

ED ECMO and MORTALITY

Atıf BAYRAMOĞLU

MD, ASS. PROFESSOR

Atatürk University School Of Medicine

ED ECMO and MORTALITY

❑ ECMO is a treatment that uses a man-made heart and lung to support the body when a person's own organs are too sick to do the job

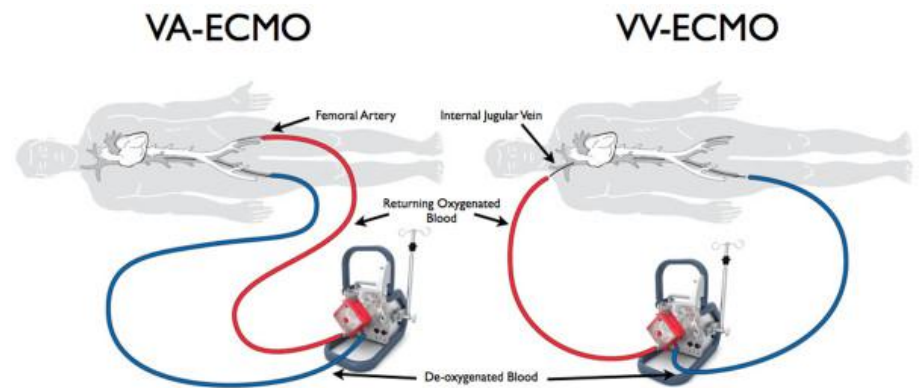
❑ Synonyms:

- extracorporeal membrane oxygenation (ECMO)
- extracorporeal life support
- extracorporeal lung assist.
- Extracorporeal cardiopulmonary resuscitation(ECPR)

ED ECMO and MORTALITY

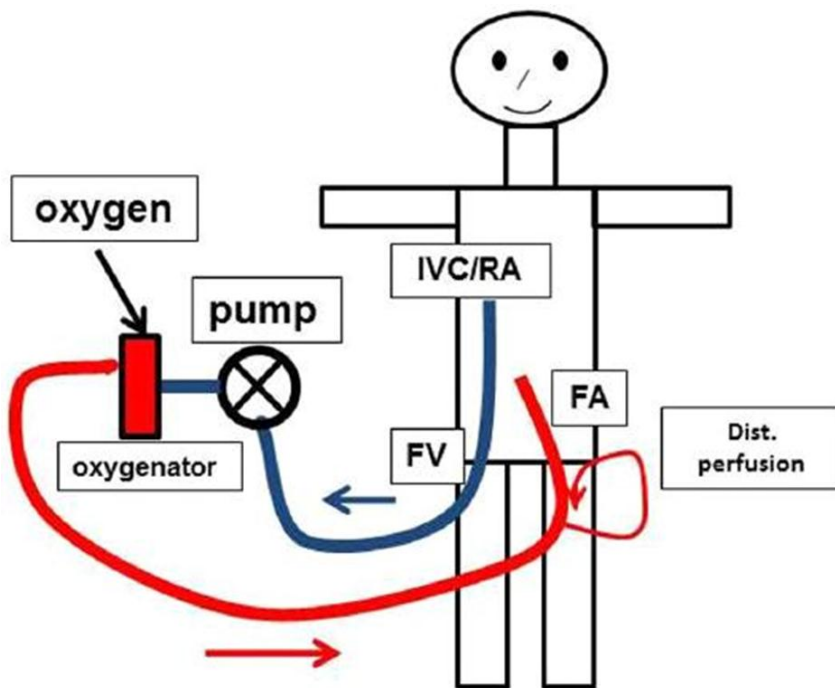
❑ There are two types of ECMO:

- venoarterial (VA)
- venovenous (VV).



❑ Both provide respiratory support, but only VA ECMO provides hemodynamic support.

ED ECMO and MORTALITY

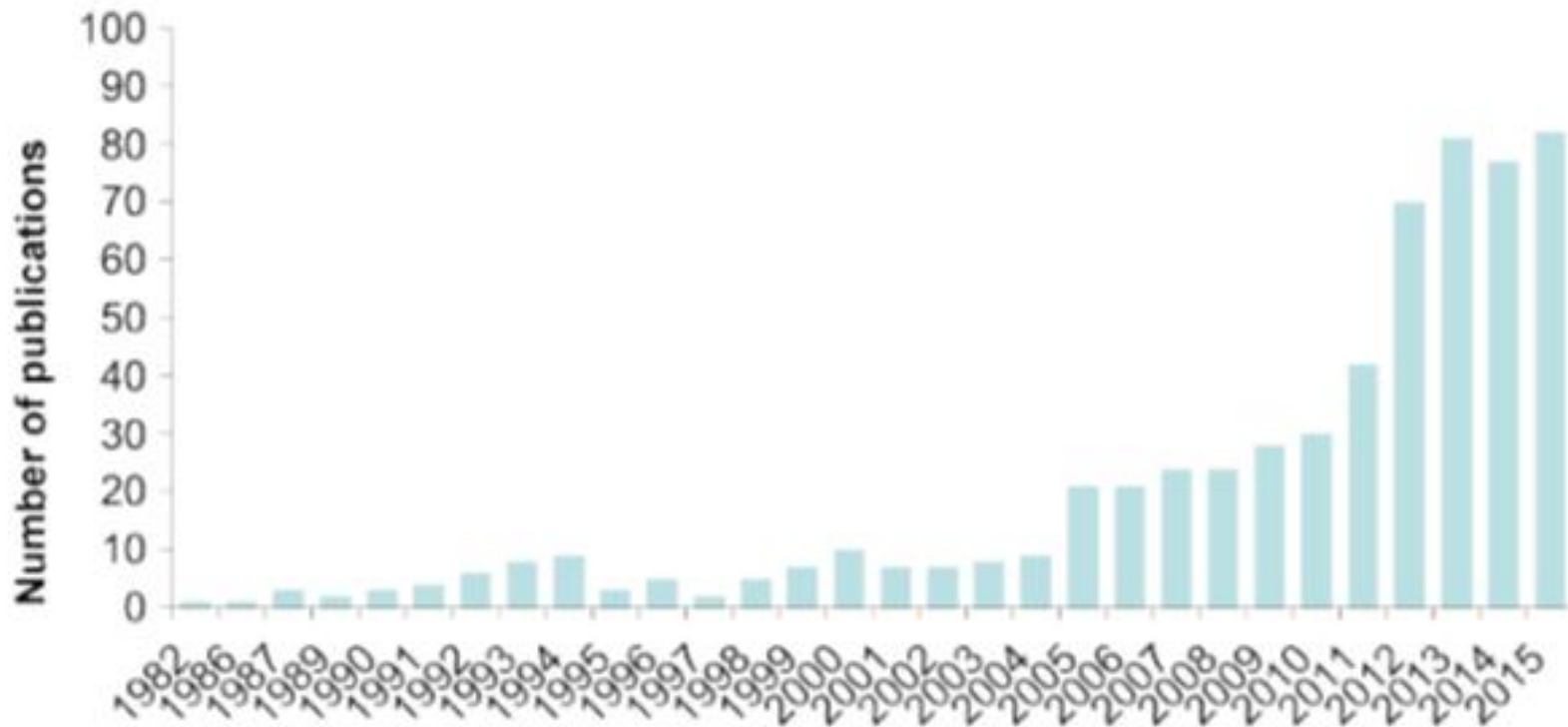


I'd Like to
Help, but...
You Need
ECMO,
Not Elmo.



ED ECMO and MORTALITY

Pubmed: extracorporeal and CPR



ED ECMO and MORTALITY

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

**Part
Dev
2015 American
Res**

Steven C. Brooks
Alan Gaffney; et al.

2015 Recommendation—New

There is insufficient evidence to recommend the routine use of ECPR for patients with cardiac arrest. In settings where it can be rapidly implemented, ECPR may be considered for select patients for whom the suspected etiology of the cardiac arrest is potentially reversible during a limited period of mechanical cardiorespiratory support (Class IIb, LOE C-LD). Published series have used rigorous inclusion and exclusion criteria to select patients for ECPR. Although these inclusion criteria are highly variable, most included only patients aged 18 to 75 years, with arrest of cardiac origin, after conventional CPR for more than 10 minutes without ROSC. Such inclusion criteria should be considered in a provider's selection of potential candidates for ECPR.



ED ECMO and MORTALITY

Venoarterial Extracorporeal Membrane Oxygenation for Cardiogenic Shock and Cardiac Arrest: A Meta-Analysis

Ashleigh Xie,*† Kevin Phan, BSc,*¶ Yi-Chin Tsai MBBS,‡ Tristan D. Yan, MD, MS, PhD, FRACS,*§¶ and Paul Forrest, MBChB, FANZCA||¶

Objective: To evaluate the effect of extracorporeal membrane oxygenation (ECMO) on survival and complication rates in adults with refractory cardiogenic shock or cardiac arrest.

Design: Meta-analysis.

Setting: University hospitals.

Participants: One thousand one hundred ninety-nine patients from 22 observational studies.

Interventions: None.

Measurements and Main Results: Observational studies published from the year 2000 onwards, examining at least 10 adult patients who received ECMO for refractory cardiogenic shock or cardiac arrest were included. Pooled estimates with 95% confidence intervals were calculated based on the Freeman-Tukey double-arcsine transformation and DerSimonian-Laird random-effect model. Survival to discharge was 40.2% (95% confidence intervals [CI], 33.9-46.7), while survival at 3, 6, and 12 months was 55.9% (95% CI, 41.5-69.8), 47.6% (95% CI, 25.4-70.2), and 54.4% (95% CI, 36.6-71.7), respectively. Survival up to 30 days was higher in cardiogenic shock patients (52.5%, 95% CI, 43.7%-61.2%)

compared to cardiac arrest (36.2%, 95% CI, 23.1%-50.4%). Concurrently, complication rates were particularly substantial for neurologic deficits (13.3%, 95% CI, 8.3-19.3), infection (25.1%, 95% CI, 15.9-35.5), and renal impairment (47.4%, 95% CI, 30.2-64.9). Significant heterogeneity was detected, although its levels were similar to previous meta-analyses that only examined short-term survival to discharge.

Conclusions: Venoarterial ECMO can improve short-term survival in adults with refractory cardiogenic shock or cardiac arrest. It also may provide favorable long-term survival at up to 3 years postdischarge. However, ECMO also is associated with significant complication rates, which must be incorporated into the risk-benefit analysis when considering treatment. These findings require confirmation by large, adequately controlled and standardized trials with long-term follow-up.

© 2015 Elsevier Inc. All rights reserved.

KEY WORDS: cardiogenic shock, cardiac arrest, extracorporeal membrane oxygenation, extracorporeal circulation, meta-analysis, adult

CARDIOGENIC SHOCK AND CARDIAC arrest that are refractory to conventional therapy have a persistently high mortality.¹⁻³ In more than 75% of cases, cardiogenic shock is due to acute myocardial infarction.^{4,5} This has a mortality of 40% to 60%,^{5,6} which recently has been shown to be unaltered by the use of an intra-aortic balloon pump placed after an attempted percutaneous coronary intervention.⁷ Cardiogenic shock is also an uncommon but serious complication in adult

selection is essential for acceptable survival outcomes.⁹ Recent data on ECMO use in refractory cardiac shock^{3,17,25,26} and arrest^{14,27,28} primarily consist of cohort studies, case series, and case reports, with small sample sizes. Although the International Extracorporeal Life Support Organization registry provides multicenter data on cardiac extracorporeal support, these represent collective results only, without statistical analysis for factors such as heterogeneity. To date, there remains a lack of

Xie, A., et al. (2015). "Venoarterial extracorporeal membrane oxygenation for cardiogenic shock and cardiac arrest: a meta-analysis." *J Cardiothorac Vasc Anesth* 29(3): 637-645.

ED ECMO and MORTALITY



Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation



Clinical Paper

Emergency cardio-pulmonary bypass in cardiac arrest: Seventeen years of experience[☆]

Christian Wallmüller^a, Fritz Sterz^{a,*}, Christoph Testori^a, Andreas Schober^a, Peter Stratil^a, David Hörburger^a, Mathias Stöckl^a, Christoph Weiser^a, Danica Kricanac^a, Daniel Zimpfer^b, Zeno Deckert^b, Michael Holzer^a

^a Department of Emergency Medicine, Medical University Vienna, Austria

^b Department of Cardiac Surgery, Medical University Vienna, Austria

ARTICLE INFO

Article history:

Received 23 January 2012

Received in revised form 8 April 2012

Accepted 11 May 2012

Keywords:

Emergency cardiopulmonary bypass

Cardiac arrest

Feasibility

Outcome

Safety

ABSTRACT

Aim: Emergency cardiopulmonary bypass (E-CPB) is an advanced and rarely used procedure for patients in cardiac arrest that do not regain restoration of spontaneous circulation with standard resuscitation methods. The feasibility, safety and outcome of the intervention with E-CPB in cardiac arrest situations at our department have been evaluated.

Methods: Clinical presentation, time intervals, diagnosis and outcome of all patients who received E-CPB at an emergency department of a tertiary care university hospital were evaluated. Patient charts were reviewed regarding cardiac arrest variables and treatment data of all patients from 1993 to 2010.

Results: E-CPB was performed in 55 patients. Of all patients, 33 (60%) were male and the median age was 32 years (IQR 24–44). In all cases cardiac arrest was witnessed. The first recorded ECG rhythm showed pulseless electric activity in 23 (42%), ventricular fibrillation in 21 (38%) and asystole in 11 (20%) patients. Cardiac arrest occurred out-of-hospital in 33 (60%) patients. The median duration of CPR before performing E-CPB was 86 min (IQR 69–121). The median 'cannulation'-time was 33 min (IQR 21–45) and the duration on bypass was 311 min (IQR 161–953). Cardiac causes of arrest were found in 19 (35%) patients. Eight patients (15%) survived to 6 months with good neurological outcome.

Conclusion: E-CPB for cardiac arrest is feasible and safe. In this seemingly desperate patient population after prolonged cardiac arrest, we observed a high survival rate of 15%. E-CPB is a meaningful treatment option, which should be considered more often and earlier.

© 2012 Elsevier Ireland Ltd. All rights reserved.

ED ECMO and MORTALITY

- 3621 patients with cardiac arrest at the ED
- 55 patients(2%) were treated with ECPR
- 60% OHCA
- Time to till start of canulation 52 minutes
- Weaning from ECMO 14(25%)
- 6 months survival 8(15%)

ED ECMO and MORTALITY

Articles



Cardiopulmonary resuscitation with assisted extracorporeal life-support versus conventional cardiopulmonary resuscitation in adults with in-hospital cardiac arrest: an observational study and propensity analysis

Yih-Shang Chen*, Jou-Wei Lin*, Hsi-Yu Yu, Wen-Je Ko, Jih-Shuin Jerng, Wei-Tien Chang, Wen-Jone Chen, Shu-Chien Huang, Nai-Hsin Chi, Chih-Hsien Wang, Li-Chin Chen, Pi-Ru Tsai, Sheoi-Shen Wang, Juey-Jen Hwang, Fang-Yue Lin

Summary

Background Extracorporeal life-support as an adjunct to cardiac resuscitation has shown encouraging outcomes in patients with cardiac arrest. However, there is little evidence about the benefit of the procedure compared with conventional cardiopulmonary resuscitation (CPR), especially when continued for more than 10 min. We aimed to assess whether extracorporeal CPR was better than conventional CPR for patients with in-hospital cardiac arrest of cardiac origin.

Methods We did a 3-year prospective observational study on the use of extracorporeal life-support for patients aged 18–75 years with witnessed in-hospital cardiac arrest of cardiac origin undergoing CPR of more than 10 min compared with patients receiving conventional CPR. A matching process based on propensity-score was done to equalise potential prognostic factors in both groups, and to formulate a balanced 1:1 matched cohort study. The primary endpoint was survival to hospital discharge, and analysis was by intention to treat. This study is registered with ClinicalTrials.gov, number NCT00173615.

Findings Of the 975 patients with in-hospital cardiac arrest events who underwent CPR for longer than 10 min, 113 were enrolled in the conventional CPR group and 59 were enrolled in the extracorporeal CPR group. Unmatched patients who underwent extracorporeal CPR had a higher survival rate to discharge (log-rank $p < 0.0001$) and a better 1-year survival than those who received conventional CPR (log rank $p = 0.007$). Between the propensity-score matched groups, there was still a significant difference in survival to discharge (hazard ratio [HR] 0.51, 95% CI 0.35–0.74, $p < 0.0001$), 30-day survival (HR 0.47, 95% CI 0.28–0.77, $p = 0.003$), and 1-year survival (HR 0.53, 95% CI 0.33–0.83, $p = 0.006$) favouring extracorporeal CPR over conventional CPR.

Interpretation Extracorporeal CPR had a short-term and long-term survival benefit over conventional CPR in patients with in-hospital cardiac arrest of cardiac origin.

Funding National Science Council, Taiwan.

Lancet 2008; 372: 554–61

Published Online

July 7, 2008

DOI:10.1016/S0140-6736(08)60958-7

See Comment page 512

* These authors contributed equally

Department of Surgery (Y-S Chen MD, H-Y Yu MD,

W-J Ko MD, S-C Huang MD,

N-H Chi MD, C-H Wang MD,

P-R Tsai RN, S-S Wang MD,

F-Y Lin MD), Department of

Medicine (J-S Jerng MD,

W-J Chen MD, L-C Chen RN,

J-J Hwang MD), and Department

of Emergency (W-T Chang MD),

National Taiwan University

Hospital, Taipei, Taiwan; and

Cardiovascular Center, National

Taiwan University Hospital

Yun-Lin Branch, Dou-Liou City,

Yun-Lin, Taiwan (J-W Lin MD,

J-J Hwang)

Correspondence to:

Fang-Yue Lin, Department of

Surgery, National Taiwan

University Hospital, Taipei 100,

Taiwan

yschen1234@gmail.com

Chen YS et al. (2008). "Cardiopulmonary resuscitation with assisted extracorporeal life-support versus conventional cardiopulmonary resuscitation in adults with in-hospital cardiac arrest: an observational study and propensity analysis." Lancet 372(9

ED ECMO and MORTALITY

- 3-year prospective observational study
- ECMO for 59 patients
- Conventional CPR 113 patients
- Age 18-75 years
- Patients with witnessed IHCA of cardiac origin
- Undergoing CPR for more than 10 minutes
- Propensity score matched with conventional CPR

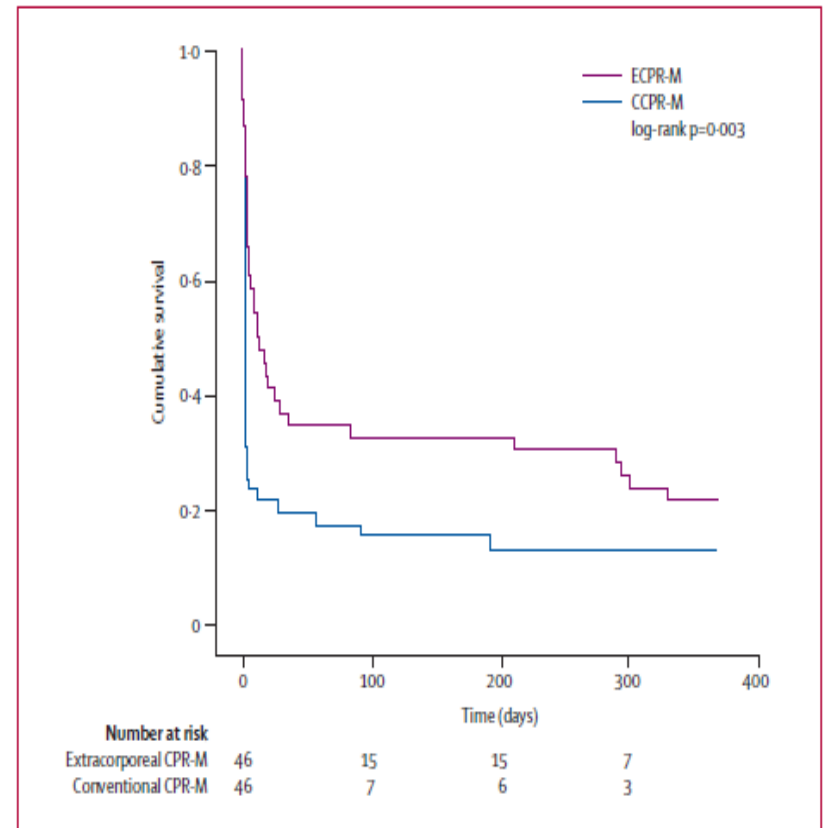


Figure 3: Kaplan-Meier plot of the survival curves in the extracorporeal CPR-M and conventional CPR-M groups for 1 year

Chen, Y. S., et al. (2008). "Cardiopulmonary resuscitation with assisted extracorporeal life-support versus conventional cardiopulmonary resuscitation in adults with in-hospital cardiac arrest: an observational study and propensity analysis." *Lancet*

ED ECMO and MORTALITY

- Weaning from ECMO 49%
- Survival to discharge 29%(ECMO) to 12%(CCPR)

ED ECMO and MORTALITY

Should We Emergently Revascularize Occluded Coronaries for Cardiac Arrest?

Rapid-Response Extracorporeal Membrane Oxygenation and Intra-Arrest Percutaneous Coronary Intervention

Eisuke Kagawa, MD; Keigo Dote, MD, PhD; Masaya Kato, MD, PhD; Shota Sasaki, MD, PhD; Yoshinori Nakano, MD; Masato Kajikawa, MD; Akifumi Higashi, MD; Kiho Itakura, MD; Akihiko Sera, MD, PhD; Ichiro Inoue, MD, PhD; Takuji Kawagoe, MD, PhD; Masaharu Ishihara, MD, PhD; Yuji Shimatani, MD; Satoshi Kurisu, MD, PhD

Background—Extracorporeal membrane oxygenation (ECMO) and percutaneous coronary intervention (PCI) may be useful in cardiopulmonary resuscitation. However, little is known about the combination of ECMO and intra-arrest PCI. This study investigated the efficacy of rapid-response ECMO and intra-arrest PCI in patients with cardiac arrest complicated by acute coronary syndrome who were unresponsive to conventional cardiopulmonary resuscitation.

Methods and Results—This multicenter cohort study was conducted with the use of the database of ECMO in Hiroshima City, Japan. Between January 2004 and May 2011, rapid-response ECMO was performed in 86 patients with acute coronary syndrome who were unresponsive to conventional CPR. The median age of the study patients was 63 years, and 81% were male. Emergency coronary angiography was performed in 81 patients (94%), and intra-arrest PCI was performed in 61 patients (71%). The rates of return of spontaneous heartbeat, 30-day survival, and favorable neurological outcomes were 88%, 29%, and 24%, respectively. All of the patients who received intra-arrest PCI achieved return of spontaneous heartbeat. In patients who survived up to day 30, the rate of out-of-hospital cardiac arrest was lower (58% versus 28%; $P=0.01$), the intra-arrest PCI was higher (88% versus 70%; $P=0.04$), and the time interval from collapse to the initiation of ECMO was shorter (40 [25–51] versus 54 minutes [34–74 minutes]; $P=0.002$).

Conclusions—Rapid-response ECMO plus intra-arrest PCI is feasible and associated with improved outcomes in patients who are unresponsive to conventional cardiopulmonary resuscitation. On the basis of these findings, randomized studies of intra-arrest PCI are needed. (*Circulation*. 2012;126:1605-1613.)

Key Words: acute coronary syndrome ■ cardiac arrest ■ cardiopulmonary bypass ■ cardiopulmonary resuscitation

ED ECMO and MORTALITY

- 7-year retrospective study
- ECMO for 86 patients
- Age 18–74 years
- Cardiac arrest of cardiac origin,
- 49% OHCA
- Weaning from ECMO 50%
- 30-days survival 29%

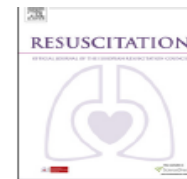
ED ECMO and MORTALITY



Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation



Clinical Paper

Extracorporeal cardiopulmonary resuscitation versus conventional cardiopulmonary resuscitation in adults with out-of-hospital cardiac arrest: A prospective observational study[☆]



Tetsuya Sakamoto, Naoto Morimura*, Ken Nagao, Yasufumi Asai, Hiroyuki Yokota, Satoshi Nara, Mamoru Hase, Yoshio Tahara, Takahiro Atsumi, SAVE-J Study Group¹

The Japanese Scientific Research Group of the Ministry of Health, Labour and Welfare for Extracorporeal Cardiopulmonary Resuscitation: Study of Advanced Cardiac Life Support for Ventricular Fibrillation with Extracorporeal Circulation in Japan (SAVE-J), Japan

ARTICLE INFO

Article history:

Received 21 August 2013

Received in revised form 27 January 2014

Accepted 30 January 2014

Keywords:

Out-of-hospital cardiac arrest

Ventricular fibrillation

Cardiopulmonary resuscitation

Extracorporeal cardiopulmonary resuscitation

Advanced life support

Percutaneous cardiopulmonary support

ABSTRACT

Background: A favorable neurological outcome is likely to be achieved in out-of-hospital cardiac arrest (OHCA) patients with ventricular fibrillation or pulseless ventricular tachycardia (VF/VT) on the initial electrocardiogram (ECG). However, in patients without pre-hospital restoration of spontaneous circulation despite the initial VF/VT, the outcome is extremely low by conventional cardiopulmonary resuscitation (CPR).

Extracorporeal CPR (ECPR) may enhance cerebral blood flow and recovery of neurological function. We prospectively examined how ECPR for OHCA with VF/VT would affect neurological outcomes.

Methods and results: The design of this trial was a prospective, observational study. We compared differences of outcome at 1 and 6 months after OHCA between ECPR group (26 hospitals) and non-ECPR group (20 hospitals). Primary endpoints were the rate of favorable outcomes defined by the Glasgow-Pittsburgh Cerebral Performance and Overall Performance Categories (CPC) 1 or 2 at 1 and 6 months after OHCA. Based on intention-to-treat analysis, CPC 1 or 2 were 12.3% (32/260) in the ECPR group and 1.5% (3/194) in the non-ECPR group at 1 month ($P < 0.0001$), and 11.2% (29/260) and 2.6% (5/194) at 6 months ($P = 0.001$), respectively. By per protocol analysis, CPC 1 or 2 were 13.7% (32/234) in the ECPR group and 1.9% (3/159) in the non-ECPR group at 1 month ($P < 0.0001$), and 12.4% (29/234) and 3.1% (5/159) at 6 months ($P = 0.002$), respectively.

Conclusions: In OHCA patients with VF/VT on the initial ECG, a treatment bundle including ECPR, therapeutic hypothermia and IABP was associated with improved neurological outcome at 1 and 6 months after OHCA.

ED ECMO and MORTALITY

- 3 year prospective study
- VF/VT initial ECG, 20-70 years
- Hospital arrival within 45min after EMS call

Number of participating hospital	26 hospitals ECPR	20 hospitals non-ECPR
Number of patients	260 patients	194 patients
After a month	13,7%	1.9%
After 6 months	12.4%	3.1%

ED ECMO and MORTALITY



Contents lists available at ScienceDirect

Resuscitation

Journal homepage: www.elsevier.com/locate/resuscitation



Clinical Paper

Refractory cardiac arrest treated with mechanical CPR, hypothermia, ECMO and early reperfusion (the CHEER trial)[☆]



Dion Stub^{c,f,g}, Stephen Bernard^{a,b,d,*}, Vincent Pellegrino^a, Karen Smith^{b,d,e}, Tony Walker^d, Jayne Sheldrake^a, Lisen Hockings^a, James Shaw^{a,b,c}, Stephen J. Duffy^{a,b,c}, Aidan Burrell^{a,b}, Peter Cameron^{a,b}, De Villiers Smit^a, David M. Kaye^{a,b,c}

^a Alfred Hospital, Australia

^b Monash University, Australia

^c Baker IDI Heart and Diabetes Research Institute, Australia

^d Ambulance Victoria, Australia

^e University of Western Australia, Australia

^f University of Washington, United States

^g St. Paul's Hospital, Vancouver, Canada

ARTICLE INFO

Article history:

Received 20 November 2013

Received in revised form 22 August 2014

Accepted 11 September 2014

Keywords:

Cardiac arrest

Resuscitation

Extracorporeal membrane oxygenation

ABSTRACT

Introduction: Many patients who suffer cardiac arrest do not respond to standard cardiopulmonary resuscitation. There is growing interest in utilizing veno-arterial extracorporeal membrane oxygenation assisted cardiopulmonary resuscitation (E-CPR) in the management of refractory cardiac arrest. We describe our preliminary experiences in establishing an E-CPR program for refractory cardiac arrest in Melbourne, Australia.

Methods: The CHEER trial (mechanical CPR, Hypothermia, ECMO and Early Reperfusion) is a single center, prospective, observational study conducted at The Alfred Hospital. The CHEER protocol was developed for selected patients with refractory in-hospital and out-of-hospital cardiac arrest and involves mechanical CPR, rapid intravenous administration of 30 mL/kg of ice-cold saline to induce intra-arrest therapeutic hypothermia, percutaneous cannulation of the femoral artery and vein by two critical care physicians and commencement of veno-arterial ECMO. Subsequently, patients with suspected coronary artery occlusion are transferred to the cardiac catheterization laboratory for coronary angiography. Therapeutic hypothermia (33 °C) is maintained for 24 h in the intensive care unit.

Results: There were 26 patients eligible for the CHEER protocol (11 with OHCA, 15 with IHCA). The median age was 52 (IQR 38–60) years. ECMO was established in 24 (92%), with a median time from collapse until initiation of ECMO of 56 (IQR 40–85) min. Percutaneous coronary intervention was performed on 11 (42%) and pulmonary embolectomy on 1 patient. Return of spontaneous circulation was achieved in 25 (96%) patients. Median duration of ECMO support was 2 (IQR 1–5) days, with 13/24 (54%) of patients successfully weaned from ECMO support. Survival to hospital discharge with full neurological recovery (CPC score 1) occurred in 14/26 (54%) patients.

Conclusions: A protocol including E-CPR instituted by critical care physicians for refractory cardiac arrest which includes mechanical CPR, peri-arrest therapeutic hypothermia and ECMO is feasible and associated with a relatively high survival rate.

ED ECMO and MORTALITY

- Prospective study
- Age 18-65 years
- Cardiac arrest of cardiac origin
- Initial rhythm ventricular fibrillation
- CPR > 30min
- 26 patients, 11 OHCA, 15 IHCA

ED ECMO and MORTALITY

- ROSC 92% (25/26)
- Median duration of ECMO support 2 days(1-5)
- Weaning from ECMO 54% (13/24)
- Survival to hospital discharge 54%(15/26)
- Patients with IHCA 60%(9/15)
- Patients with ;OHCA 45% (5/11)
- CPC 1 of survivors: 100%

ED ECMO and MORTALITY

- ❑ ECMO might be recommended for adult IHCA and OHCA patients of cardiac origin who have undergone CPR for more than 10 min and could provide a short-term and long-term survival advantage.
- ❑ Further studies will be needed to identify potential subgroups in cardiac arrest patients who could benefit from ECMO.

ED ECMO and MORTALITY

- THANK YOU
- QUESTIONS? COMMENTS?
- atifbay@gmail.com