Clinical Case Report

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Case of a cardiac arrest patient who survived after extracorporeal cardiopulmonary resuscitation and 1.5 hours of resuscitation

A case report

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Abstract

Rationale: Per the American Heart Association guidelines, extracorporeal cardiopulmonary resuscitation should be considered for in-hospital patients with easily reversible cardiac arrest. However, there are currently no consensus recommendations regarding resuscitation for prolonged cardiac arrest cases.

Patient concerns and diagnosis: We encountered a 48-year-old man who survived a cardiac arrest that lasted approximately 1.5 hours. He visited a local hospital's emergency department complaining of chest pain and dyspnea that had started 3 days earlier. Immediately after arriving in the emergency department, a cardiac arrest occurred; he was transferred to our hospital for extracorporeal membrane oxygenation (ECMO).

Interventions: Resuscitation was performed with strict adherence to the American Heart Association/American College of Cardiology advanced cardiac life support guidelines until ECMO could be placed.

Outcomes: On hospital day 7, he had a full neurologic recovery. On hospital day 58, additional treatments, including orthotopic heart transplantation, were considered necessary; he was transferred to another hospital.

Lessons: To our knowledge, this is the first case in South Korea of patient survival with good neurologic outcomes after resuscitation that lasted as long as 1.5 hours. Documenting cases of prolonged resuscitation may lead to updated guidelines and improvement of outcomes of similar cases in future.

Abbreviations: CCU = cardiovascular care unit, ECMO = extracorporeal membrane oxygenation, ECPR = extracorporeal cardiopulmonary resuscitation, EF = ejection fraction, IABP = intra-aortic balloon pump, LAD = left anterior descending artery, PCI = percutaneous coronary intervention, VF = ventricular fibrillation, VVA = veno-veno-arterial.

Keywords: cardiac arrest, cardiopulmonary resuscitation, extracorporeal circulation, myocardial infarction

1. Introduction

The cardiopulmonary resuscitation (CPR) guidelines are reexamined and updated every 5 years, and the past 10 years have seen some major changes. The most important change of these guidelines is the addition of "You're never encouraged to give up".[1] One of the things that have made this possible is the introduction of extracorporeal cardiopulmonary resuscitation (ECPR). ECPR is a method of CPR using an extracorporeal membrane oxygenator (ECMO) for patients with cardiac arrest deemed to be refractory to CPR. The American Heart Association guidelines recommend that ECPR should be considered for in-hospital patients with an easily reversible cardiac arrest, who have undergone, but not responded to, CPR.[2] However, there are currently no consensus recommendations for patients with prolonged cardiac arrest. Hence, we report the present case of a patient who survived with good neurologic outcomes after a resuscitation that lasted as long as 1.5 hours. This case is an example of how CPR using ECMO can improve a patient's chance of survival.

2. Case presentation

On June 1, 2017, at 10:25 AM, a 48-year-old man with a history of hypertension visited his local hospital complaining of chest

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The Human Research Ethics Committee of Gyeongsang National University Hospital provided a waiver considering that approval is not necessary for a single case report. The patient provided written informed consent for publication of clinical details and images.

The authors report no conflicts of interest.

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pain and dyspnea that had started 3 days earlier. On arriving in the emergency department, he was hemodynamically unstable (blood pressure: 70/30 mmHg, heart rate: difficult to measure, respiration rate: 35 breaths per minute). At 10:33 AM, the patient experienced sustained ventricular tachycardia and lost consciousness. He had no palpable carotid or femoral pulse, and no spontaneous respirations. Subsequently, resuscitation was performed; ventricular fibrillation (VF) was detected after 5 minutes of CPR. The patient was transferred to our hospital for ECMO. At arrival (11:36 AM), resuscitation was performed by strictly adhering to the American Heart Association/American College of Cardiology advanced cardiac life support guidelines until ECMO could be placed. Veno-veno-arterial (VVA) ECMO was started 80 minutes after the initiation of CPR, and return of spontaneous circulation was achieved 10 minutes later.

Subsequently, percutaneous coronary intervention (PCI) was performed for evaluation of the cause of the cardiac arrest. Using the right femoral artery approach, we confirmed total occlusion of the left anterior descending artery (LAD) (Fig. 1A), and PCI of the LAD was performed as per the standard protocol. Subsequently, we confirmed partial recovery of the coronary circulation to the mid-LAD (Fig. 1B). At the end of the PCI procedure, we inserted an intra-aortic balloon pump (IABP) into the PCI procedure site. The patient was admitted to the cardiovascular care unit (CCU) and treated with inotropic drugs, anticoagulation, antiarrhythmic therapy, mild hypothermia (34°C–36°C), and continuous renal replacement therapy owing to acute renal failure. Echocardiography performed in the CCU revealed akinesia of the mid-anteroseptal and anterior left ventricle (LV), along with severe LV (ejection fraction [EF] 15%) and right ventricle dysfunction.

On hospital day 7, the patient remained hemodynamically stable in the CCU; his LV function had recovered (EF 35%–40%) and the pulmonary edema had disappeared. As the patient had a full neurologic recovery, ECMO and the IABP were consequently weaned. However, he became progressively bradycardic and again lost circulation 2 days after ECMO weaning. At this time, the patient was found to have pulseless electrical activity; CPR was again initiated and VVA ECMO was restarted. On hospital day 15, the patient's consciousness was still normal and his general condition had been restored. We attempted ECMO weaning again; however, the next day, the patient's condition deteriorated and VVA ECMO and IABP were started again. On hospital day 25, his hemodynamic state had stabilized, but he showed evidence of acute respiratory distress syndrome because of pneumonia (*Burkholderia cepacia*), and the VVA ECMO was converted to VV ECMO and maintained. The acute respiratory distress syndrome deteriorated gradually (Fig. 2A); at 30 days of admission, *Burkholderia cepacia* and *Candida albicans* were confirmed in the blood culture and sputum. On the 50th day of hospitalization, the blood and sputum cultures were negative and the pneumonia was partially improved (Fig. 2B). On hospital day 58, the patient's consciousness was still normal; however, as additional treatments such as orthotopic heart transplantation were considered necessary (LVEF 20%~25%), the patient was transferred to another hospital for these procedures.

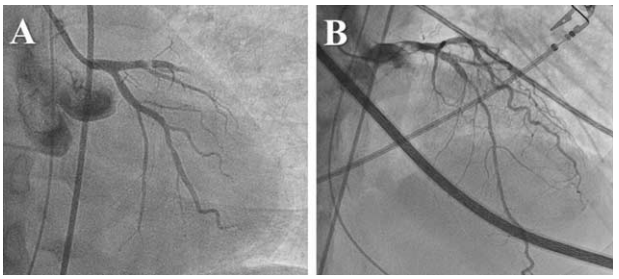

Figure 1. Percutaneous coronary angiography (A) before and (B) after percutaneous coronary intervention.

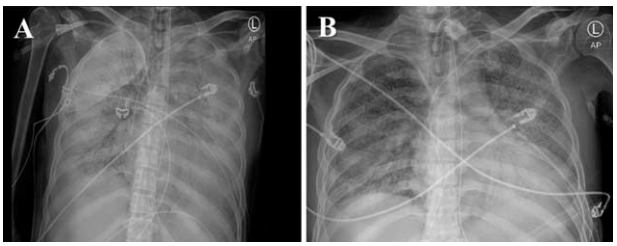

Figure 2. Chest x-ray findings. (A) On hospital day 25, findings of progressive acute respiratory distress syndrome were noted. (B) On hospital day 50, signs of the patients recovering from acute respiratory distress syndrome were seen.

3. Discussion

There are some previous reports of patients surviving with good neurologic outcomes after prolonged resuscitation for cardiac arrest.[3–5] The first patient was a 40-year man with a history of hypertension and hyperlipidemia who collapsed and was found to be in VF. Several rounds of CPR were performed during hospitalization, with the entire cardiac arrest lasting approximately 3.5 hours. On hospital day 5, ECMO and an IABP were initiated. On day 160, he underwent orthotopic heart and cadaveric kidney transplantations. He was discharged from the hospital on day 179, at which time he was ambulatory.[3] The second patient was a 56-year-old man with no history of cardiac illness who collapsed and was found to be in VF. He was resuscitated by means of CPR for 60 minutes. The patient had an anterior myocardial infarction, underwent stenting of the closed proximal descending artery, and was discharged 3 months after admission.[4] The third patient was a 69-year-old woman. She experienced cardiogenic shock owing to non-ST elevation myocardial infarction and underwent 60 minutes of CPR. Subsequently, she underwent stenting and was discharged 16 days after admission.[5]

Baskett et al suggested that termination of resuscitation should be considered in a patient if the asystolic duration lasts >20 minutes without a known reversible cause.[6] However, every situation is different, and additional research and accumulation of cases can help provide a better way to predict the outcomes of individual patients. To improve the survival outcome of CPR patients, the CPR guidelines are continuously being developed and new techniques are being implemented; however, not all patients follow the general rules of these guidelines. One of the things that has made resuscitation possible in such patients is ECPR, that is, CPR conducted using ECMO. In Japan, Morimura et al showed the utility of ECPR for out-of-hospital cardiac arrest. They reviewed cases of ECPR for out-of-hospital cardiac arrest published in Japanese between 1983 and 2008. The authors suggested that ECPR appears to provide a higher survival rate, with excellent neurological outcome in patients with out-of-hospital cardiac arrest.[7]

Our patient had several factors that contributed to his recovery. He was relatively young and CPR was carried out

immediately and very effectively after the initial cardiac arrest, owing to the fact that the arrest occurred in a hospital. The transfer of the patient was performed in a timely manner, and ECMO and PCI were implemented immediately on arrival at our hospital.

In conclusion, the survival rate after cardiac arrest remains low, and not all patients will experience the same results as in our patient and the above-mentioned cases. However, we consider that documenting cases of successful prolonged resuscitation may help improve the overall outcomes in the future. We hope that the case presented herein may aid in the ongoing improvement of the current CPR guidelines.

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