

**Abstract**
AIM: The simplified cardiac arrest hospital prognosis (sCAHP) score is a validated tool for predicting neurological outcomes after out-of-hospital cardiac arrest (OHCA). We used the sCAHP score to evaluate whether the effects of early coronary angiography (CAG) and targeted temperature management (TTM) for OHCA were modulated by immediate neuroprognosis. METHODS: This was a single-centre retrospective observational study. Consecutive OHCA patients were screened between 2011 and 2017. Multivariate logistic regression analysis and generalised additive models (GAMs) were used to examine the associations between independent variables and outcomes. Early CAG was defined as CAG performed within 24 h after return of spontaneous circulation (ROSC). RESULTS: A total of 412 patients were included in the study, and 94 (22.8%) patients had neurologically intact survival. The GAM plot identified a sCAHP score of 185 as the cut-off point to differentiate high-risk (sCAHP score ≧185) from low-risk (sCAHP score <185) patients. Regression models indicated that early CAG was significantly associated with favourable neurological [odds ratio (OR) 4.43, 95% confidence interval (CI) 2.28-8.60, p < 0.001] and survival outcomes (OR 3.47, 95% CI 1.93-6.25, p < 0.001), independent of the sCAHP score. Although TTM was associated with favourable neurological outcome only in low-risk patients (OR 2.13, 95% CI 1.10-4.13, p = 0.02), TTM was associated with improved survival for all patients (OR 2.66, 95% CI 1.54-4.59, p < 0.001), independent of the sCAHP score. CONCLUSIONS: Early CAG and TTM should be considered for all OHCA patients as suggested by guidelines, irrespective of the immediately predicted neuroprognosis after ROSC.

**ORGANITZACIÓ I ENTRENAMENT**

**Simulating blood pressure and end tidal CO2 in a CPR training manikin.**
Widmann N(1), Sutton R(2), Buchanan N(3), Niles DE(4), Nazareth G(3), Nadkarni V(5), Maltese MR(6).

**Abstract**
BACKGROUND AND OBJECTIVE: The American Heart Association supports titrating the mechanics of cardiopulmonary resuscitation (CPR) to blood pressure and end tidal carbon dioxide (ETCO2) thresholds during in-hospital cardiac arrest. However, current CPR manikin training systems do not prepare clinicians to use these metrics to gauge their performance, and currently provide only feedback on hand placement, depth, rate, release, and interruptions of chest compressions. We addressed this training hardware deficiency through development of a novel CPR training manikin that displays simulated blood pressure and ETCO2 waveforms in real time on a simulated clinical monitor visible to the learner, reflecting the mechanics of chest compressions provided to the manikin. Such a manikin could improve clinicians' CPR technique while also training them to titrate CPR quality to physiologic blood pressure and ETCO2 targets as performance indicators. METHODS: We used data and key findings from 4 human and 6 animal studies (including 132 human subjects, 61 pigs, and 16 dogs in total) to develop an algorithm that simulates blood pressure and ETCO2 waveforms based on compression mechanics for a pediatric patient. We modified an off-the-shelf infant manikin to incorporate a microcontroller sufficient to process the aforementioned algorithm, and a tablet computer to wirelessly display the simulated waveform. We recruited clinicians with in-hospital CPR experience to perform compressions with the manikin and complete a post-test survey on their satisfaction with designated elements of the manikin and display. RESULTS: 34 clinicians performed CPR on the prototype manikin system that simulates real-time bedside monitoring of blood pressure and ETCO2. 100% of clinicians surveyed reported "satisfaction" with the blood pressure waveform. 97% said they thought depth was accurately reflected in blood pressure (0% inaccurate, 3% not sure). 88% reported an accurate chest compression rate modification effect on blood pressure and ETCO2 (3% inaccurate, 9% not sure) and 59% an accurate effect of leaning (6% inaccurate, 35% not sure). Most importantly, all 34 respondents responded "yes" when asked if they thought this system would be helpful for CPR training. CONCLUSION: A CPR manikin that simulates blood pressure and ETCO2 was successfully developed with acceptable relevance, performance and feasibility as a CPR quality training tool.

**Phenomenological study exploring ethics in prehospital research from the paramedic's perspective: experiences from the Paramedic-2 trial in a UK ambulance service.**
Charlton K(1), Franklin J(2), McNaughton R(2).
**Abstract**

OBJECTIVES: We set out to investigate paramedics' views of ethics and research, drawing on experiences from Paramedic-2, a randomised controlled trial comparing epinephrine and placebo in out-of-hospital cardiac arrest (OHCA). METHODS: An interpretative phenomenological approach was adopted. A purposive sample of paramedics (n=6) from North East Ambulance Service NHS Foundation Trust were invited to a semi-structured, in-depth interview. RESULTS: Three superordinate themes emerged: (1) morality, (2) emotion and (3) equipoise. Some viewed Paramedic-2 as an opportunity to improve OHCA outcomes for the many, viewing participation as a moral obligation; others viewed the study as unethical, equating participation with immoral behaviour. Morality was a motivator to drive individual action. Positive and negative emotions were exhibited by the paramedics involved reflecting the wider view each paramedic held about trial participation. Those morally driven to participate in Paramedic-2 discussed their pride in being associated with the trial, while those who found participation unethical, discussed feelings of guilt and regret. Individual experience and perceptions of epinephrine guided each paramedic's willingness to accept or reject equipoise. Some questioned the role of epinephrine in OHCA; others believed withholding epinephrine was synonymous to denying patient care. CONCLUSION: A paucity of evidence exists to support any beneficial role of epinephrine in OHCA. Despite this, some paramedics were reluctant to participate in Paramedic-2 and relied on their personal perceptions and experiences of epinephrine to guide their decision regarding participation. Failure to acknowledge the importance of individual perspectives may jeopardise the success of future out-of-hospital trials.

**Impact of the caller's emotional state and cooperation on out-of-hospital cardiac arrest recognition and dispatcher-assisted cardiopulmonary resuscitation.**

Chien CY(#)(1)(2), Chien WC(#)(1)(3), Tsai LH(1), Tsai SL(1), Chen CB(1), Seak CJ(1), Chou YS(1)(4), Ma M(5), Weng YM(1)(6), Ng CJ(1), Lin CY(2), Tzeng IS(7)(8), Lin CC(1)(2), Huang CH(1)(6).

**Abstract**

OBJECTIVE: This study determined the impact of the caller's emotional state and cooperation on out-of-hospital cardiac arrest (OHCA) recognition and dispatcher-assisted cardiopulmonary resuscitation (DA-CPR) performance metrics. METHODS: This was a retrospective study using data from November 2015 to October 2016 from the emergency medical service dispatching centre in northern Taiwan. Audio recordings of callers contacting the centre regarding adult patients with non-traumatic OHCA were reviewed. The reviewers assigned an emotional content and cooperation score (ECCS) to the callers. ECCS 1-3 callers were graded as cooperative and ECCS 4-5 callers as uncooperative and highly emotional. The relation between ECCS and OHCA recognition, time to key events and DA-CPR delivery were investigated. RESULTS: Of the 367 cases, 336 (91.6%) callers were assigned ECCS 1-3 with a good inter-rater reliability ($k$=0.63). Dispatchers recognised OHCA in 251 (68.4%) cases. Compared with callers with ECCS 1, callers with ECCS 2 and 3 were more likely to give unambiguous responses about the patient's breathing status (adjusted OR (AOR)=2.6, 95% CI 1.1 to 6.4), leading to a significantly higher rate of OHCA recognition (AOR=2.3, 95% CI 1.1 to 5.0). Thirty-one callers were rated uncooperative (ECCS 4-5) but had shorter median times to OHCA recognition and chest compression (29 and 122 s, respectively) compared with the cooperative caller group (38 and 170 s, respectively). Nevertheless, those with ECCS 4-5 had a significantly lower DA-CPR delivery rate (54.2% vs 85.9%) due to 'caller refused' or 'overly distraught' factors. CONCLUSIONS: The caller's high emotional state is not a barrier to OHCA recognition by dispatchers but may prevent delivery of DA-CPR instruction. However, DA-CPR instruction followed by first chest compression is possible despite the caller's emotional state if dispatchers are able to skilfully reassure the emotional callers.

**Trends in survival from out-of-hospital cardiac arrests defibrillated by paramedics, first responders and bystanders.**

Nehme Z(1), Andrew E(2), Bernard S(3), Haskins B(4), Smith K(5).

**Abstract**

BACKGROUND: Although survival from out-of-hospital cardiac arrest (OHCA) is increasing, little is known about the long-term trends in survival for patients defibrillated by first responders and bystanders. METHODS: Between 2000 and 2017, we included adult non-traumatic OHCA with an initial shockable rhythm from the Victorian Ambulance Cardiac Arrest Registry. Adjusted logistic regression analyses were used to

assess trends in survival to hospital discharge according to whether the patient was initially shocked by paramedics, first responders or bystanders. RESULTS: Of the 10,451 initial shockable arrests, 796 (7.6%) and 526 (5.0%) were initially shocked by first responders and bystanders, respectively. Between 2000-02 and 2015-17, the proportion of cases initially shocked by first responders and bystanders increased from 3.8% to 8.2% and from 2.0% to 11.2%, respectively. Over the same period, survival to hospital discharge increased from 11.6% to 28.8% for cases initially shocked by paramedics, from 10.5% to 37.8% for cases initially shocked by first responders, and from 6.7% to 55.5% for cases initially shocked by bystanders (p trend <0.001 for all). In the adjusted analyses, patients initially shocked by first responders (AOR 1.40, 95% CI: 1.18, 1.67; p < 0.001) and bystanders (AOR 2.11, 95% CI: 1.72, 2.59; p < 0.001) were more likely to survive to hospital discharge than those initially shocked by paramedics. The odds of survival increased year-on-year by 8.1% for patients shocked by paramedics (p < 0.001), 6.1% for patients shocked by first responders (p = 0.004), and 11.8% for patients shocked by bystanders (p < 0.001). CONCLUSION: OHCA patients initially defibrillated by bystanders yielded the largest improvements in survival over time.

CURES POST-RCE

**Determination of Cut-off Serum Values for Resistin and S100B Protein in Patients Who Survived a Cardiac Arrest.**
Tat RM(1), Golea A(2), Vesa ŞC(3), Ionescu D(1).
**Abstract**
INTRODUCTION: In an attempt to identify patients who have successfully survived a resuscitated cardiac arrest (CA), attention is drawn to resistin and S100B protein, two biomarkers that have been studied in relation to CA. AIM: The study aimed to identify the potential cut-off serum values for resistin and S100B in patients who had CA, compared to healthy volunteers, given that, currently, none of the markers have normal and pathological reference range limits for human assay levels related to this pathology. MATERIALS AND METHODS: Forty patients, resuscitated after out-of-hospital CA and forty healthy controls, were included in the study. All patients were followed up for seventy-two hours after CA or until death. Blood samples for biomarkers were collected on admission to the ED (0-time interval) and at 6, 12, 24, 48 and 72 hours following resuscitation. Only one blood sample was collected from the controls. The serum concentrations of biomarkers were measured. RESULTS: For each time interval, median serum levels of resistin and S100 B were  significantly higher in patients with CA compared to healthy controls. The cut-of value for resistin in patients with CA, at the 12-hours versus controls, was > 8.2 ng/ml. The cut-of value for S100B in patients with CA versus controls recorded at 6 hours, was > 11.6 pg/ml. CONCLUSION: Serum levels of resistin and S100B are higher among resuscitated CA patients compared to controls.

**TARGETED TEMPERATURE MANAGEMENT**

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**ELECTROFISIOLOGIA I DESFIBRIL·LACIÓ**

**Shorter defibrillation interval promotes successful defibrillation and resuscitation outcomes.**
Roh YI(1), Jung WJ(1), Hwang SO(1), Kim SY(1), Kim HS(2), Kim JH(1), Kim TY(1), Kang HS(1), Lee JS(1), Cha KC(3).
**Abstract**
AIM: Current cardiopulmonary resuscitation guidelines recommend performing defibrillation every 2 minutes during resuscitation. This study aimed to compare the rate of successful defibrillation using 1- and 2-minute defibrillation intervals. METHODS: Twenty-six pigs were randomly assigned to 1- or 2-minute interval groups. After inducing ventricular fibrillation (VF), we observed pigs for 2 minutes. Thereafter, basic life support was initiated with a 30:2 compression-to-ventilation ratio for 8 minutes. Defibrillation was performed with an energy of 2 J/kg at 10 minutes after VF and was repeated every 1 or 2 minutes according to randomization. Advanced cardiac life support, including continuous chest compression with ventilation

every 6 seconds and intravenous injection of 1 mg epinephrine every 3 minutes, was performed until the return of spontaneous circulation (ROSC) or until 20 minutes after VF induction. Haemodynamic parameters and baseline arterial blood gas profiles were compared between groups. ROSC, 24 -h survival, and the neurologic deficit score (NDS) were evaluated at 24 hours. RESULTS: Haemodynamic parameters during resuscitation and baseline arterial blood gas profiles did not differ between groups. ROSC was more frequently observed in the 1-minute interval group (p = 0.047). Time to ROSC was not different between groups (p = 0.054). The 24 -h survival was higher (p = 0.047) and NDS at 24 hours was lower (92 ± 175) in the 1-minute interval group than in the 2-minute interval group (272 ± 190) (p = 0.028). CONCLUSIONS: Defibrillation success and resuscitation outcomes were superior when using a 1-minute defibrillation interval in animal models of cardiac arrest.


## ECMO

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## PEDIATRIA

**A novel homozygous mutation in the TRDN gene causes a severe form of pediatric malignant ventricular arrhythmia.**
Rossi D(1), Gigli L(2), Gamberucci A(1), Bordoni R(3), Pietrelli A(3), Lorenzini S(1), Pierantozzi E(1), Peretto G(2), De Bellis G(3), Della Bella P(2), Ferrari M(4), Sorrentino V(1), Benedetti S(5), Sala S(2), Di Resta C(6).
**Abstract**
BACKGROUND: Triadin is a protein expressed in cardiac and skeletal muscle with an essential role in the structure and functional regulation of calcium release units and excitation-contraction coupling. Mutations in the triadin gene (TRDN) have been described in different forms of human arrhythmia syndromes with early onset and severe arrhythmogenic phenotype, among which the triadin knockout syndrome. OBJECTIVE: To characterize the pathogenetic mechanism underlying a case of severe pediatric malignant arrhythmia associated with defect in the TRDN gene. METHODS: We exploited trio whole exome sequencing approach to identify the genetic defect in a 2-years old boy with a resuscitated sudden cardiac arrest, frequent ventricular fibrillations and positive family history for sudden death. Then we performed in vitro functional analysis to investigate possible pathogenic mechanisms underlying this severe phenotype. RESULTS: We identified a novel homozygous missense variant (p.L56P) in the TRDN gene in the proband, inherited by the heterozygous unaffected parents. Expression of a GFP-tagged mutant human cardiac triadin isoform (TRISK32-L56P-GFP) in heterologous systems revealed that the mutation alters protein dynamics. Furthermore, when co-expressed with the type 2 ryanodine receptor, the caffeine-induced calcium release from TRISK32-L56P-GFP was relatively lower compared to that observed with wild type construct. CONCLUSIONS: These evidences allowed to hypothesize a pathogenic mechanism underlying this rare arrhythmogenic recessive form, suggesting that the mutant protein can potentially trigger arrhythmias by altering calcium homeostasis.

**Pauses in Compressions during Pediatric CPR: Opportunities for Improving CPR Quality.**
O'Connell KJ(1), Keane RR(2), Cochrane NH(3), Sandler AB(4), Donoghue AJ(5), Kerrey BT(6), Myers SR(7), Vazifedan T(8), Mullan PC(9).
**Abstract**
OBJECTIVE: Minimizing pauses in chest compressions during cardiopulmonary resuscitation (CPR) is recommended by the American Heart Association (AHA) and is associated with improved patient outcomes. We studied the quality of pediatric CPR performed in a tertiary pediatric emergency department (ED) with a focus on pauses in chest compressions. METHODS: We conducted an observational study of CPR quality in two pediatric EDs using video review during pediatric cardiac arrest. Events were reviewed for AHA guideline adherence. Parameters of CPR performance were described according to individual compressor segment. Pauses in compressions were analyzed for duration and pause activities. RESULTS: From a 30-month period, 81 cardiac arrests were analyzed, including 1003 individual compressor segments and 900 pauses. Median chest compression fraction was 91%, with a median pause duration of 4 seconds (IQR 2, 10); 22% of pauses

were prolonged (>10 seconds). Pulse checks occurred in 23% of pauses; 62% were prolonged. Checking a single pulse site (p < 0.001) and having fingers ready pre-pause (p = 0.001) were associated with significantly shorter pause duration. Pause duration was correlated with the number of pause tasks (r = 0.559, p < 0.001). "Coordinated pauses" (pulse check, rhythm check and compressor change) were rare (6%) and long in duration (19 seconds; IQR 11, 30). CONCLUSIONS: Prolonged pauses in chest compressions occurred frequently during CPR and were associated with pulse checks and multiple simultaneous tasks. Checking a single pulse site with fingers ready on the pulse site pre-pause could decrease pause duration and improve CPR quality.

## RECERCA EXPERIMENTAL

**Mild hypothermia improves neurological outcome in mice after cardiopulmonary resuscitation through Silent Information Regulator 1-actviated autophagy.**
Wei H(#)(1)(2), Yin M(#)(1)(2), Lu Y(2)(3), Yang Y(1)(2), Li B(2)(3), Liao XX(2)(3), Dai G(3), Jing X(1)(2), Xiong Y(1), Hu C(1)(2).
**Abstract**
Mild hypothermia treatment (MHT) improves the neurological function of cardiac arrest (CA) patients, but the exact mechanisms of recovery remain unclear. Herein, we generated a CA and cardiopulmonary resuscitation (CPR) mouse model to elucidate such function. Naïve mice were randomly divided into two groups, a normothemia (NT) group, in which animals had normal body temperature, and a MHT group, in which animals had a body temperature of 33 °C (range: 32-34 °C), after the return of spontaneous circulation (ROSC), followed by CA/CPR. MHT significantly improved the survival rate of CA/CPR mice compared with NT. Mechanistically, MHT increased the expression of Silent Information Regulator 1 (Sirt1) and decreased P53 phosphorylation (p-P53) in the cortex of CA/CPR mice, which coincided with the elevated autophagic flux. However, Sirt1 deletion compromised the neuroprotection offered by MHT, indicating that Sirt1 plays an important role. Consistent with the observations obtained from in vivo work, our in vitro study utilizing cultured neurons subjected to oxygen/glucose deprivation and reperfusion (OGD/R) also indicated that Sirt1 knockdown increased OGD/R-induced neuron necrosis and apoptosis, which was accompanied by decreased autophagic flux and increased p-P53. However, the depletion of P53 did not suppress neuron death, suggesting that P53 was not critically involved in MHT-induced neuroprotection. In contrast, the application of autophagic inhibitor 3-methyladenine attenuated MHT-improved neuron survival after OGD/R, further demonstrating that increased autophagic flux significantly contributes to MHT-linked neuroprotection of CA/CRP mice. Our findings indicate that MHT improves neurological outcome of mice after CA/CPR through Sirt1-mediated activation of autophagic flux.

**Mechanisms Associated with the Adverse Vascular Consequences of Rapid Posthypothermic Rewarming and Their Therapeutic Modulation in Rats.**
Ueda Y(1), Oda Y(2), Povlishock JT(3), Wei EP(3).
**Abstract**
We previously demonstrated that rapid posthypothermic rewarming in noninjured animals was capable of damaging cerebral arterioles both at endothelial and smooth muscle levels. Such adverse consequences could be prevented with antioxidants, suggesting the involvement of free radicals. In this study, we further investigate the mechanisms associated with free radicals production by using two radical scavengers, superoxide dismutase (SOD) and catalase. Employing rats, the cerebral vascular response was evaluated at 2, 3, and 4 hours after onset of hypothermia. Before rapid rewarming, SOD treatment, but not catalase, preserved the NO-mediated dilation induced by acetylcholine (ACh). On the contrary, catalase preserved the hypercapnia-induced relaxation of the smooth muscle cells, whereas SOD offered only partial protection. Adding SOD to catalase treatment offered no additional benefit. These results suggest that rapid posthypothermic rewarming impairs ACh- and hypercapnia-induced vasodilation through different subcellular mechanisms. In the case of diminished vascular response to ACh, it appears to act on the endothelial front primarily by superoxide anions, as evidenced by its full preservation after SOD treatment. In terms of impaired dilation to hypercapnia, hydrogen peroxide and/or its derivatives are the likely candidates in targeting the smooth muscle cells. The partial protection of SOD to hypercapnia-induced dilation is believed to be the reduced amount of superoxide that would otherwise spontaneously dismutate

to produce hydrogen peroxide. Although SOD exerts some indirect influence on the hydrogen peroxide production downstream, catalase apparently has no influence on upstream superoxide production.

## CASE REPORTS

**Intravenous potassium solution boluses save a life from hypokalemic cardiac arrest.**
Liu JK(1), Sim SS(2), Hsieh FC(3), Wu YH(4).
**NO ABSTRACT AVAILABLE**

**Severe Calcific Chronic Constrictive Pericarditis as an Unexpected Cause of Death: An Autopsy Case.**
Boussaid M(1)(2)(3), Mesrati MA(1)(2)(3), Mahjoub Y(1)(2)(3), Limem H(1)(2)(3), Ben Abdeljalil N(2)(3), Zakhama A(2)(3), Aissaoui A(1)(2)(3).
**Abstract**
Chronic calcific constrictive pericarditis is a rare condition. It can cause
severe morbidity and even mortality. The diagnosis may be difficult to establish
due to its variable clinical signs. We report an autopsy case of a 54-year-old
male with a past medical history of well treated hypertension, diabetes and
dyspnea present of 2 weeks, who was discovered dead in his bed. The postmortem
examination showed a large band of calcification of the pericardium with
obliteration of the pericardial space. Both pericardium and epicardium were
thickened with bread-and-butter appearance. Microscopic examination showed
thickened pericadium which is formed by a fibrous paucicellular tissue containing
extensive basophilic calcifications.

**Cardiogenic Shock in a Hemodialyzed Patient on Flecainide: Treatment with Intravenous Fat Emulsion, Extracorporeal Cardiac Life Support, and CytoSorb® Hemoadsorption.**
De Schryver N(1), Hantson P(2)(3), Haufroid V(3)(4), Dechamps M
**Abstract**
A 67-year-old woman with a history of end-stage renal disease on hemodialysis received a therapeutic dose (150 mg daily) of flecainide for three weeks. She was admitted to the Emergency Department for malaise and dizziness, and the electrocardiogram revealed ventricular tachycardia treated by amiodarone. Hemodynamic condition remained stable, and the toxicity of flecainide was initially not suspected until she developed within 8 hours a cardiogenic shock requiring vasopressors. The patient then received sodium bicarbonate (300 mmol) and dobutamine but experienced cardiac arrest two hours later. The administration of intravenous fat emulsion (IFE) was associated with return of spontaneous circulation, but there was a relapse of cardiovascular shock at the end of IFE infusion. The patient was placed on extracorporeal cardiac life support (ECLS), continuous hemofiltration, and hemoadsorption using the CytoSorb® cartridge. Serial determinations of serum flecainide concentration were obtained during the course of hemoadsorption, with a terminal half-life of 3.7 h during the first four hours and a global plasma clearance of 40.3 ml/min over the first 22 hours. The weaning of ECLS was possible on day 7. Intravenous fat emulsion infusion was followed by a significant increase in serum flecainide concentration. In addition, while conventional techniques of extrarenal epuration usually appear as poorly effective for flecainide removal, a mean plasma clearance of 40.3 ml/min was observed using the hemoadsorption technique based on CytoSorb® cartridge. However, the impact on the clinical course was probably extremely modest in comparison with ECLS.

**Successful Resuscitation with Extracorporeal Membrane Oxygenation in a Case with Prolonged Cardiac Arrest.**
Wang XN(1), Pham SM(2).
**Abstract**
This case study describes a 25-year-old patient who had a witnessed cardiac arrest in the medical intensive care unit. The patient received 107 minutes of cardiopulmonary resuscitation before the veno-arterial extracorporeal membrane oxygenation was initiated. During extracorporeal life support, the patient's cardiac function improved. The patient was weaned from extracorporeal membrane oxygenation on day 6 and was discharged without physical and neurological complications on day 28. The successful resuscitation in this case attributed to high-quality CCPR and timely ECMO support.

**An unusual complication during alcohol septal ablation: severe left anterior descending artery vasospasm causing cardiac arrest: a case report and review of the literature.**
Keskin ÖF(1), Iyisoy A(1).
**Abstract**
BACKGROUND: Septal reduction therapy can be considered along the lines of hypertrophic obstructive cardiomyopathy patients who have drug-refractory symptoms. This can be applied either surgical myectomy or either alcohol septal ablation (ASA). Alcohol septal ablation has been performed successfully since the first announcement of ASA in 1995. CASE SUMMARY: We present a case report of coronary artery vasospasm that occurred in the left anterior descending artery (LAD) during ASA. We performed ASA via first septal artery. Two cubic centimetre of 99% ethanol was slowly injected and 10 min later balloon was withdrawn. Then the patient felt severe chest pain; his systolic blood pressure went down quickly and fibrillated. We started the cardiopulmonary resuscitation (CPR). After CPR, the rhythm was achieved total 4 min later cardiac arrest but blood pressure was low. Emergent coronary angiography showed that coronary spasm caused severe occlusion in the LAD segment just after the first septal artery and impaired coronary flow nearly totally in the LAD just after septal artery. At that time, we decided to implant a stent due to the patient's serious condition and a 3.5 × 18 mm drug-eluting stent was implanted. We performed control angiography to patient 3 days later of the procedure and LAD flow was TIMI 3. DISCUSSION: The causes of LAD occlusion are alcohol leakage, dissection, and vasospasm. It is important to detect the correct reason for appropriate treatment. Alcohol leakage impairs and causes coronary flow disruption; this can cause ventricular wall motion abnormalities. In our case, there was severe spasm in the LAD coronary artery and LAD flow was severely impaired. On echocardiogram, there was no myocardial wall motion abnormality. So alcohol leakage was ruled out. Left anterior descending artery image was not typical dissection. As a result of these findings, we concluded that the cause of LAD occlusion was coronary artery vasospasm.

**Automated external defibrillator use in a previously healthy 31-day-old infant with out-of-hospital cardiac arrest due to ventricular fibrillation.**
Hoyt WJ Jr(1), Fish FA(1), Kannankeril PJ(1).
**Abstract**
INTRODUCTION: Current resuscitation guidelines state that the safety of automated external defibrillators (AEDs) in infants less than 1 year of age is unknown. METHODS AND RESULTS: We report successful AED use in a 31-day-old previously healthy infant with out-of-hospital cardiac arrest. Chest compressions began immediately, pediatric AED pads were applied in less than 5 minutes and the initial rhythm was ventricular fibrillation. After two 50 J shocks, return of spontaneous circulation was achieved. She was diagnosed with a rare but previously described syndrome of infant ventricular fibrillation and was discharged to home in good condition after epicardial defibrillator placement. CONCLUSIONS: This case represents, to our knowledge,

the youngest patient successfully defibrillated by an AED in a nonmedical setting. Although she received two shocks more than 11 J/kg each, she had no apparent myocardial damage at presentation.

**Primary axillary venous aneurysm in a young patient presenting with cardiac arrest.**
Pierre-Louis WS(1), Tikhtman R(2), Bonta A(1), Meier G(1).
**Abstract**
Primary venous aneurysms are rare and usually asymptomatic. Venous aneurysms are manifested more frequently in the lower extremities than in the upper extremities. Primary venous aneurysms of the upper extremities are more often reported as aesthetically displeasing bulges or incidental findings. Here, we report the rare case of an axillary primary venous aneurysm in a pediatric patient who presented with syncope and massive pulmonary embolism and highlight the management.

**Splenic Artery Aneurysm (SAA) Rupture in Pregnancy: A Case Report of a Rare but Life-Threatening Obstetrical Complication.**
Ballout RA(1), Ghanem R(2), Nassar A(2), Hallal AH(3), Ghulmiyyah LM(2).
**Abstract**
This is the case of a 38 year-old Lebanese woman G2P1, history of previous cesarean section, presenting at 30+5 weeks of gestation with acute left-sided flank pain and a two-day history of chills and dysuria. In light of the clinical presentation, the patient was initially diagnosed with pyelonephritis and managed accordingly; however, her clinical status deteriorated with worsening hypotension and lethargy despite resuscitative measures and a normal abdominal ultrasound. Failure to revive the patient eventually led to a cardiac arrest for which a peri-mortem cesarean section was performed at bedside. Upon abdominal entry, an actively-bleeding ruptured splenic artery aneurysm (SAA) was identified, for which massive transfusion protocol was activated, and the patient was transferred to the operating room. The patient had a complicated postoperative course, the fetus was stillborn, and she was discharged home after 6 months of hospital stay. In view of the high mortality and morbidity associated with ruptured SAA in pregnancy, early recognition and prompt intervention are crucial for maternal and fetal benefit.

**Peri-mortem caesarean section after traumatic arrest: Crisis resource management.**
Ng WM(1), Lee WF(2), Cheah SO(2), Chung YEL(2), Lee CY(2), Lim BL(2).
**Abstract**
Peri-mortem caesarean section (PMCS) is a very rare procedure performed to improve the chances of survival for both mother and fetus following cardiorespiratory arrest. Non-obstetricians including Emergency Physicians (EPs) are often called upon to perform this procedure under challenging and suboptimal circumstances. We reported a case of PMCS performed timely after traumatic cardiorespiratory arrest that resulted in fetal survival. A 25-year-old primigravida female and six-month pregnant presented to the Emergency Department (ED) of an adult tertiary hospital. She experienced traumatic cardiorespiratory arrest for nearly 27 min following a high-speed motor vehicle crash. Upon ED arrival, she was in pulseless electrical activity. She was immediately intubated with continuation of cardiopulmonary resuscitation. She received bilateral tube thoracostomies as well as intravenous (IV) transfusion of blood products, adrenaline and tranexamic acid. Her fundal height was two centimeters above the umbilicus on palpation. The EP performed a PMCS via a midline laparotomy 3-4 min upon ED arrival. The baby was bradycardic and cyanosed with no spontaneous respiration at birth and was resuscitated by a second EP. She was intubated and the EP gained IV access using a cannula introduced into the umbilical vein. Neonatal hypothermia was avoided using cling wrap. The baby was transported to a nearby neonatal intensive unit. She survived and is currently one year old. The mother, however, did not respond to our resuscitation and succumbed to her multiple injuries. We reviewed the limited literature regarding this potentially life-saving emergency procedure and highlighted the challenges facing our resuscitation team.