Resuscitation 83 (2012) 976–981

Contents lists available at SciVerse ScienceDirect

Resuscitation

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

Clinical Paper

Resuscitation of non-postcardiotomy cardiogenic shock or cardiac arrest with extracorporeal life support: The role of bridging to intervention☆

Meng-Yu Wu[a], Ming-Yih Lee[b], Chien-Chao Lin[a], Yu-Sheng Chang[a], Feng-Chun Tsai[a], Pyng-Jing Lin[a,*]

[a] Department of Cardiovascular Surgery, Chang Gung Memorial Hospital and Chang Gung University, Taoyuan, Taiwan, ROC
[b] Department of Mechanical Engineering, Chang Gung University, Taoyuan, Taiwan, ROC

ARTICLE INFO

Article history:
Received 20 August 2011
Received in revised form 6 January 2012
Accepted 8 January 2012

Keywords:
Extracorporeal life support
Extracorporeal membrane oxygenation
Cardiopulmonary resuscitation
Mechanical circulatory support
Post-cardiac arrest syndrome

ABSTRACT

Background: To investigate the predictors of adverse outcomes of extracorporeal life support (ECLS) in rescuing adult non-postcardiotomy cardiogenic shock or cardiac arrest (non-PC CS/CA).
Materials and methods: This retrospective study included 60 adult patients receiving ECLS for non-PC CS/CA in a single institution between June 2003 and June 2010. The exclusion criteria were (1) pre-ECLS cardiac surgeries in the same admission and (2) age < 18 years. Pre-ECLS and ECLS characteristics were compared in patients surviving to hospital discharge and those who did not. Mortalities after hospital discharge were also investigated.
Results: Of the 38 patients weaned from ECLS, 32 survived to discharge. Acute myocardial infarction (AMI) and myocarditis were the most common aetiologies in this study. Forty patients experienced pre-ECLS conventional cardiopulmonary resuscitation (C-CPR) and 29 required an ECLS-assisted CPR (E-CPR). Thirteen patients who received E-CPR had profound anoxic encephalopathy later. In-hospital mortality was similar in AMI patients who underwent emergent coronary artery bypass grafting (CABG) after a failed percutaneous coronary intervention (PCI, 43%, 5/11) and those who underwent PCI only (58%, 7/12). Aetiologies other than myocarditis (odds ratio (OR) 11.0, 95% confidence interval (CI) 1.5–78.5), requirement for E-CPR (OR 5.6, 95% CI 1.5–22.0) and profound anoxic encephalopathy (OR 8.9, 95% CI 2.0–40.5) were predictors of in-hospital mortality. No risk factors of mortality after hospital discharge were identified.
Conclusion: ECLS was effective in bridging adults with non-PC CS/CA to definite treatments. Their prognosis depended on the cause of collapse and the severity of the post-cardiac arrest syndrome.

Extracorporeal life support (ECLS) is regarded as an effective device to treat non-postcardiotomy cardiogenic shock or cardiac arrest (non-PC CS/CA) now due to its ability to provide a quick circulatory support via peripheral implantation.[1] However, ECLS alone is insufficient to solve the problems of patients who collapsed due to anatomical cardiac diseases such as acute myocardial infarction (AMI) or pulmonary emboli (PE). The role of ECLS in these scenarios is to keep the patients alive temporarily to allow physicians time to perform diagnostic and therapeutic interventions to solve the anatomic problems.[2–4] This is particularly crucial in patients who have collapsed due to extensive AMI since the continuing myocardial injuries can only be eliminated by effective re-perfusion, and the viability of the myocardium is important to both short-term and long-term survival after this episode.[5,6] Most rescued patients require a period of ECLS to recover from injuries of the original disease, adverse effects of interventions and ischaemic–reperfusion responses to the temporary cessation of circulation (the 'post-cardiac arrest syndrome'[7]). The occurrence of significant anoxic encephalopathy is closely related to an extended cessation of circulation before the spontaneous circulation is restored by ECLS,[8] and it is an important determinant of proceeding with aggressive interventions when on ECLS.[9] Therefore, strategies to shorten the duration of cessation of circulation and to expeditiously resolve the original insults on ECLS are crucial to increasing the survival of ECLS in treating non-PC CS/CA.[2] To investigate the predictors of adverse outcomes of ECLS in rescuing adult patients with non-PC CS/CA, we reviewed a 7-year experience of adult ECLS.

1. Materials and methods

From January 2003 to June 2010, 296 adult patients (aged > 18 years) received ECLS with intent to treat in our institution. After excluding patients who received ECLS due to PC CS/CA,

☆ A Spanish translated version of the abstract of this article appears as Appendix in the final online version at doi:10.1016/j.resuscitation.2012.01.010.

* Corresponding author at: Division of Cardiovascular Surgery, Chang Gung Memorial Hospital, 5, Fushing Street, Gueishan Shiang, Taoyuan 333, Taiwan, ROC. Tel.: +886 3 3281200x2118; fax: +886 3 3285818.
E-mail address: archer3627@gmail.com (P.-J. Lin).

0300-9572/$ – see front matter © 2012 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.resuscitation.2012.01.010

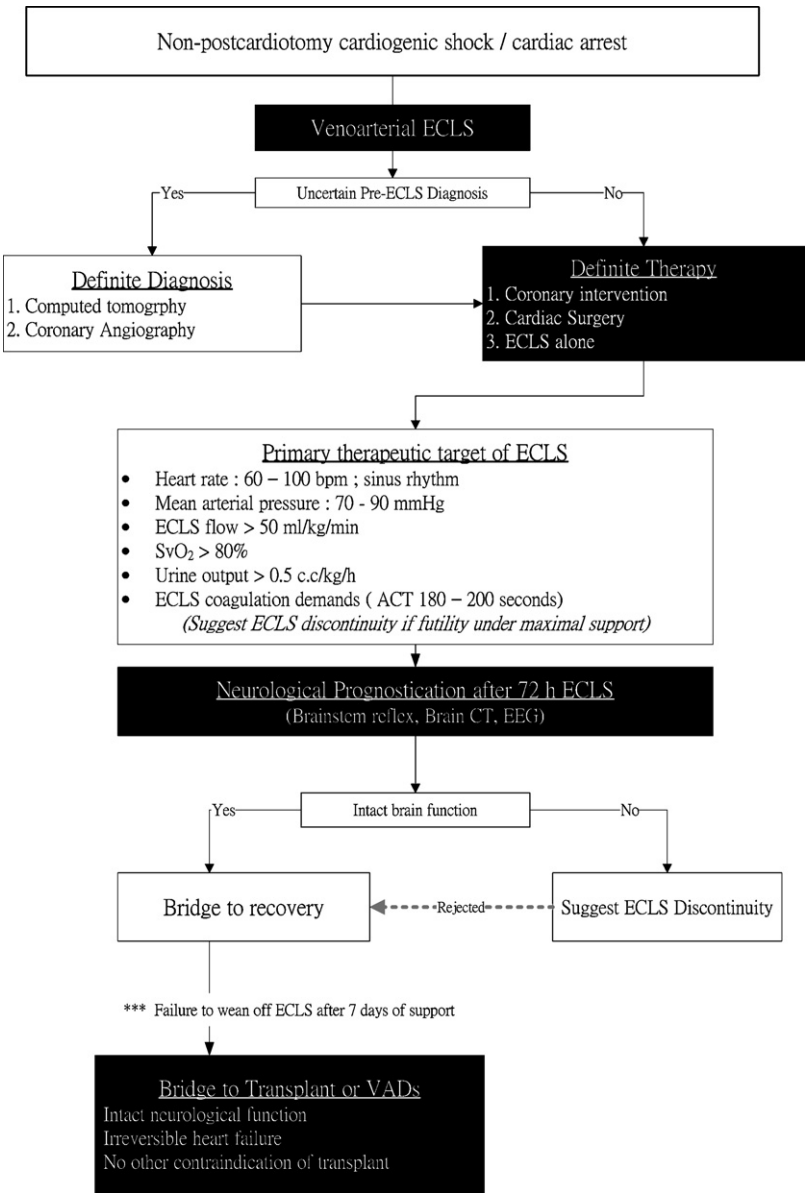

Fig. 1. Therapeutic protocol for adult non-postcardiotomy extracorporeal life support (ECLS) in cardiogenic shock or cardiac arrest. MAP, mean arterial pressure; SvO_2, mixed venous oxygen saturation; VAD, ventricular assist device.

had an out-of-hospital CA with an uncertain period of cessation of spontaneous circulation and had a respiratory distress without shock, only 60 patients (mean age: 49 years, M:F = 40:20) were considered to have ECLS due to non-PC CS/CA and were enrolled in this retrospective study. The study protocol was approved by the institutional review board of our hospital.

Venoarterial (VA) ECLS was considered when a refractory CS or a CA without restoration of spontaneous circulation (ROSC) after 15 min of conventional cardiopulmonary resuscitation (C-CPR) occurred. Refractory CS was defined as: (1) persistent hypotension (systolic blood pressure < 90 mmHg) in patients with a newly developed or known heart failure under the support of high-dose inotropic drugs or intra-aortic balloon counterpulsation or (2) ventricular tachycardia refractory to anti-arrhythmic medications and cardioversions. The ECLS-assisted CPR (E-CPR) was defined as the rescue process while ECLS was used to obtain ROSC in cardiac-arrested patients unresponsive to C-CPR. The duration of E-CPR was defined as the duration from witnessed CA to ROSC with ECLS. The details of our device and techniques of ECLS have been described in our previous studies.[4,10] Fig. 1 summarises our ECLS protocol in rescuing adult patients with non-PC CS/CA. In brief, after ECLS deployment, patients were sent for image studies or therapeutic interventions according to the pre-ECLS diagnosis. Patients with a definite pre-ECLS diagnosis received specific therapeutic interventions to resolve the culprit lesions as soon as possible. Diagnostic interventions, including echocardiogram, coronary catheterisation, and chest and cerebral computed tomography (CT), were provided optionally when extensive AMI, cardiac valve obstruction, massive PE, aortic dissection or cerebral haemorrhage was suspected as the cause. Coronary catheterisation was often the first intervention on ECLS to exclude significant coronary artery disease (CAD) in patients with CA or clinical evidences of myocardial ischaemia.[6] Percutaneous coronary intervention (PCI) was the choice of coronary revascularisation when a significant CAD