Complete Recovery after Prolonged Resuscitation Using Extracorporeal Membrane Oxygenation for In-hospital Arrest Due to Refractory Ventricular Fibrillation

Division of Cardiology, Department of Internal Medicine, School of Medicine, Chungnam National University, Chungnam National University Hospital, Daejeon, Republic of Korea

Yong Kyu Park, M.D., Si Wan Choi, M.D., Seon-Ah Jin, M.D., Kye Taek Ahn, M.D., Jun Hyung Kim, M.D., Jae-Hyeong Park, M.D., Jae-Hwan Lee, M.D., Jin-Ok Jeong, M.D., In-Whan Seong, M.D.

Extracorporeal life support (ECLS) has been used as an adjunctive therapy to conventional cardiopulmonary resuscitation (CPR) in patients with in-hospital cardiac arrest. However, whether to apply ECLS after prolonged CPR (>30 minutes) is a difficult decision. We present the case of a 49-year-old woman with in-hospital cardiac arrest caused by refractory ventricular fibrillation and rescued by extracorporeal membrane oxygenation (ECMO) during prolonged CPR. The ECMO was implemented 90 minutes after the initiation of CPR and the total duration of CPR was about 5 hours. The patient fully recovered and was discharged without neurological complications.

Key Words: Extracorporeal membrane oxygenation, Cardiopulmonary resuscitation, Ventricular fibrillation

Introduction

ECLS system has undergone rapid technological improvements and is being used for broader indications then before. Recently, it has been proposed as rescue therapy for refractory in-hospital cardiac arrest in patients unresponsive to conventional CPR. However, there is a controversy about the application of ECLS after prolonged CPR (>30 minutes).

Case Report

A 49-year-old woman presented with an episode of syncope. Her electrocardiography (ECG) showed atrial fibrillation and T wave inversion in leads II, III, aVF, V3-6 (Fig. 1), but the coronary angiogram was normal. Initial laboratory finding including cardiac enzyme was nonspecific except mild hypokalemia (3.3 mEq/L). The blood pressure was 128/78 mmHg, heart rate was 114 beats per minute, respiratory rate was 28 breaths per minutes, body temperature was 36.7 °C, and saturation was 91% on arrival. She had no past medical history. Shortly after her arrival, she suddenly collapsed with mental change. ECG revealed ventricular fibrillation (VF, Fig. 2). Immediate defibrillation and standard CPR were started. We performed intubation, manual chest compression with repeated defibrillation (6 times), repeated intravenous injection of epinephrine (16 times), continuous infusion of amiodarone, dopamine, dobutamine and norepinephrine and replacement of magnesium and bicarbonate for 90 minutes. However, there was no return of spontaneous circulation (ROSC). The attending physician decided to use ECMO (Rotaflow, Maquet corp.). After insertion of a 17-F arterial and a 21-F venous catheter to right femoral vessels, the flow rate was set at 2.5 L/min and gradually increased up to 4.0 L/min. VF persisted despite of ECMO support and continuous CPR. The total duration of CPR was about 5 hours and finally ROSC was achieved with defibrillation 200 J (biphasic shock). After ROSC, hemodynamic stability was maintained and there was no recurrence of VF. The patient showed spontaneous eye opening and cooperation on day 2 and weaned off ECMO support on day 4. The ventilator care was continued until tenth hospital day. The echocardiography showed no specific findings and ECG showed normal sinus rhythm. Hospital course was complicated by pneumonia, acute renal failure requiring hemodialysis, rectal ulcer with bleeding, but the patient was fully recovered. She was discharged on day 80 without serious complications and neurological
deficits after insertion of implantable cardioverter defibrillator for idiopathic ventricular fibrillation.

**Discussion**

In-hospital cardiac arrest still has a low survival rate despite the development of CPR\(^1\). Prolonged CPR is related to poor prognosis and especially the survival rate of patients who received CPR of more than 1 hour is extremely low\(^2,3\). Generally, clinicians are reluctant to continue efforts more than 30 minutes\(^4\). However, there is no clear recommendation about when to stop resuscitation efforts in patients who arrested in hospitals. Extracorporeal life support (ECLS) has been shown to have survival benefit over conventional CPR and proposed as rescue therapy in refractory cardiac arrest failing conventional CPR in patients with in-hospital cardiac arrest\(^5\). In fact, it is challenging to decide to apply ECLS after prolonged CPR as in this case because prolonged CPR (>30 minutes) is poor prognostic marker for the implementation of ECLS\(^6\). In our hospital, ECMO is indicated for potentially reversible, life-threatening forms of respiratory or cardiac failure, which are unresponsive to conventional therapy. We expected organ recovery in this patient because the arrest event was witnessed by the emergency medical team and CPR was started immediately and also the patient was relatively young. ECLS could offer the last chance to survive in these patients because chest compression quality deteriorates over time and it is difficult to maintain effective chest compression over prolonged CPR\(^6\). According to the study that compared conventional CPR to extracorporeal CPR, the survival rate of patients who received CPR of more than 1 hour was zero in conventional CPR group versus 17.7% in extracorporeal CPR group\(^2\). Chung et al\(^7\) reported two cases of emergency ECLS after prolonged CPR for in-hospital arrest caused by
refractory VF in patients with AMI. Fux et al\(^8\) reported a case of persistent VF for 30 hours that was rescued by insertion of ECMO during CPR and they showed that ECMO could replace the heart during continuous VF. Our patient eventually achieved ROSC and survived to discharge without serious complications. The outcome of our patient was above expectations and the favorable result is probably due to use of ECMO as well as effective CPR. Our experiences suggest that well organized CPR with adequate application of ECMO can protect the major organs, including the brain.

In summary, the present case supports that ECLS system can be a rescue therapy for in-hospital cardiac arrest unresponsive to conventional CPR, even after an extended period of CPR.

REFERENCES