

## **BIBLIOGRAFIA RECOMANADA OCTUBRE 2013**

### **PRONÒSTIC**

*Crit Care Med.* 2013 Oct 8. [Epub ahead of print]

#### **Prediction of Survival to Discharge Following Cardiopulmonary Resuscitation Using Classification and Regression Trees.**

Ebell MH, Afonso AM, Geocadin RG; for the American Heart Association's Get With the Guidelines-Resuscitation (formerly National Registry of Cardiopulmonary Resuscitation) Investigators.

Source: 1Department of Epidemiology and Biostatistics and the Institute for Evidence-Based Health Professions Education, University of Georgia, Athens, GA. 2Duke University School of Medicine, Durham, NC. 3Departments of Neurology, Anesthesiology-Critical Care Medicine, and Neurosurgery, Johns Hopkins University School of Medicine, Baltimore, MD.

#### **Abstract**

**OBJECTIVES:**To predict the likelihood that an inpatient who experiences cardiopulmonary arrest and undergoes cardiopulmonary resuscitation survives to discharge with good neurologic function or with mild deficits (Cerebral Performance Category score = 1).

**DESIGN:**Classification and Regression Trees were used to develop branching algorithms that optimize the ability of a series of tests to correctly classify patients into two or more groups. Data from 2007 to 2008 (n = 38,092) were used to develop candidate Classification and Regression Trees models to predict the outcome of inpatient cardiopulmonary resuscitation episodes and data from 2009 (n = 14,435) to evaluate the accuracy of the models and judge the degree of over fitting. Both supervised and unsupervised approaches to model development were used.

**SETTING:** 366 hospitals participating in the Get With the Guidelines-Resuscitation registry.

**SUBJECTS:**Adult inpatients experiencing an index episode of cardiopulmonary arrest and undergoing cardiopulmonary resuscitation in the hospital.

**MEASUREMENTS AND MAIN RESULTS:** The five candidate models had between 8 and 21 nodes and an area under the receiver operating characteristic curve from 0.718 to 0.766 in the derivation group and from 0.683 to 0.746 in the validation group. One of the supervised models had 14 nodes and classified 27.9% of patients as very unlikely to survive neurologically intact or with mild deficits (< 3%); the best unsupervised model had 11 nodes and classified 21.7% as very unlikely to survive.

**CONCLUSIONS:** We have developed and validated Classification and Regression Tree models that predict survival to discharge with good neurologic function or with mild deficits following in-hospital cardiopulmonary arrest. Models like this can assist physicians and patients who are considering do-not-resuscitate orders.

*PLoS One.* 2013 Sep 30;8(9):e76720.

#### **Serial Plasma Choline Measurements after Cardiac Arrest in Patients Undergoing Mild Therapeutic Hypothermia: A Prospective Observational Pilot Trial.**

Storm C, Danne O, Ueland PM, Leithner C, Hasper D, Schroeder T.

Source: Department of Intensive Care Medicine and Nephrology, Charité Universitätsmedizin Berlin, Campus Virchow-Klinikum, Berlin, Germany.

## Abstract

**OBJECTIVE:** Choline is related to phospholipid metabolism and is a marker for global ischaemia with a small reference range in healthy volunteers. The aim of our study was to characterize the early kinetics of plasma free choline in patients after cardiac arrest. Additionally, we investigated the potential of plasma free choline to predict neurological outcome.

**METHODS:** Twenty patients admitted to our medical intensive care unit were included in this prospective, observational trial. All patients were enrolled between May 2010 and May 2011. They received post cardiac arrest treatment including mild therapeutic hypothermia which was initiated with a combination of cold fluid and a feedback surface cooling device according to current guidelines. Sixteen blood samples per patient were analysed for plasma free choline levels within the first week after resuscitation. Choline was detected by liquid chromatography-tandem mass spectrometry.

**RESULTS:** Most patients showed elevated choline levels on admission (median 14.8  $\mu\text{mol/L}$ ; interquartile range; IQR 9.9-20.1) which subsequently decreased. 48 hours after cardiac arrest choline levels in all patients reached subnormal levels at a median of 4.0  $\mu\text{mol/L}$  (IQR 3-4.9;  $p=0.001$ ). Subsequently, choline levels normalized within seven days. There was no significant difference in choline levels when groups were analyzed in relation to neurological outcome.

**CONCLUSIONS:** Our data indicate a choline deficiency in the early postresuscitation phase. This could potentially result in impaired cell membrane recovery. The detailed characterization of the early choline time course may aid in planning of choline supplementation trials. In a limited number of patients, choline was not promising as a biomarker for outcome prediction.

**Resuscitation.** 2013 Oct 1. pii: S0300-9572(13)00755-7. doi: 10.1016/j.resuscitation.2013.09.017. [Epub ahead of print]

### **Health-related quality of life improves during the first six months after cardiac arrest and hypothermia treatment.**

Larsson IM, Wallin E, Rubertsson S, Kristofferzon ML.

Source: Department of Surgical Sciences-Anaesthesiology & Intensive Care, Uppsala University, SE- 751 85 Uppsala, Sweden. Electronic address: [ing-marie.larsson@surgsci.uu.se](mailto:ing-marie.larsson@surgsci.uu.se).

## Abstract

**AIM OF THE STUDY:** To investigate whether there were any changes in and correlations between, anxiety, depression and health-related quality of life (HRQoL) over time, between hospital discharge, and one and six months after cardiac arrest (CA), in patients treated with therapeutic hypothermia, (TH).

**METHOD:** During a 4-year period at three hospitals in Sweden, 26 patients were prospectively included, after CA treated with TH. All patients completed the questionnaires Hospital Anxiety and Depression, Scale (HADS), Euroqol (EQ5D), Euroqol visual analogue scale (EQ-VAS) and Short Form 12 (SF12) at, three occasions, at hospital discharge, and at one and 6 months after CA.

**RESULT:** There was improvement over time in HRQoL, the EQ5D index ( $p=0.002$ ) and the SF12 physical, component score (PCS) ( $p=0.005$ ). Changes over time in anxiety and depression were not found. Seventy-three percent of patients had an EQ-VAS score below 70 (scale 0-100) on overall health status, at discharge from hospital; at 6 months the corresponding figure was 41%. Physical problems were the, most common complaint affecting HRQoL. A correlation was found between depression and HRQoL, and this was strongest at six months ( $r_s = -.44$  to  $-.71$ ,  $p \leq 0.001$ ).

Conclusion: HRQoL improves over the first 6 months after a CA. Patients reported lower levels of, HRQoL on the physical as compared to mental component. The results indicate that the less anxiety, and depression patients perceive, the better HRQoL they have and that time can be an important factor, in recovery after CA.

**Circulation.** 2013 Oct 17. [Epub ahead of print]

**Doing the Same Thing Over and Over, yet Expecting Different Results.**

Atkins DL.

Source: University of Iowa Children's Hospital, Carver College of Medicine University of Iowa, Iowa City, IA.

Abstract

The fundamentals of modern day CPR, compressions and ventilations, were first described in the 1950s and 1960s. The American Heart Association endorsed CPR in 1963 followed by the first publication of the Advanced Cardiac Life Support Guidelines 1974. Since then, there have been modest changes in the delivery of CPR, primarily recommendations for compression/ventilation ratios, compression depth, advanced life support measures with early defibrillation, airway management and pharmacologic therapies and improved organization of emergency response systems. Despite these changes, survival from out-of-hospital cardiac arrest remains poor, usually < 10%. The usual scenario is institution of CPR by bystanders or emergency medical system (EMS) providers, advanced life support provided at the scene, then transport to the closest emergency department. If return of spontaneous circulation (ROSC) does not occur, the patient is declared at the scene or the process is repeated by hospital personnel until a pre-determined time interval has passed and the patient declared dead.

## VENTILACIÓ

**Prehosp Emerg Care.** 2013 Oct 10. [Epub ahead of print]

**Airways in Out-of-hospital Cardiac Arrest: Systematic Review and Meta-analysis.**

Fouche PF, Simpson PM, Bendall J, Thomas RE, Cone DC, Doi SA.

Source: From Paramedics Australasia (PFF), Sydney, New South Wales, Australia; the University of Western Sydney, School of Science and Health (PMS) , Sydney, New South Wales , Australia ; Department of Anaesthesia, Gosford Hospital (JB) , Gosford, New South Wales , Australia ; Australia and New Zealand College of Paramedicine (RET), Sydney , New South Wales , Australia ; Section of EMS, Department of Emergency Medicine, Yale University School of Medicine (DCC) , New Haven , Connecticut ; University of Queensland, School of Population Health (SARD) , Brisbane, Queensland , Australia .

Abstract

Objective: To determine the differences in survival for out-of-hospital advanced airway intervention (AAI) compared with basic airway intervention (BAI) in cardiac arrest. Background: AAI is commonly utilized in cardiac arrest in the out-of-hospital setting as a means to secure the airway. Observational studies and clinical trials of AAI suggest that AAI is associated with worse outcomes in terms of survival. No controlled trials exist that compares AAI to BAI. Methods: We conducted a bias-adjusted meta-analysis on 17 observational studies. The outcomes were survival, short-term (return of spontaneous circulation and to hospital

admission), and longer-term (to discharge, to one month survival). We undertook sensitivity analyses by analyzing patients separately: those who were 16 years and older, nontrauma only, and attempted versus successful AAI.

Results: This meta-analysis included 388,878 patients. The short-term survival for AAI compared to BAI were overall OR 0.84(95% CI 0.62 to 1.13), for endotracheal intubation (ETI) OR 0.79 (95% CI 0.54 to 1.16), and for supraglottic airways (SGA) OR 0.59 (95% CI 0.39 to 0.89). Long-term survival for AAI were overall OR 0.49 (95% CI 0.37 to 0.65), for ETI OR 0.48 (95% CI 0.36 to 0.64), and for SGA OR 0.35 (95% CI 0.28 to 0.44). Sensitivity analyses shows that limiting analyses to adults, non-trauma victims, and instances where AAI was both attempted and successful did not alter results meaningfully. A third of all studies did not adjust for any other confounding factors that could impact on survival.

Conclusions: This meta-analysis shows decreased survival for AAIs used out-of-hospital in cardiac arrest, but are likely biased due to confounding, especially confounding by indication. A properly conducted prospective study or a controlled trial is urgently needed and are possible to do.

**Resuscitation.** 2013 Oct 12. pii: S0300-9572(13)00771-5. doi:

10.1016/j.resuscitation.2013.08.279. [Epub ahead of print]

**Real-time tracheal ultrasonography for confirmation of endotracheal tube placement during cardiopulmonary resuscitation.**

Chou HC, Lien WC, Ma MH.

Source: Department of Emergency Medicine, National Taiwan University Hospital, No.7, Chung-Shan S. Road, Taipei, Taiwan 100. Electronic address: [erichaochang@gmail.com](mailto:erichaochang@gmail.com).

**Abstract**

Sir, We sincerely thank Dr. Miss and colleagues for showing interest in our manuscript, entitled "Real-time tracheal ultrasonography for confirmation of endotracheal tube placement during cardiopulmonary resuscitation". In response to comments by Dr. Miss et al., we agree that varying viewpoints on the definition of sensitivity and specificity in diagnostic testing exist. To compare the test characteristics with a previous study that examined tube position,<sup>1</sup> we regarded the correct endotracheal intubation as true positive and presented sensitivity and specificity accordingly in this study. Complete data in a 2x2 table were provided to improve our readers' understanding of the actual performance of tracheal ultrasonography from various perspectives. Our results clearly demonstrated both the strengths and weaknesses of tracheal ultrasonography. The misdiagnosis of endotracheal tube placement involves two scenarios: esophageal intubations that are incorrectly identified as tracheal; and tracheal intubations that are incorrectly identified as esophageal. For cardiac arrest patients, both situations can cause morbidity and mortality. Waveform capnography is the current preferred method of confirming tracheal intubation, and has thus far been the optimal screening tool to exclude esophageal intubation. However, in 5 of our study patients, endotracheal intubations were incorrectly identified as esophageal with waveform capnography. By contrast, tracheal ultrasonography correctly identified endotracheal positioning in all these patients. These false results may in turn lead to unnecessary re-intubation, causing undue interruption of chest compressions during cardiopulmonary resuscitation. We recognize the limitations of tracheal ultrasonography in some situations. However, with near-perfect negative likelihood ratios in assessing endotracheal tube position, tracheal ultrasonography not only excludes esophageal intubation, but also provides definite confirmation of correct endotracheal intubation that can

complement the weakness of capnography in cardiac arrest patients. Therefore, we are convinced that tracheal ultrasonography has a niche role to play in airway management during resuscitation. The combination of tracheal ultrasonography and capnography has the potential to achieve the optimal sensitivity and specificity to confirm endotracheal tube placement in critical patients.

*Crit Care Med.* 2013 Oct 23. [Epub ahead of print]

**Mechanical Ventilation During Cardiopulmonary Resuscitation With Intermittent Positive-Pressure Ventilation, Bilevel Ventilation, or Chest Compression Synchronized Ventilation in a Pig Model.**

Kill C, Hahn O, Dietz F, Neuhaus C, Schwarz S, Mahling R, Wallot P, Jerrentrup A, Steinfeldt T, Wulf H, Dersch W.

Source: 1Department of Anaesthesiology and Critical Care, Philipps University, Marburg, Germany. 2Department of Emergency Medicine, Philipps University, Marburg, Germany. 3Weinmann Geräte für Medizin GmbH + Co. KG, Hamburg, Germany. 4Institut für Assistenzsysteme und Qualifizierung an der SRH-Hochschule Heidelberg e.V., Heidelberg, Germany. 5Department of Internal Medicine, Section Respiratory Diseases, Philipps University, Marburg, Germany.

**Abstract**

**OBJECTIVE:** Mechanical ventilation with an automated ventilator is recommended during cardiopulmonary resuscitation with a secured airway. We investigated the influence of intermittent positive-pressure ventilation, bilevel ventilation, and the novel ventilator mode chest compression synchronized ventilation, a pressure-controlled ventilation triggered by each chest compression, on gas exchange, hemodynamics, and return of spontaneous circulation in a pig model.

**DESIGN:** Animal study.

**SETTING:** University laboratory.

**SUBJECTS:** Twenty-four three-month-old female domestic pigs.

**INTERVENTIONS:** The study was performed on pigs under general anesthesia with endotracheal intubation. Arterial and central venous catheters were inserted and IV rocuronium (1 mg/kg) was injected. After 3 minutes of cardiac arrest (ventricular fibrillation at  $t = 0$  min), animals were randomized into intermittent positive-pressure ventilation (control group), bilevel, or chest compression synchronized ventilation group. Following 10 minute uninterrupted chest compressions and mechanical ventilation, advanced life support was performed (100% O<sub>2</sub>, up to six defibrillations, vasopressors).

**MEASUREMENTS AND MAIN RESULTS:** Blood gas samples were drawn at 0, 4 and 13 minutes. At 13 minutes, hemodynamics was analyzed beat-to-beat in the end-inspiratory and end-expiratory cycle comparing the IPPV with the bilevel group and the CCSV group. Data were analyzed with the Mann-Whitney U test. Return of spontaneous circulation was achieved in five of eight (intermittent positive-pressure ventilation), six of eight (bilevel), and four of seven (chest compression synchronized ventilation) pigs. The results of arterial blood gas analyses at  $t = 4$  minutes and  $t = 13$  minutes (torr) were as follows: PaO<sub>2</sub> intermittent positive-pressure ventilation, 143 (76/256) and 262 (81/340); bilevel, 261 (109/386) ( $p = 0.195$  vs intermittent positive-pressure ventilation) and 236 (86/364) ( $p = 0.878$  vs intermittent positive-pressure ventilation); and chest compression synchronized ventilation, 598 (471/650) ( $p < 0.001$  vs intermittent positive-pressure ventilation) and 634 (115/693) ( $p = 0.054$  vs intermittent

positive-pressure ventilation); PaCO<sub>2</sub> intermittent positive-pressure ventilation, 40 (38/43) and 45 (36/52); bilevel, 39 (35/41) ( $p = 0.574$  vs intermittent positive-pressure ventilation) and 46 (42/49) ( $p = 0.798$ ); and chest compression synchronized ventilation, 28 (27/32) ( $p = 0.001$  vs intermittent positive-pressure ventilation) and 26 (18/29) ( $p = 0.004$ ); mixed venous pH intermittent positive-pressure ventilation, 7.34 (7.31/7.35) and 7.26 (7.25/7.31); bilevel, 7.35 (7.29/7.37) ( $p = 0.645$  vs intermittent positive-pressure ventilation) and 7.27 (7.17/7.31) ( $p = 0.645$  vs intermittent positive-pressure ventilation); and chest compression synchronized ventilation, 7.34 (7.33/7.39) ( $p = 0.189$  vs intermittent positive-pressure ventilation) and 7.35 (7.34/7.36) ( $p = 0.006$  vs intermittent positive-pressure ventilation). Mean end-inspiratory and end-expiratory arterial pressures at  $t = 13$  minutes (mm Hg) were as follows: intermittent positive-pressure ventilation, 28.0 (25.0/29.6) and 27.9 (24.4/30.0); bilevel, 29.1 (25.6/37.1) ( $p = 0.574$  vs intermittent positive-pressure ventilation) and 28.7 (24.2/36.5) ( $p = 0.721$  vs intermittent positive-pressure ventilation); and chest compression synchronized ventilation, 32.7 (30.4/33.4) ( $p = 0.021$  vs intermittent positive-pressure ventilation) and 27.0 (24.5/27.7) ( $p = 0.779$  vs intermittent positive-pressure ventilation).

**CONCLUSIONS:** Both intermittent positive-pressure ventilation and bilevel provided similar oxygenation and ventilation during cardiopulmonary resuscitation. Chest compression synchronized ventilation elicited the highest mean arterial pressure, best oxygenation, and a normal mixed venous pH during cardiopulmonary resuscitation.

## COMPRESSIONS TORÀCIQUES

**Emerg Med J.** 2013 Oct 14. doi: 10.1136/emered-2013-202515. [Epub ahead of print]  
**Relative effectiveness of dominant versus non-dominant hand position for rescuer's side of approach during chest compressions between right-handed and left-handed novice rescuers.**

You JS, Kim H, Park JS, Baek KM, Jang MS, Lee HS, Chung SP, Kim S.

Source: Department of Emergency Medicine, Yonsei University College of Medicine, Seoul, Republic of Korea.

### Abstract

**INTRODUCTION:** The major components affecting high quality cardiopulmonary resuscitation (CPR) have been defined as the ability of the rescuer, hand position, position of the rescuer and victim, depth and rate of chest compressions, and fatigue. Until now, there have been no studies on dominant versus non-dominant hand position and the rescuer's side of approach. This study was designed to evaluate the effectiveness of hand position and approach side on the quality of CPR between right-handed (RH) and left-handed (LH) novice rescuers.

**MATERIAL AND METHODS:** 44 health science university students with no previous experience of basic life support (BLS) volunteered for the study. We divided volunteers into two groups by handedness. Adult BLS was performed on a manikin for 2 min in each session. The sequences were randomly performed on the manikin's left side of approach (Lap) with the rescuer's left hand in contact with the sternum (Lst), Lap/Rst, Rap/Lst and Rap/Rst.

**RESULTS:** We compared the quality of chest compressions between the RH and LH groups according to predetermined positions. A significant decrease in mean compression depth between the two groups was only observed when rescuers performed in the Rap/Lst scenario, regardless of hand dominance. The frequency of correct hand placement also significantly decreased in the Lap/Rst position for the LH group.

**CONCLUSIONS:** The performance of novice rescuers during chest compressions is influenced by the position of the dominant hand and the rescuer's side of approach. In CPR training and real world situations, a novice rescuer, regardless of handedness, should consider hand positions for contacting the sternum identical to the side of approach after approaching from the nearest and most accessible side, for optimal CPR performance.

**Resuscitation.** 2013 Oct 11. pii: S0300-9572(13)00769-7. doi: 10.1016/j.resuscitation.2013.10.002. [Epub ahead of print]

### **Chest Compression Depth and Survival in Out-of-Hospital Cardiac Arrest.**

Vadeboncoeur T, Stolz U, Panchal A, Silver A, Venuti M, Tobin J, Smith G, Nunez M, Karamooz M, Spaite D, Bobrow B.

Source: Mayo Clinic, Jacksonville, Florida. Electronic address: [Vadeboncoeur.tyler@mayo.edu](mailto:Vadeboncoeur.tyler@mayo.edu).

### Abstract

**AIM:** Outcomes from out-of-hospital cardiac arrest (OHCA) may improve if rescuers perform chest compressions (CCs) deeper than the previous recommendation of 38-51mm and consistent with the 2010 AHA Guideline recommendation of at least 51mm. The aim of this study was to assess the relationship between CC depth and OHCA survival.

**METHODS:** Prospective analysis of CC depth and outcomes in consecutive adult OHCA of presumed cardiac etiology from two EMS agencies participating in comprehensive CPR quality improvement initiatives. **Analysis:** Multivariable logistic regression to calculate adjusted odds ratios (aORs) for survival to hospital discharge and favorable functional outcome.

RESULTS: Among 593 OHCA, 136 patients (22.9%) achieved return of spontaneous circulation, 63 patients (10.6%) survived and 50 had favorable functional outcome (8.4%). Mean CC depth was 49.8±11.0mm and mean CC rate was 113.9±18.1 CC/min. Mean depth was significantly deeper in survivors (53.6mm, 95% CI: 50.5-56.7) than non-survivors (48.8mm, 95% CI: 47.6-50.0). Each 5mm increase in mean CC depth significantly increased the odds of survival and survival with favorable functional outcome: aORs were 1.29 (95% CI 1.00-1.65) and 1.30 (95% CI 1.00-1.70) respectively.

CONCLUSION: Deeper chest compressions were associated with improved survival and functional outcome following OHCA. Our results suggest that adhering to the 2010 AHA Guideline-recommended depth of at least 51mm could improve outcomes for victims of OHCA.

*Crit Care Med.* 2013 Oct 23. [Epub ahead of print]

**Neurologic Recovery From Profound Accidental Hypothermia After 5 Hours of Cardiopulmonary Resuscitation.**

Boue Y, Lavolaine J, Bouzat P, Matraxia S, Chavanon O, Payen JF.

Source: 1Pole Anesthésie-Réanimation, Hôpital Michallon, Grenoble, France. 2Grenoble Institut des Neurosciences, Université Joseph Fourier, Grenoble, France. 3INSERM, U836, Grenoble, France. 4Service Urgences-SMUR, Centre Hospitalier Albertville Moutiers, Moutiers, France. 5Service de Chirurgie Cardiaque, Hôpital Michallon, Grenoble, France.

Abstract

OBJECTIVE: To describe the successful neurologic recovery from profound accidental hypothermia with cardiac arrest despite the longest reported duration of cardiopulmonary resuscitation.

DESIGN: Case report.

SETTING: Mountain.

PATIENT: A 57-year-old woman experienced profound accidental hypothermia (16.9°C) in a mountainous region of Grenoble. She was unconscious and had extreme bradycardia (6 beats/min) at presentation. A cardiac arrest occurred at the mobilization that was not responsive to electrical shocks or epinephrine.

INTERVENTION: Cardiopulmonary resuscitation was continued for 307 minutes after rescue until venoarterial extracorporeal membrane oxygenation blood flow had been established at the emergency department.

MEASUREMENTS AND MAIN RESULTS: At a 3-month follow-up, the patient showed good physical and mental recovery.

CONCLUSION: With no evidence of trauma or asphyxia, profound accidental hypothermia with cardiac arrest represents a specific condition for which successful neurologic recovery is feasible despite prolonged cardiopulmonary resuscitation

**DESFIBRIL·LACIÓ**

*Br J Sports Med.* 2013 Oct 11. doi: 10.1136/bjsports-2013-092786. [Epub ahead of print]

**Outcomes from sudden cardiac arrest in US high schools: a 2-year prospective study from the National Registry for AED Use in Sports.**

Drezner JA, Toresdahl BG, Rao AL, Huszti E, Harmon KG.

Source: Department of Family Medicine, University of Washington, Seattle, Washington, USA.

Abstract



**BACKGROUND:** Sudden cardiac arrest (SCA) is the leading cause of death in athletes during exercise. The effectiveness of school-based automated external defibrillator (AED) programmes has not been established through a prospective study.

**METHODS:** A total of 2149 high schools participated in a prospective observational study beginning 1 August 2009, through 31 July 2011. Schools were contacted quarterly and reported all cases of SCA. Of these 95% of schools confirmed their participation for the entire 2-year study period. Cases of SCA were reviewed to confirm the details of the resuscitation. The primary outcome was survival to hospital discharge.

**RESULTS:** School-based AED programmes were present in 87% of participating schools and in all but one of the schools reporting a case of SCA. Fifty nine cases of SCA were confirmed during the study period including 26 (44%) cases in students and 33 (56%) in adults; 39 (66%) cases occurred at an athletic facility during training or competition; 55 (93%) cases were witnessed and 54 (92%) received prompt cardiopulmonary resuscitation. A defibrillator was applied in 50 (85%) cases and a shock delivered onsite in 39 (66%). Overall, 42 of 59 (71%) SCA victims survived to hospital discharge, including 22 of 26 (85%) students and 20 of 33 (61%) adults. Of 18 student-athletes 16 (89%) and 8 of 9 (89%) adults who arrested during physical activity survived to hospital discharge.

**CONCLUSIONS:** High school AED programmes demonstrate a high survival rate for students and adults who suffer SCA on school campus. School-based AED programmes are strongly encouraged.

## CURES POSTRESSUSCITACIÓ

**Resuscitation.** 2013 Oct 12. pii: S0300-9572(13)00768-5. doi: 10.1016/j.resuscitation.2013.09.022. [Epub ahead of print]

### **The Incidence and Significance of Bacteremia in Out of Hospital Cardiac Arrest. Cobra-Bacteremia in Out of Hospital Cardiac Arrest.**

Coba V, Jaehne AK, Suarez A, Dagher GA, Brown SC, Yang JJ, Manteuffel J, Rivers EP.

Source: Department of Surgery, Henry Ford Hospital, Detroit, MI. Electronic address:

[vcoba1@hfhs.org](mailto:vcoba1@hfhs.org).

#### Abstract

**BACKGROUND:** The most common etiology of cardiac arrest is presumed of myocardial origin. Recent retrospective studies indicate that preexisting pneumonia, a form of sepsis, is frequent in patients who decompensate with abrupt cardiac arrest without preceding signs of septic shock, respiratory failure or severe metabolic disorders shortly after hospitalization. The contribution of pre-existing infection on pre and post cardiac arrest events remains unknown and has not been studied in a prospective fashion. We sought to examine the incidence of pre-existing infection in out-of-hospital cardiac arrest (OHCA) and assess characteristics associated with bacteremia, the gold standard for presence of infection.

**METHODS AND RESULTS:** We prospectively observed 250 OHCA adult patients who presented to the Emergency Department (ED) between 2007-2009 to an urban academic teaching institution. Bacteremia was defined as one positive blood culture with non-skin flora bacteria or two positive blood cultures with skin flora bacteria. 77 met pre-defined exclusion criteria. Of the 173 OHCA adults, 65 (38%) were found to be bacteremic with asystole and PEA as the most common presenting rhythms. Mortality in the ED was significantly higher in bacteremic OHCA (75.4%) compared to non-bacteremic OHCA (60.2%,  $p < 0.05$ ). After adjustment for potential confounders,

predictive factors associated with bacteremic OHCA were lower initial arterial pH, higher lactate, WBC, BUN and creatinine.

**CONCLUSIONS:** Over one-third of OHCA adults were bacteremic upon presentation. These patients have greater hemodynamic instability and significantly increased short-term mortality. Further studies are warranted to address the epidemiology of infection as possible cause of cardiac arrest.

*PLoS One*. 2013 Oct 4;8(10):e75172. doi: 10.1371/journal.pone.0075172.

**The Post-Resuscitative Urinalysis Associate the Survival of Patients with Non-Traumatic Out-of-Hospital Cardiac Arrest.**

Chang CF, Li CJ, Ko CJ, Teng TH, Lai SC, Yang MC, Chiu CW, Chou CC, Chang CY, Yao YC, Wu LH, Wu HP, Chen WL, Lin YR.

Source: Department of Emergency Medicine, Changhua Christian Hospital, Changhua, Taiwan.

**Abstract**

**OBJECTIVE:** To analyze whether urine output and urinalysis results are predictive of survival and neurologic outcomes in patients with non-traumatic out-of-hospital cardiac arrest (OHCA).

**METHODS:** Information was obtained from 1,340 patients with non-traumatic OHCA who had achieved a sustained return of spontaneous circulation (ROSC). Factors that were associated with survival in the post-resuscitative period were evaluated. The association between urine output and fluid challenge in the early resuscitative period was analyzed and compared between the survivors and the non-survivors. The results of the initial urinalysis, including the presence of proteinuria and other findings, were used to evaluate the severity of vascular protein leakage and survival. The association between proteinuria and the neurologic outcomes of the survivors was also analyzed. The clinical features of capillary leakage were examined during the post-resuscitative period.

**RESULTS:** Of the 1,340 patients, 312 survived. A greater urine output was associated with a higher chance of survival. The initial urine output increased in proportion to the amount of fluid that was administered during early resuscitation in the emergency department for the survivors but not for the non-survivors ( $p < 0.05$ ). In the initial urinalysis, proteinuria was strongly associated with survival, and severe proteinuria indicated significantly poorer neurologic outcomes ( $p < 0.05$  for both comparisons). Proteinuria was associated with a risk of developing signs of capillary leakage, including body mass index gain and pitting edema (both  $p < 0.001$ ).

**CONCLUSION:** The severity of proteinuria during the early post-resuscitative period was predictive of survival.

*Crit Care Med*. 2013 Oct 23. [Epub ahead of print]

**Effects of Viscosity on Cerebral Blood Flow After Cardiac Arrest.**

Bisschops LL, Pop GA, Teerenstra S, Struijk PC, van der Hoeven JG, Hoedemaekers CW.

Source: 1Department of Intensive Care, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands. 2Department of Cardiology, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands. 3Department of Clinical Epidemiology, Biostatistics and Health Technology Assessment, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands. 4Department of Obstetrics and Gynecology, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands.

**Abstract**

**OBJECTIVES:** To determine blood viscosity in adult comatose patients treated with mild therapeutic hypothermia after cardiac arrest and to assess the relation between blood viscosity, cerebral blood flow, and cerebral oxygen extraction.

**DESIGN:** Observational study.

SETTING: Tertiary care university hospital.

PATIENTS: Ten comatose patients with return of spontaneous circulation after out-of-hospital cardiac arrest.

INTERVENTION: Treatment with mild therapeutic hypothermia for 24 hours followed by passive rewarming to normothermia.

MEASUREMENTS AND MAIN RESULTS: Median viscosity at shear rate 50/s was 5.27 mPa · s (4.29-5.91 mPa · s) at admission; it remained relatively stable during the first 12 hours and decreased significantly to 3.00 mPa · s (2.72-3.58 mPa · s) at 72 hours ( $p < 0.001$ ). Median mean flow velocity in the middle cerebral artery was low (27.0 cm/s [23.8-30.5 cm/s]) at admission and significantly increased to 63.0 cm/s (51.0-80.0 cm/s) at 72 hours. Median jugular bulb saturation at the start of the study was 61.5% (55.5-75.3%) and significantly increased to 73.0% (69.0-81.0%) at 72 hours. Median hematocrit was 0.41 L/L (0.36-0.44 L/L) at admission and subsequently decreased significantly to 0.32 L/L (0.27-0.35 L/L) at 72 hours. Median C-reactive protein concentration was low at admission (2.5 mg/L [2.5-6.5 mg/L]) and increased to 101 mg/L (65-113.3 mg/L) in the following hours. Median fibrinogen concentration was increased at admission 2,795 mg/L (2,503-3,565 mg/L) and subsequently further increased to 6,195 mg/L (5,843-7,368 mg/L) at 72 hours. There was a significant negative association between blood viscosity and the mean flow velocity in the middle cerebral artery ( $p = 0.0008$ ).

CONCLUSIONS: Changes in blood viscosity in vivo are associated with changes in flow velocity in the middle cerebral artery. High viscosity early after cardiac arrest may reduce cerebral blood flow and may contribute to secondary brain injury. Further studies are needed to determine the optimal viscosity during the different stages of the postcardiac arrest syndrome.

**Resuscitation.** 2013 Oct 18. pii: S0300-9572(13)00802-2. doi: 10.1016/j.resuscitation.2013.10.008. [Epub ahead of print]

**Prognostic value of cell-free DNA in plasma of out-of-hospital cardiac arrest survivors at ICU admission and 24hours post-admission.**

Gornik I, Wagner J, Gašparović V, Miličić D, Degoricija V, Skorić B, Gornik O, Lauc G.

Source: University of Zagreb School of Medicine, Zagreb, Croatia; University Hospital Centre Zagreb, Department of Medicine, Intensive Care Unit, Zagreb, Croatia. Electronic address: ivan.gornik@gmail.com.

Abstract

Cell-free DNA has been associated with outcome in several acute conditions including two reports concerning the outcomes after cardiac arrest that found association of circulating DNA quantities at admission with mortality. The origins of cell-free DNA are primarily necrosis and apoptosis, which in cardiac arrest occur during ischemia ("no-flow" and "low-flow" period), during reperfusion injury and as a consequence of post-arrest inflammatory response.

Respecting the facts that significant cellular damage may occur during the post-arrest period, and that that damage might be reduced by mild therapeutic hypothermia, we investigated the prognostic value of cell free DNA at ICU admission and 24hours after admission. A prospective study was conducted in three university associated intensive care units and included patients resuscitated from non-traumatic out-of-hospital cardiac arrest. Patient data were collected in accordance with the Utstein protocol. Therapeutic hypothermia was performed according to ICU policies. Blood for cell-free DNA quantification was sampled at admission and at 24±1hour after admission. Outcome measures were hospital mortality and cerebral performance

expressed with CPC scale at discharge. Inclusion criteria were met in 67 patients; 24-hour mortality was 37.3% and hospital mortality 71.6%. The following variables were associated with 24-hour mortality in univariate analysis: asystole as the presenting rhythm, "no-flow" time, "low-flow" time and cell-free DNA at admission (median 0.081 in survivors vs. 0.160ng/ $\mu$ l in non-survivors;  $P=0.038$ ). Multivariate analysis that included the above variables showed that no-flow time and low-flow time were independently associated with 24-hour mortality. Hospital mortality was associated with the following factors: "low flow" time, coronary intervention, cell-free DNA at ICU admission and at 24hours after admission (0.042 vs. 0.188ng/ $\mu$ l;  $P=0.048$ ). ROC curve for cell-free DNA 24h post-admission showed sensitivity of 81.0% and specificity of 78.3% for the cut-off value of 0.115ng/ $\mu$ l. Multivariate analysis showed that "low-flow" time and cell-free DNA at 24hours after ICU admission were independently associated with hospital mortality. Cell free DNA showed different dynamics in patients who were and who were not treated with mild therapeutic hypothermia: it decreased in treated patients and slightly increased in non-treated patients. Cell-free DNA quantity at ICU admission and 24h after admission is associated with hospital mortality. Further studies will need to additionally investigate possible practical use of this new laboratory marker in patients resuscitated from cardiac arrest.

*Int J Cardiol.* 2013 Oct 16. pii: S0167-5273(13)01825-1. doi: 10.1016/j.ijcard.2013.10.011.

[Epub ahead of print]

**Diagnosis performance of high sensitivity troponin assay in out-of-hospital cardiac arrest patients.**

Geri G, Mongardon N, Dumas F, Chenevier-Gobeaux C, Varenne O, Jouven X, Vivien B, Mira JP, Empana JP, Spaulding C, Cariou A.

Source: Medical Intensive Care Unit, Cochin Hospital, Groupe Hospitalier Universitaire Cochin Broca Hôtel-Dieu, Assistance Publique - Hôpitaux de Paris, 27 rue du Faubourg Saint-Jacques, 75014 Paris, France; Université Paris Descartes, Sorbonne Paris Cité, Faculté de médecine, 15 rue de l'Ecole de Médecine, 75006 Paris, France.

**Abstract**

**PURPOSE:** Early identification of the cause of out-of-hospital cardiac arrest (OHCA) remains a challenge. Our aim was to determine whether high-sensitivity cardiac troponin T (HsTnT) was useful to diagnose a recent coronary artery occlusion as the cause of OHCA.

**METHODS:** Retrospective study including OHCA patients evaluated by systematic coronary angiogram at hospital admission. HsTnT was assessed at ICU admission. Predictive factors of a recent coronary occlusion were identified by logistic regression. Net reclassification improvement (NRI) was calculated to estimate the potential enhancement of prediction with HsTnT.

**RESULTS:** During the 5year study period, 272 patients (median age 60y, 76.5% men) were included, and a culprit coronary occlusion was found in 133 (48.9%). The optimum HsTnT cut-off to predict a recent coronary occlusion was 575ng/l (sensitivity 65.4%, specificity 65.5%). In multivariate analysis, current smoking (OR 3.2 95%, 95%CI 1.62-6.33), time from collapse to BLS<3min (OR 2.11, 95%CI 1.10-4.05), initial shockable rhythm (OR 5.29, 95%CI 2.06-13.62), ST-segment elevation (OR 2.44, 95%CI 1.18-5.03), post-resuscitation shock onset (OR 2.03, 95%CI 1.01-4.07) and HsTnT $\geq$ 575ng/l (OR 2.22, 95%CI 1.16-4.27) were associated with the presence of a recent coronary occlusion. Nevertheless, adding HsTnT to established risk factors of recent coronary occlusion identified above provided a non-significant NRI of -0.43%.

**CONCLUSIONS:** Admission HsTnT is increased after OHCA and is an independent factor of a recent coronary occlusion. However, HsTnT does not seem to be a strong enough diagnostic tool to select candidates for emergent coronary angiogram in OHCA survivors.

*Crit Care Med.* 2013 Oct 18. [Epub ahead of print]

**Inhaled Isoflurane Sedation During Therapeutic Hypothermia After Cardiac Arrest: A Case Series.**

Hellström J, Owall A, Martling CR, Sackey PV.

Source: 1Institution of Molecular Medicine and Surgery, Section of Cardiothoracic Surgery and Anesthesiology, Karolinska Institutet, Stockholm, Sweden. 2Institution of Physiology and Pharmacology, Section of Anesthesiology and Intensive Care Medicine, Karolinska Institutet, Stockholm, Sweden.

**Abstract**

**OBJECTIVE:** Therapeutic hypothermia in the ICU requires mechanical ventilation and sedation. Hypothermia reduces the metabolism of commonly used IV sedatives. The use of long-acting sedative agents may confound neurologic assessment. Volatile anesthetics have been reported to provide protection against ischemia-reperfusion injury and have been safely used in the ICU to provide sedation in trials with shorter wake-up times. There are no clinical studies in this setting. We describe a case series and discuss potential benefits.

**DESIGN:** Retrospective study.

**SETTINGS:** Ten-bed ICU, university hospital.

**PATIENTS:** Twelve patients resuscitated from cardiac arrest with Glasgow Coma Scale score less than or equal to 4.

**INTERVENTION:** Isoflurane sedation with the AnaConDa during 24 hours therapeutic hypothermia, until rewarming.

**MEASUREMENTS AND MAIN RESULTS:** Data were extracted from the computerized ICU chart/monitors, hospital and prehospital charts, and the national death index. Patients were 49-76 years old. Median return of spontaneous circulation was 14 minutes. Glasgow Coma Scale scores were assessed within 24 hours from reaching normal body temperature and compared with outcomes at 6 months: six patients had poor Glasgow Coma Scale scores (< 8) that remained low and all died before 6-month follow-up, whereas another six patients had high scores (> 8) and survived to 6 months with good Cerebral Performance Category. In the ICU, four of the survivors were directly extubated after rewarming while two were once more sedated due to pneumonia requiring invasive ventilator therapy. All patients required norepinephrine to maintain adequate mean arterial pressure. Isoflurane sedation was changed to midazolam in two nonsurviving patients because of hemodynamic instability, which persisted despite the change.

**CONCLUSIONS:** Sedation with volatile anesthetics during therapeutic hypothermia may be a feasible short-acting option with potential postconditioning effects protecting vital organs from ischemia-reperfusion injury. Its measurability and insignificant drug accumulation could facilitate early neurologic assessment. Prospective clinical trials are warranted.

*Acta Anaesthesiol Scand.* 2013 Jul;57(6):784-92. doi: 10.1111/aas.12117. Epub 2013 Mar 31.

**Factors influencing outcome in patients with cardiac arrest in the ICU.**

Lee HK, Lee H, No JM, Jeon YT, Hwang JW, Lim YJ, Park HP.

Source: Department of Anesthesiology and Pain Medicine, Seoul National University Hospital, Seoul, Korea.

#### Abstract

**BACKGROUND:** Post-arrest variables associated with long-term survival after cardiopulmonary resuscitation (CPR) in intensive care unit (ICU) patients remain unclear. This study was designed to identify pre- and intra-arrest factors associated with survival 3 months after CPR in ICU patients and to identify post-arrest factors associated with long-term survival in those who survived 24 h after CPR.

**METHODS:** A total of 131 ICU patients undergoing CPR from January 2009 to June 2010 were included. Data were retrospectively analysed and categorized based on the Utstein template.

**RESULTS:** The overall survival rate 3 months after CPR was 20.6%. Logistic regression analysis revealed that acute physiology and chronic health evaluation (APACHE) II score (odds ratio, 95% confidence interval, 0.87 [0.83-0.93];  $P < 0.001$ ), ventricular tachycardia/ventricular fibrillation (VT/VF, 5.55 [1.55-19.83];  $P = 0.032$ ), and normoxia during CPR (4.45 [1.34-14.71];  $P = 0.045$ ) were significant independent pre- and intra-arrest predictors of 3-month survival after CPR in ICU patients. Fifty-seven patients survived 24 h after CPR, and their 3-month survival rate was 47.4%. Early enteral nutrition (9.94 [1.96-50.43];  $P = 0.030$ ) and normoxia after return of spontaneous circulation (10.75 [2.03-55.56];  $P = 0.030$ ) were predictive of 3-month survival in patients who survived 24 h after CPR.

**CONCLUSIONS:** Normoxia during CPR and VT/VF were predictors of long-term survival after CPR in ICU patients. In patients surviving 24 h after CPR, initiation of enteral nutrition within 48 h and maintenance of normoxia were associated with a positive outcome.

## CENTRALS DE COORDINACIÓ

**Resuscitation.** 2013 Oct 1. pii: S0300-9572(13)00753-3. doi: 10.1016/j.resuscitation.2013.09.015. [Epub ahead of print]

### **Quality of CPR performed by trained bystanders with optimized pre-arrival instructions.**

Birkenes TS, Myklebust H, Neset A, Kramer-Johansen J.

Source: Institute for Experimental Medical Research, Oslo University Hospital and University of Oslo, Oslo, Norway; Laerdal Medical, Stavanger, Norway. Electronic address:

[tonje.birkenes@laerdal.no](mailto:tonje.birkenes@laerdal.no).

#### Abstract

**OBJECTIVE:** Telephone-CPR (T-CPR) can increase initiation of bystander CPR. We wanted to study if quality oriented continuous T-CPR would improve CPR performance versus standard T-CPR.

**METHOD:** Ninety-five trained rescuers aged 22-69 were randomized to standard T-CPR or experimental continuous T-CPR (comprises continuous instructions, questions and encouragement). They were instructed to perform 10minutes of chest compressions-only on a manikin, which recorded CPR performance in a small, confined kitchen. Three video-cameras captured algorithm time data, CPR technique and communication. Demography and training experience were captured during debriefing.

**RESULTS:** Participants receiving continuous T-CPR delivered significantly more chest compressions (median 1000 vs. 870 compressions,  $p=0.014$ ) and compressed more frequently to a compression rate between 90-120min<sup>-1</sup> (median 87% vs. 60% of compressions,  $p<0.001$ ), compared to those receiving standard T-CPR. This also resulted in less time without compressions after CPR had started (median 12 s vs. 64 s,  $p<0.001$ ), but longer time interval from initiating contact with

dispatcher to first chest compression (median 144 s vs. 84,  $p<0.001$ ). There was no difference in chest compression depth (mean 47mm vs. 48mm,  $p=0.90$ ) or in demography, education and previous CPR training between the groups.

CONCLUSION: In our simulated scenario with CPR trained lay rescuers, experimental continuous T-CPR gave better chest compression rate and less hands-off time during CPR, but resulted in delayed time to first chest compression compared to standard T-CPR instructions.

**Resuscitation.** 2013 Oct 17. pii: S0300-9572(13)00799-5. doi:

10.1016/j.resuscitation.2013.10.005. [Epub ahead of print]

**Implementation of the ALERT algorithm, a new dispatcher-assisted telephone cardiopulmonary resuscitation protocol, in non-Advanced Medical Priority Dispatch System (AMPDS) Emergency Medical Services centres.**

Stipulante S, Tubes R, Fassi ME, Donneau AF, Van Troyen B, Hartstein G, D'Orio V, Ghuysen A.

Source: Federal Public Health Services, Liege, Belgium. Electronic address:

Samuel.stipulante@icloud.com.

**Abstract**

Objectives: Early bystander cardiopulmonary resuscitation (CPR) is a key factor in improving survival from out-of-hospital cardiac arrest (OHCA). The ALERT (Algorithme Liégeois d'Encadrement à la Réanimation par Téléphone) algorithm has the potential to help bystanders initiate CPR. This study evaluates the effectiveness of the implementation of this protocol in a non-Advanced Medical Priority Dispatch System area. Methods: We designed a before and after study based on a 3-month retrospective assessment of victims of OHCA in 2009, before the implementation of the ALERT protocol in Liege emergency medical communication centre (EMCC), and the prospective evaluation of the same 3 months in 2011, immediately after the implementation. Results: At the moment of the call, dispatchers were able to identify 233 OHCA in the first period and 235 in the second. Victims were predominantly male (59%, both periods), with mean ages of 64.1 and 63.9 years, respectively. In 2009, only 9.9% victims benefited from bystander CPR, this increased to 22.5% in 2011 ( $p<0.0002$ ). The main reasons for protocol under-utilisation were: assistance not offered by the dispatcher (42,3%), caller physically remote from the victim (20.6%). Median time from call to first compression, defined here as no flow time, was 253sec in 2009 and 168sec in 2011 (NS). Ten victims were admitted to hospital after ROSC in 2009 and 13 in 2011 ( $p=0.09$ ). Conclusion: From the beginning and despite its under-utilisation, the ALERT protocol significantly improved the number of patients in whom bystander CPR was attempted.

**EPIDEMIOLOGIA**

**The Clin Risk Manag.** 2013;9:377-81. doi: 10.2147/TCRM.S50981. Epub 2013 Oct 8.

**A 6-year experience of CPR outcomes in an emergency department in Thailand.**

Sittichanbuncha Y, Prachanukool T, Sawanyawisuth K.

Source: Emergency Medicine Department, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand.

**Abstract**

PURPOSE: Sudden cardiac arrest is a common emergency condition found in the emergency department of the hospital. The survival rate of out-of-hospital cardiac arrest patients is 2.0%-10.0% and 7.4%-27.0% percent for in-hospital cardiac arrest patients. The factors for survival

outcome are divided into three main groups: patient characteristics, pre-hospital factors, and resuscitated information. The objective of this study was to evaluate the related factors, outcome, and survival rate in patients with cardiac arrest who received cardiopulmonary resuscitation (CPR) at Ramathibodi Emergency Medicine Department. There are limited data for this issue in Thailand and other Asian countries.

**METHODS:** This retrospective study included all patients who were older than 15 years with sudden cardiac arrest and who were resuscitated in the emergency room between January 2005 and December 2010. Descriptive analytic statistics and logistic regressions were used to analyze factors that related to the sustained return of spontaneous circulation (ROSC) and survival at discharge.

**RESULTS:** There were 181 patients enrolled. The overall sustained ROSC rate was 34.8% and the survival rate at discharge was 11.1%. There were 145 out-of-hospital cardiac arrest patients, in whom the survival rate was 52.4% and the survival to discharge rate was 7.6%. For inhospital cardiac arrest, there were 36 patients with a survival rate of 86.1% and the survival to discharge rate was 25.0%. Statistically significant factors related to sustained ROSC were good and moderate cerebral performance, in-hospital cardiac arrest, beginning of CPR in less than 30 minutes, and cardiopulmonary cause of arrest. The factors influencing survival to discharge were cardiopulmonary causes of cardiac arrest.

**CONCLUSION:** Factors associated with sustained ROSC were functional status before cardiac arrest, location of cardiac arrest, duration of CPR, and cause of cardiac arrest. Survival rate was related to the cause of cardiac arrest.

## **MONITORATGE I PRONÒSTIC**

*Am J Emerg Med.* 2013 Oct 16. pii: S0735-6757(13)00612-8. doi: 10.1016/j.ajem.2013.09.010. [Epub ahead of print]

### **An assessment of the use of near infrared spectrophotometry (cerebral oximetry) in predicting the return of spontaneous circulation in out-of-hospital cardiac arrest.**

Asim K, Gokhan E, Ozlem B, Ozcan Y, Deniz O, Kamil K, Murat Z, Aydın C, Selman Y.

Source: Recep Tayyip Erdogan University Faculty of Medicine, Department of Emergency Medicine, Rize, Turkey. Electronic address: drasimkalkan@hotmail.com.

#### **Abstract**

**AIM:** We assessed out-of-hospital cardiac arrest patients' cerebral oxygenation during cardiopulmonary resuscitation (CPR) using near infrared spectrophotometry (NIRS). We evaluated the relation between a rise in patients' cerebral saturation values between the start and end of CPR and return of spontaneous circulation.

**MATERIALS AND METHODS:** Twenty-three patients with unwitnessed out-of-hospital cardiac arrest and brought to our emergency department by emergency ambulance were evaluated. Cerebral saturations from time of start of CPR were measured using NIRS. CPR was performed for a maximum of 30 min. The relation between cerebral saturations in patients with or without return of spontaneous circulation was then evaluated.

**RESULTS:** Twenty-three patients, 12 (52.2%) female and 11 (47.8%) male, with a mean age of  $64.09 \pm 13.66$  were included. A correlation was determined between a rise in cerebral saturation measured throughout CPR and the return of spontaneous circulation ( $P < .001$ ).



CONCLUSION: Patients whose cerebral saturation values measured with NIRS rise during CPR have a higher post-resuscitation survival rate. Monitoring of patients during CPR with this non-invasive technique may be a good method for predicting return of spontaneous circulation.

*Crit Care*. 2013 Oct 22;17(5):R252. [Epub ahead of print]

**A Cerebral Recovery Index (CRI) for early prognosis in patients after cardiac arrest.**

Tjepkema-Cloostermans MC, van Meulen FB, Meinsma G, van Putten MJ.

Abstract

INTRODUCTION: Electroencephalogram (EEG) monitoring in patients treated with therapeutic hypothermia after cardiac arrest may assist in early outcome prediction. Quantitative EEG (qEEG) analysis can reduce the time needed to review long-term EEG, and makes the analysis more objective. In this study we evaluated the predictive value of qEEG analysis for neurological outcome in postanoxic patients.

METHODS: In total, 109 patients admitted to the ICU for therapeutic hypothermia after cardiac arrest were included, divided over a training and a test set. Continuous EEG was recorded during the first 5 days or until ICU discharge. Neurological outcomes were based on the best achieved Cerebral Performance Category (CPC) score within six months. Of the training set 27 out of 56 patients (48%) and 26 out of 53 patients (49%) of the test set achieved good outcome (CPC 1--2). In all patients a five minute epoch was selected each hour, and five qEEG features were extracted. We introduced the Cerebral Recovery Index (CRI), which combines these features into a single number.

RESULTS: At 24 hours after cardiac arrest, a CRI < 0.29 was always associated with poor neurological outcome, with a sensitivity of 0.55 (95% Confidence interval (CI): 0.32--0.76) at a specificity of 1.00 (CI: 0.86--1.00) in the test set. This results in a positive predictive value (PPV) of 1.00 (CI: 0.73--1.00) and a negative predictive value (NPV) of 0.71 (CI: 0.53--0.85). At the same time point a CRI >0.69 predicted good outcome, with a sensitivity of 0.25 (CI: 0.10--0.14) at a specificity of 1.00 (CI: 0.85--1.00) in the test set, and a corresponding NPV of 1.00 (CI: 0.54--1.00) and a PPV of 0.55 (CI: 0.38--0.70).

CONCLUSIONS: We introduced a combination of qEEG measures expressed in a single number, the CRI, which can assist in prediction of both poor and good outcome in postanoxic patients, within 24 hours after cardiac arrest.

## ENTRENAMENT

*Crit Care Med*. 2013 Oct 23. [Epub ahead of print]

**Improving Code Team Performance and Survival Outcomes: Implementation of Pediatric Resuscitation Team Training.**

Knight LJ, Gabhart JM, Earnest KS, Leong KM, Anglemyer A, Franzon D.

Source: 1Center for Nursing Excellence, Lucile Packard Children's Hospital, Palo Alto, CA.

2Department of Pediatrics, Lucile Packard Children's Hospital, Palo Alto, CA. 3Department of Pediatrics, Stanford University, Palo Alto, CA. 4Division of Trauma Services, Department of Pediatrics, Lucile Packard Children's Hospital, Palo Alto, CA. 5Center for Quality Effectiveness and Process Improvement, Lucile Packard Children's Hospital, Palo Alto, CA. 6Division of Global Health Sciences, Department of Epidemiology and Biostatistics, University of California, San

Francisco, CA. 7Division of Pediatric Critical Care, Department of Pediatrics, Lucile Packard Children's Hospital, Palo Alto, CA.

#### Abstract

**OBJECTIVE:** To determine whether implementation of Composite Resuscitation Team Training is associated with improvement in survival to discharge and code team performance after pediatric in-hospital cardiopulmonary arrest.

**DESIGN, SETTING, AND SUBJECTS:** We conducted a prospective observational study with historical controls at a 302-bed, quaternary care, academic children's hospital. Inpatients who experienced cardiopulmonary arrest between January 1, 2006, and December 31, 2009, were included in the control group (123 patients experienced 183 cardiopulmonary arrests) and between July 1, 2010, and June 30, 2011, were included in the intervention group (46 patients experienced 65 cardiopulmonary arrests).

**INTERVENTION:** Code team members were introduced to Composite Resuscitation Team Training and continued training throughout the intervention period (January 1, 2010-June 30, 2011). Training was integrated via in situ code blue simulations (n = 16). Simulations were videotaped and participants were debriefed for education and process improvement. Primary outcome was survival to discharge after cardiopulmonary arrest. Secondary outcome measures were 1) change in neurologic morbidity from admission to discharge, measured by Pediatric Cerebral Performance Category, and 2) code team adherence to resuscitation Standard Operating Performance variables.

**MEASUREMENTS AND MAIN RESULTS:** The intervention group was more likely to survive than the control group (60.9% vs 40.3%) (unadjusted odds ratio, 2.3 [95% CI, 1.15-4.60]) and had no significant change in neurologic morbidity (mean change in Pediatric Cerebral Performance Category 0.11 vs 0.27; p = 0.37). Code teams exposed to Composite Resuscitation Team Training were more likely than control group to adhere to resuscitation Standard Operating Performance (35.9% vs 20.8%) (unadjusted odds ratio, 2.14 [95% CI, 1.15-3.99]). After adjusting for adherence to Standard Operating Performance, survival remained improved in the intervention period (odds ratio, 2.13 [95% CI, 1.06-4.36]).

**CONCLUSION:** With implementation of Composite Resuscitation Team Training, survival to discharge after pediatric cardiopulmonary arrest improved, as did code team performance. Demonstration of improved survival after adjusting for code team adherence to resuscitation standards suggests that this may be a valuable resuscitation training program. Further studies are needed to determine causality and generalizability.

## ESTUDIS EXPERIMENTALS

*Clinics (Sao Paulo)*. 2013 Sep;68(9):1231-8. doi: 10.6061/clinics/2013(09)10.

**Ulinastatin attenuates oxidation, inflammation and neural apoptosis in the cerebral cortex of adult rats with ventricular fibrillation after cardiopulmonary resuscitation.**

Hu CL, Xia JM, Cai J, Li X, Liao XX, Li H, Zhan H, Dai G, Jing XL.

Source: Department of Emergency Medicine, Sun Yat-Sen University, Guangzhou, China.

#### Abstract

**OBJECTIVE:** The role of Ulinastatin in neuronal injury after cardiopulmonary resuscitation has not been elucidated. We aim to evaluate the effects of Ulinastatin on inflammation, oxidation, and neuronal injury in the cerebral cortex after cardiopulmonary resuscitation.

**METHODS:** Ventricular fibrillation was induced in 76 adult male Wistar rats for 6 min, after which cardiopulmonary resuscitation was initiated. After spontaneous circulation returned, the rats were split into two groups: the Ulinastatin 100,000 unit/kg group or the PBS-treated control group. Blood and cerebral cortex samples were obtained and compared at 2, 4, and 8 h after return of spontaneous circulation. The protein levels of tumor necrosis factor alpha (TNF- $\alpha$ ) and interleukin 6 (IL-6) were assayed using an enzyme-linked immunosorbent assay, and mRNA levels were quantified via real-time polymerase chain reaction. Myeloperoxidase and Malondialdehyde were measured by spectrophotometry. The translocation of nuclear factor- $\kappa$ B p65 was assayed by Western blot. The viable and apoptotic neurons were detected by Nissl and terminal deoxynucleotidyl transferase dUTP nick end labeling (TUNEL).

**RESULTS:** Ulinastatin treatment decreased plasma levels of TNF- $\alpha$  and IL-6, expression of mRNA, and Myeloperoxidase and Malondialdehyde in the cerebral cortex. In addition, Ulinastatin attenuated the translocation of nuclear factor- $\kappa$ B p65 at 2, 4, and 8 hours after the return of spontaneous circulation. Ulinastatin increased the number of living neurons and decreased TUNEL-positive neuron numbers in the cortex at 72 h after the return of spontaneous circulation.

**CONCLUSIONS:** Ulinastatin preserved neuronal survival and inhibited neuron apoptosis after the return of spontaneous circulation in Wistar rats via attenuation of the oxidative stress response and translocation of nuclear factor- $\kappa$ B p65 in the cortex. In addition, Ulinastatin decreased the production of TNF- $\alpha$ , IL-6, Myeloperoxidase, and Malondialdehyde.

**Crit Care Med.** 2013 Oct 18. [Epub ahead of print]

**Prolonged Therapeutic Hypothermia Is More Effective in Attenuating Brain Apoptosis in a Swine Cardiac Arrest Model.**

Suh GJ, Kwon WY, Kim KS, Lee HJ, Jeong KY, Jung YS, Lee JH.

Source: 1Department of Emergency Medicine, Seoul National University Hospital, Seoul, Republic of Korea. 2Department of Emergency Medicine, Seoul Metropolitan Government-Seoul National University Boramae Medical Center, Seoul, Republic of Korea. 3Department of Emergency Medicine, National Medical Center, Seoul, Republic of Korea. 4Department of Emergency Medicine, Seoul National University Bundang Hospital, Seongnam, Gyeonggi-do, Republic of Korea.

**Abstract**

**OBJECTIVES:** To investigate whether 48 hours of therapeutic hypothermia is more effective to attenuate brain apoptosis than 24 hours and to determine whether the antiapoptotic effects of therapeutic hypothermia are associated with the suppressions of the cleavage of protein kinase C- $\delta$ , the cytosolic release of cytochrome c, and the cleavage of caspase 3 in a swine cardiac arrest model.

**DESIGN:** Prospective laboratory study.

**SETTING:** University laboratory.

**SUBJECTS:** Male domestic pigs (n = 24).

**INTERVENTIONS:** After 6 minutes of no-flow time that was induced by ventricular fibrillation, cardiopulmonary resuscitation was provided, and the return of spontaneous circulation was achieved. The animals were randomly assigned to the following groups: sham, normothermia, 24 hours of therapeutic hypothermia, or 48 hours of therapeutic hypothermia. Therapeutic hypothermia (core temperature, 32-34°C) was maintained for 24 or 48 hours post return of

spontaneous circulation, and the animals were rewarmed for 8 hours. At 60 hours post return of spontaneous circulation, the animals were killed, and brain tissues were harvested.

**MEASUREMENTS AND MAIN RESULTS:** We examined cellular apoptosis and neuronal damage in the brain hippocampal cornu ammonis 1 region. We also measured the cleavage of protein kinase C- $\delta$ , the cytosolic release of cytochrome c, and the cleavage of caspase 3 in the hippocampus. The 48 hours of therapeutic hypothermia attenuated cellular apoptosis and neuronal damage when compared with normothermia. There was also a decrease in the cleavage of protein kinase C- $\delta$ , the cytosolic release of cytochrome c, and the cleavage of caspase 3. However, 24 hours of therapeutic hypothermia did not significantly attenuate cellular apoptosis or neuronal damage.

**CONCLUSIONS:** We found that 48 hours of therapeutic hypothermia was more effective in attenuating brain apoptosis than 24 hours of therapeutic hypothermia. We also found that the antiapoptotic effects of therapeutic hypothermia were associated with the suppressions of the cleavage of protein kinase C- $\delta$ , the cytosolic release of cytochrome c, and the cleavage of caspase 3.

**Resuscitation.** 2013 Oct 21. pii: S0300-9572(13)00803-4. doi: 10.1016/j.resuscitation.2013.10.009. [Epub ahead of print]

**Low-dose nitroglycerine improves outcome after cardiac arrest in rats.**

Ebmeyer U, Esser T, Keilhoff G.

Source: Department of Anaesthesiology, University of Magdeburg, Leipziger Strasse 44, Magdeburg, Germany. Electronic address: uwe.ebmeyer@med.ovgu.de.

**Abstract**

**OBJECTIVE:** The aim of this study was to evaluate the outcome of intravenously applied nitroglycerine (NTG, 1 $\mu$ g/kg/min for 1hour) after resuscitation from an asphyxia cardiac arrest (ACA) insult. We hypothesized that NTG infused for one hour after the return of spontaneous circulation (ROSC) would improve functional and neuro-morphological outcomes.

**METHODS:** Adult rats were subjected to 8min of ACA followed by resuscitation. There were three treatment groups: ACA, ACA+NTG and sham operated. Vital and blood parameters were monitored during the one hour post-resuscitation intensive care phase. After survival times of 3, 6, 12, 24, 72hours and 7 days, the neurological deficit score (NDS) was measured.

Histological evaluation of the hippocampus, cortex, the thalamic reticular nucleus and the caudate-putamen was performed 7 days post insult.

**RESULTS:** We found that NTG (i) induced significantly higher initial MAP peaks; (ii) resulted in a less-pronounced elevation of heart rates after ROSC with significantly faster normalization to baseline levels; and (iii) influenced glucose metabolism, temporarily elevating blood glucose to non-physiological levels. Even so, NTG (iv) improved the neurological outcome and (v) reduced neurodegeneration, mainly in the hippocampal CA1 region. A significant NTG-associated decrease in blood pressure did not occur.

**CONCLUSION:** The effect of low-dosed NTG applied post-resuscitation appears to be neuroprotective, demonstrated by reduced hippocampal damage and a better NDS, even with temporarily elevated blood glucose to non-physiological levels. Thus, additional studies are needed to evaluate NTG-triggered mechanisms and optimized dosages before clinical translation should be considered. Animal study institutional protocol number: 42502-2-2-947-Uni-MD.

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**Comparison of cold crystalloid and colloid infusions for induction of therapeutic hypothermia in a porcine model of cardiac arrest.**

Skulec R, Truhlar A, Turek Z, Parizkova R, Dostal P, Hicks S, Lehmann C, Cerny V.

Abstract

**INTRODUCTION:** Large-volume cold intravenous infusion of crystalloids has been used for induction of therapeutic hypothermia after cardiac arrest. However, the effectiveness of cold colloids has not been evaluated. Therefore, we performed an experimental study to investigate the cooling effect of cold normal saline compared to colloid solution in a porcine model of ventricular fibrillation.

**METHODS:** Ventricular fibrillation was induced for 15 minutes in 22 anesthetized domestic pigs. After spontaneous circulation was restored, the animals were randomized to receive either 45 ml/kg of 1[degree sign]C cold normal saline (Group A, 9 animals); or 45 ml/kg of 1[degree sign]C cold colloid solution (Voluven(R), 6% hydroxyethyl starch 130/0.4 in 0.9% NaCl) during 20 minutes (Group B, 9 animals); or to undergo no cooling intervention (Group C, 4 animals). Then, the animals were observed for 90 minutes. Cerebral, rectal, intramuscular, pulmonary artery, and subcutaneous fat body temperatures (BT) were recorded. In the mechanical ex-vivo sub study we added a same amount of cold normal saline or colloid into the bath of normal saline and calculated the area under the curve (AUC) for induced temperature changes.

**RESULTS:** Animals treated with cold fluids achieved a significant decrease of BT at all measurement sites, whereas there was a consistent significant spontaneous increase in group C. At the time of completion of infusion, greater decrease in pulmonary artery BT and cerebral BT in group A compared to group B was detected (-2.1 +/- 0.3 vs. -1.6 +/- 0.2[degree sign]C, and -1.7 +/- 0.4 vs. -1.1 +/- 0.3[degree sign]C,  $p < 0.05$ , respectively). AUC analysis of the decrease of cerebral BT revealed a more vigorous cooling effect in group A compared to group B (-91 +/- 22 vs. -68 +/- 23[degree sign]C/min,  $p = 0.046$ ). In the mechanical sub study, AUC analysis of the induced temperature decrease of cooled solution revealed that addition of normal saline led to more intense cooling than colloid solution (-7155 +/- 647 vs. -5733 +/- 636[degree sign]C/min,  $p = 0.008$ ).

**CONCLUSIONS:** Intravenous infusion of cold normal saline resulted in more intense decrease of cerebral and pulmonary artery BT than colloid infusion in this porcine model of cardiac arrest. This difference is at least partially related to the various specific heat capacities of the coolants.

## **ECMO**

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**An observational study of extracorporeal CPR for in-hospital cardiac arrest secondary to myocardial infarction.**

Chou TH, Fang CC, Yen ZS, Lee CC, Chen YS, Ko WJ, Wang CH, Wang SS, Chen SC.

Source: Department of Emergency Medicine, National Taiwan University Hospital and National Taiwan University College of Medicine, Taipei, Taiwan.

Abstract

**OBJECTIVE:** To determine the effects of extracorporeal cardiopulmonary resuscitation (ECPR)

in patients with in-hospital cardiac arrest (IHCA) due to acute myocardial infarction (AMI).

**METHODS:** IHCA patients due to AMI undergoing CPR between 1 January 2006 and 1 July 2010 were analysed retrospectively. We compared the survival outcome of 43 patients who received ECPR with that of 23 patients who underwent conventional CPR.

**RESULTS:** The survival rate was 34.9% for patients who received ECPR and 21.8% for those who received conventional CPR ( $p=0.4$ ). Increased survival rates to hospital discharge were seen in patients with ST segment elevation ( $p<0.01$ ), or had initial rhythm of ventricular tachycardia/ventricular fibrillation (VT/VF) during resuscitation ( $p=0.031$ ).

**CONCLUSIONS:** ECPR may improve survival in cardiac arrest patients who have a ST segment elevation or initial rhythm of VT/VF myocardial infarction.