

Extracorporeal Life Support After Prolonged Resuscitation for In-Hospital Cardiac Arrest due to Refractory Ventricular Fibrillation: Two Cases Resulting in a Full Recovery

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Extracorporeal life support (ECLS) has well demonstrated its efficacy in treating in-hospital cardiac arrest and is being used for broader indications. However, ECLS after prolonged cardiopulmonary resuscitation (CPR) has been traditionally contraindicated and is now challenging. Here, we introduce two cases of successful ECLS after prolonged CPR, resulting in an immediate and full recovery. Both these acute ST elevation myocardial infarction patients waiting for primary percutaneous coronary intervention (PCI) suddenly collapsed due to ventricular fibrillation (VF), which was refractory to conventional treatment. After 2 hours of conventional CPR, the ECLS had been implemented and primary PCI could be performed. Subsequent to successful revascularization, the VF was stopped with a single electric shock. In our second case, normal sinus rhythm was spontaneously restored after ECLS implementation, which was completed after 45 minutes of conventional resuscitation. Both patients made a full neurological recovery on the day of the event and were discharged with only minor complications. (**Korean Circ J 2012;42:423-426**)

KEY WORDS: Cardiopulmonary resuscitation; Extracorporeal membrane oxygenation.

Introduction

Ventricular tachycardia or fibrillation (VT/VF) in patients with acute myocardial infarction (AMI) is associated with a poor prognosis.¹⁾ Despite a better prognosis for early VT/VF compared to late VT/VF, early refractory VT/VF is a serious obstacle for the definitive treatment with primary percutaneous coronary intervention (PCI). One of the recent advances in the field of critical care is the extracorporeal life support (ECLS) system, which is portable, readily applicable and easy to maintain. Before its advent, patients with AMI complicated by refractory VF/VT before commencing primary PCI would

rarely survive or recover without ischemic brain damage. Such patients are among those who can derive the most benefit from ECLS at present. In fact, ECLS has well demonstrated its efficacy in treating in-hospital cardiopulmonary arrest and is being used for broader indications than before.²⁾ The use of ECLS after prolonged cardiopulmonary resuscitation (CPR), a traditional contraindication, is particularly challenging.

Here, we present two cases of emergency ECLS after prolonged CPR for in-hospital cardiac arrest caused by refractory VF in patients with AMI waiting for primary PCI.

Cases

Case 1

A 55-year old man visited the emergency room due to acute chest pain. His vital signs were stable but his electrocardiogram (ECG) showed ST-elevation in leads II, III and aVF as well as Q waves in leads V 1 and 2 (Fig. 1). The patient had a history of repeated AMIs, for which he had received multiple stents in two different hospitals. Despite the higher risk of recurrent cardiovascular events, his compliance seemed poor and he was still a heavy smoker. His current medication included triple antiplatelet therapy, a lipid-lowering agent, a beta-blocker, and an angiotensin-converting enzyme inhibitor. The

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pain-to-door time was about 30 minutes and the PCI team was called after diagnosis of an acute inferior wall ST-elevation myocardial infarction (STEMI).

During the stay in the emergency room, the patient suddenly collapsed from VF. CPR was initiated and repeated shocks at maximum energy were administered. Throughout about 30 minutes of conventional CPR, repeated shocks only stopped the VF for several seconds (Fig. 2). At this point, we decided to implement ECLS (CAPIOX EBS®, Terumo, Tokyo, Japan). The right femoral vessels were accessed guided by anatomical landmarks and ECLS was finally imple-

mented, about 2 hours from the initiation of CPR. With full support, we achieved a flow rate of 4.8 L/min and mean arterial pressure of 70 mm Hg, but VF persisted.

Now the patient could be transferred to the catheterization room to undergo primary PCI, without the need for chest compressions for his fibrillating heart. In the catheterization room, the left femoral artery accessed also guided by anatomical landmarks and a coronary angiogram (CAG) was performed. The left CAG, including stented segments, showed no significant stenosis. The right CAG revealed one stent in the proximal portion that was totally occluded by a

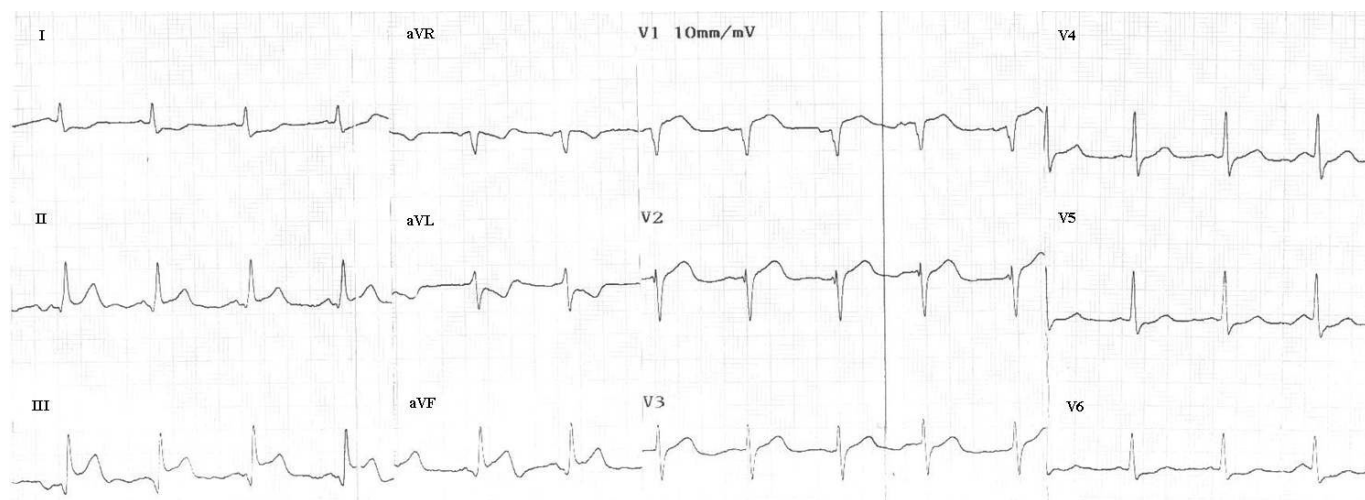


Fig. 1. Initial electrocardiogram (case 1).



Fig. 2. Ventricular fibrillation refractory to defibrillation (case 1).

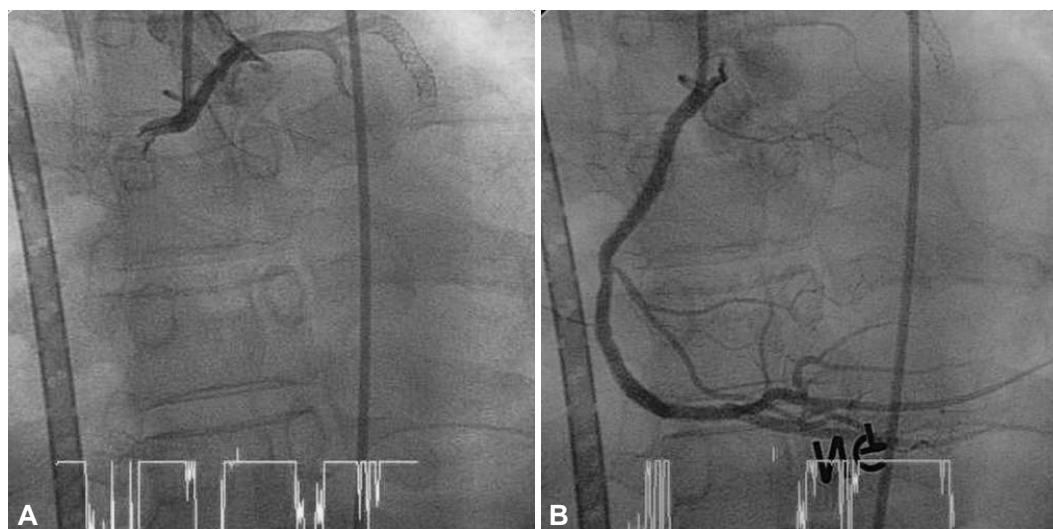


Fig. 3. Right coronary angiogram before (A) and after (B) primary percutaneous coronary intervention (case 1).

thrombus (Fig. 3A). Despite some difficulty in wiring, the coronary flow was successfully restored after ballooning, about three hours from the onset of chest pain. We implanted a long drug-eluting stent on the previous stent because the residual stenosis after ballooning was more than 80% (Fig. 3B). After the PCI, a single 360 J shock proved sufficient for successful defibrillation. We finished the procedure by installing an intra-aortic balloon pulsation (IABP) catheter to assist recovery.

The patient regained full consciousness without any neurological deficit later that day. The IABP and ECLS could be weaned on the third day and the patient was transferred to general ward on the fourth day. He was discharged with chest wall pain, caused by the CPR, and a large hematoma around the ECLS cannula insertion site, which had required a transfusion.

Case 2

A 43-year old man visited our emergency room with acute chest pain. Vital signs were stable but his ECG showed ST-elevation in leads V 1-4 and isolated VPC. He had hypertension, hypercholesterolemia and acquired immunodeficiency syndrome, for which he received regular medications including anti-viral agents. The pain-to-door time was about 60 minutes and primary PCI was promptly arranged after diagnosis of an acute anterior wall STEMI.

During transfer to the catheterization room, one run of non-sustained VT appeared which could be suppressed with intravenous lidocaine. However, during preparation for the procedure in the catheterization room, a sustained VT developed and turned into VF. CPR was initiated and repeated shocks at maximum energy were delivered. We immediately called the ECLS team and continued CPR. At about 45 minutes of continuous CPR, normal sinus rhythm spontaneously restored with the implementation of ECLS (CAPIOX EBS®, Terumo, Tokyo, Japan) via the right femoral vessels.

Restoration of sinus rhythm resulted in a stable patient with a flow rate of 2.5 L/min and mean arterial pressure of 80 mm Hg. Subsequently, the patient underwent primary PCI via the left femoral artery. His right CAG showed no significant stenosis, however, the left CAG revealed a thrombotic occlusion of proximal left anterior descending coronary artery. Coronary flow was successfully restored after ballooning, about two and half hours from the onset of chest pain. We implanted a drug-eluting stent in the culprit lesion with no further complications.

He regained full consciousness the same day, in the absence of any neurological deficit. The ECLS could be weaned the second day and the patient was transferred to general ward on the third day. Finally, he was discharged with no complications except for chest wall pain caused by the CPR.

Discussion

Our cases were not traditionally indicated for the application of ECLS. Prolonged CPR (>30 minutes) or unwitnessed cardiac arrest are poor prognostic markers for the implementation of ECLS.³⁾ According to Rhee et al.⁴⁾ the time to ECLS for in-hospital arrest or shock patients was 43±23 minutes in failed weaning cases versus 25±8 minutes in successful weaning cases in Korea. With this in mind, the favorable results of our cases were beyond our expectations. Although the precise impact of CPR duration on predicting survival or neurologic recovery seems to be unclear, our experiences suggest that well organized CPR can protect the major organs, including the brain, for up to 2 hours in witnessed in-hospital cardiac arrest. With advancements in ECLS systems, patients with in-hospital arrest may benefit from it, even after an extended period of CPR. More experience with the use of ECLS will help define its most appropriate time of deployment. Because primary PCI (the treatment of choice for STEMI) is readily available and highly successful in current practice, patients with refractory cardiac arrest are likely candidates for ECLS. However, conclusions from our limited experiences should not be generalized to other causes of cardiac arrest.

According to recent epidemiological study, sustained VT/VF occurred in 5.7% of acute STEMI patients undergoing primary PCI, which mostly happened before the end of cardiac catheterization.¹⁾ Although the frequency of refractory cardiac arrest is not well documented, it is a potential threat in all patients with AMI. Our experience of the past two years suggests refractory VF/VT accounts for about 2.5% of patients with STEMI waiting for primary PCI (unpublished data).

The importance of chest compression during CPR is increasingly emphasized.⁵⁻⁸⁾ We think the favorable results of our cases are based on the endeavored CPR, conducted with minimal interruption of chest compression. Also, the CPR in both cases was fully directed by the same experienced cardiologist. To improve the outcome of ECLS, rapid and accurate cannulation of the ECLS system is important. In one of our two cases we spent about 90 minutes on ECLS implantation, mostly due to difficulty in cannulation of the pulseless vessel without interrupting chest compression. This was further complicated by formation of a large hematoma at the cannulation site, requiring a transfusion.

We hope our experiences may contribute to improving the prognosis of patients with cardiac arrest.

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