CASE REPORT

Successful Resuscitation with Extracorporeal Membrane Oxygenation in a Case with Prolonged Cardiac Arrest

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Abstract This case study describes a 25-year-old patient who had a witnessed cardiac arrest in the medical intensive care unit. The patient received 107 minutes of cardiopulmonary resuscitation before the veno-arterial extracorporeal membrane oxygenation was initiated. During extracorporeal life support, the patient's cardiac function improved. The patient was weaned from extracorporeal membrane oxygenation on day 6 and was discharged without physical and neurological complications on day 28. The successful resuscitation in this case attributed to high-quality CCPR and timely ECMO support.

THE 2005 American Heart Association (AHA) recommends that extracorporeal cardiopulmonary resuscitation (ECPR), the use of veno-arterial extracorporeal membrane oxygenation (ECMO), should be considered for in-hospital patients who suffer cardiac arrest when the duration of the no-flow arrest is brief and the condition leading to the cardiac arrest is reversible.¹ Many studies suggest that early initiation of ECPR is critical to improve patient outcomes.^{2,3} The use of ECPR was also reviewed in the 2015 AHA guidelines.⁴ However, the upper limit

of conventional cardiopulmonary resuscitation (CCPR) duration before ECPR initiation that results in acceptable clinical outcomes is still unknown.^{5,6}

This case study discusses a successful outcome in a cardiac arrest patient who received 107 minutes of CCPR before initiation of veno-arterial ECMO. During extracorporeal life support, the patient's cardiac function improved. The patient was weaned from extracorporeal membrane oxygenation on day 6 and was discharged without physical and neurological complications on day 28.

CASE DESCRIPTION

A 25-year-old man with no past medical history presented to the emergency room with 2 days of fatigue, dyspnea and intermittent chest pain. The patient had drunk 1-2 caffeinated energy drinks a day

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for the previous 7 days. He had several episodes of vomiting and one episode of syncope before coming to the emergency room. On presentation he was pale and diaphoretic. His heart rate was 150 beats/min, his blood pressure was 93/53 mmHg, and his oxygen saturation was 88% by peripheral pulse oximetry. Electrocardiography revealed a wide complex rhythm that was consistent with monomorphic ventricular tachycardia. The patient was intubated for airway protection. Cardioversion was attempted but he remained in persistent ventricular tachycardia with a rate of 120-150 bpm. A computerized tomography angiogram of the chest revealed marked enlargement of the right heart chambers, a moderate right pleural effusion, pulmonary edema, reflux of contrast into the inferior vena cava and hepatic veins, ascites and diffuse mesenteric edema, which all suggested right heart failure. He was treated with procainamide and amiodarone, and transferred to the medical intensive care unit, (MICU) for further treatment.

In the MICU, he was administered vasopressin (4 units/hour) and epinephrine (20 mcg/minute) infusions to maintain from a systolic blood pressure above 90 mmHg. Approximately four hours after his transfer to the MICU, he suffered a cardiac arrest. CCPR was initiated immediately. With the patient undergoing CCPR, a left common femoral arterial puncture was attempted without success. A 15-French cannula was then placed in the right common femoral artery and a 25-French cannula was placed in the right common femoral vein. When ECMO was initiated, however, there appeared to be recirculation and it was suspected that the arterial catheter was in the femoral vein. Therefore a left arterial puncture was attempted again and a 17-French cannula was successfully placed. ECMO was reinitiated and 4-5 liters/minute of flow was achieved 107 minutes after initiation of CPR. The patient was immediately cooled to 34°C for 24 hours.

The patient's course was complicated by compartment syndrome of the right lower extremity that required a fasciotomy, and acute renal failure that required temporary hemodialysis. He received 15 units of red blood cells, 2 units of platelets and 10 units of fresh frozen plasma. He was intravenously administered immunoglobulin and steroids for presumed myocarditis. After 6 days of support, his function improved and he was weaned from ECMO. He was extubated on the following day and discharged to a rehabilitation facility on day 28 without neurologic deficits. Follow-up

cardiac magnetic resonance imaging five months later demonstrated normal ventricular function and no perfusion deficits. At the 6-month follow-up visit, the patient was physically and neurologically normal.

DISCUSSION

Even when CCPR takes place in hospital, the overall survival is not encouraging.⁷ It is reported that among 14 720 cases of in-hospital cardiac arrest in the National Registry of Cardiopulmonary Resuscitation, less than 50% of patients had return of spontaneous circulation (ROSC) after CCPR, whereas less than 20% of patients survived to discharge.⁸ Veno-arterial ECMO, as an adjunct to cardiac resuscitation, has been shown to improve survival rates among cardiac arrest patients.^{2,3,8} The duration of cardiac arrest and CCPR before ECPR is an important factor influencing the survival rate. Prolonged cardiac arrest is associated with multiple organ failure and neurologic deficits. A meta-analysis indicated that survival was significantly decreased when ECMO was initiated after 30 minutes of CCPR.² When CCPR exceeded 60 minutes, the mortality rate observed was as high as 70%.⁸ However, the upper limit of CCPR duration before ECPR resulting in an acceptable neurological outcome remains unknown. There are some cases reported who received more than 60 minutes of CCPR before ECMO and achieved good recovery with no significant cerebral insult.^{5,6} The longest duration of CCPR before ECMO that resulted in acceptable clinical outcomes by now was reported in a 4-year-old case with myocarditis, who suffered from ventricular tachycardia and received CCPR for 176 minutes before initiation of ECMO.⁵ The patient was on ECMO for 9 days and survived neurologically.

In our case, ECMO was initiated 107 minutes after prolonged cardiac arrest and CCPR, and was successfully used to provide cardiopulmonary life support. Although he experienced several complications after prolonged CCPR, he eventually recovered. We note that ongoing CPR is not a barrier for emergent ECMO and high quality of CCPR is critical in determining the outcome of following ECPR. Although our patient had a cardiac arrest of 107 minutes, he had completely recovered without neurological complication, which was delighted to us. The factors that contributed to his recovery include high-quality CCPR, aggressive post resuscitation treatment, hypothermic cerebral protection and, most importantly, timely ECMO support.

REFERENCES

1. ECC Committee, Subcommittees and Task Forces of the American Heart Association. 2005 American heart association Guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation* 2005; 112(24 Suppl); 1-203. doi:10.1161/CIRCULATIONAHA.105.166550.
2. Cardarelli MG, Young AJ, Griffith B. Use of extracorporeal membrane oxygenation for adults in cardiac arrest (E-CPR): A meta-analysis of observational studies. *ASAIO J* 2009; 55(6): 581-6. doi:10.1097/MAT.0b013e3181bad907.
3. Chen YS, Yu HY, Huang SC, et al. Extracorporeal membrane oxygenation support can extend the duration of cardiopulmonary resuscitation. *Crit Care Med* 2008; 36(9):2529-35.doi:10.1097/CCM.0b013e318183f491.
4. Kleinman ME, Brennan EE, Goldberger ZD, et al. Adult basic life support and cardiopulmonary resuscitation quality: 2015 American Heart Association Guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation* 2015; 132(18 Suppl 2): 414-35. doi:10.1161/CIR.0000000000000259.
5. Kelly RB, Porter PA, Meier AH, et al. Duration of cardiopulmonary resuscitation before extracorporeal rescue: how long is not long enough? *ASAIO J* 2005; 51(5): 665-7. doi:10.1097/01.mat.0000171596.39362.7a.
6. Fukuda T, Nakamura K, Fukuda-Ohashi N, et al. How long should resuscitative efforts be continued in adult out-of-hospital cardiac arrest? *Can J Cardiol* 2015; 31(3): 364.e1-2. doi:10.1016/j.cjca.2014.11.028.
7. Cooper S, Janghorbani M, Cooper G. A decade of in-hospital resuscitation: outcomes and prediction of survival? *Resuscitation* 2006; 68(2): 231-7. doi:10.1016/j.resuscitation.2005.06.012.
8. Peberdy MA, Kaye W, Ornato JP, et al. Cardiopulmonary resuscitation of adults in the hospital: A report of 14720 cardiac arrests from the National Registry of Cardiopulmonary Resuscitation. *Resuscitation* 2003; 58(3): 297-308. doi: 10.1016/S0300-9572(03)00215-6.