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Case Report

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Successful Outcome of Cardiac Arrest Refractory to Advanced Cardiac Life Support Using Extracorporeal Membrane Oxygenation

Greg Beilman[a], Eileen E. Eggenberger[a, b], Bryan S. Pershing[a], Joshua S. Huelster[a]

Abstract

Emergency cardiopulmonary bypass (CPB) for patients experiencing cardiac arrest or cardiogenic shock refractory to standard advanced cardiac life support (ACLS) can improve survival outcomes. We report the successful resuscitation of a 66-year-old male with previous heart transplant who experienced cardiac arrest following a local injection of bupivicaine after an uneventful herniorrhaphy. He was managed with cardiopulmonary resuscitation (CPR) and ACLS for 90 minutes before initiating CPB. He regained a normal perfusing rhythm and sustained no neurological deficits. Emergent CPB can be life-saving for patients in cardiac arrest or cardiogenic shock even after prolonged CPR.

Keywords: Cardiopulmonary bypass; Extracorporeal membrane oxygenation; Cardiac arrest; Bupivicaine

Introduction

Long duration of cardiopulmonary resuscitation (CPR) without restoration of spontaneous circulation (ROSC) is considered an indication of poor outcomes and high mortality. Forty-four percent of patients who undergo CPR in-hospital achieve ROSC and only 17% survive to discharge [1]. Recently there has been increased interest in the use of extracorporeal membrane oxygenation (ECMO) in the setting of cardiac arrest. Its successful application was reported over 10 years ago, but use in resuscitation of cardiac arrest is still uncommon. The 'Update on Extracorporeal Life Support' of 2004 reported a survival rate of 40% for ECMO-assisted resuscitation, a striking improvement over standard CPR [2]. We report the cardiac arrest and successful ECMO resuscitation of a 66-year-old male.

Case Report

A 66-year-old male presented to a surgical service for elective right inguinal herniorrhaphy. His past history was remarkable for heart transplant one year previous due to idiopathic cardiomyopathy. Preoperative cardiac evaluation including cardiac catheterization was unremarkable. After an uneventful surgical course under general anesthesia and a localized bupivacaine injection, the patient developed bradycardia progressing to cardiac arrest. Cardiopulmonary resuscitation was initiated, and medications and several attempts at electrocardioversion were administered per Advanced Cardiac Life Support (ACLS) protocol. These maneuvers proved unsuccessful and the patient remained in a non-perfusing bradydysrhythmia. Transcutaneous and transvenous pacemakers were attempted without evidence of ventricular capture. Chest compressions maintained a systolic blood pressure range of 80 - 110 mmHg.

After 90 minutes, the decision to place the patient on ECMO was made. The patient was given 30,000 units unfractionated heparin via central administration, and ECMO was established utilizing the right femoral artery and vein. The patient showed marked improvement over the next seven hours, converting spontaneously to a normal sinus rhythm. The patient was weaned from ECMO with no findings of neurological deficit and discharged to home on hospital day six.

Discussion

The decision to engage in emergency CPB or ECMO after prolonged CPR can be a difficult decision to make. Many experienced clinicians fear neurological deficits regardless

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[a]Critical Care and Acute Care Surgery, Department of Surgery, University of Minnesota, USA
[b]Corresponding author: B-150 PWB, 516 Delaware St. SE, Minneapolis, MN, 55455, USA. Email: ejackson@umn.edu

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of eventual return of flow and cardiac stability. However, there is mounting evidence that CPB greatly improves survival versus standard CPR. A review of 387 papers yielded an average of 15-25% of selected patients that suffer a witnessed cardiac arrest and are not responsive to ACLS resuscitation may be successfully resuscitated with CPB [3]. The most important factor for survival appears to be time until onset of mechanical circulatory support. Although there is no set timetable, when mechanical support is initiated within 60 minutes, 47% survival with no major neurologic deficits is obtained. When CPR is extended to 90 minutes, the probability of survival drops to 10% [4].

The ability to correct the underlying pathology is the determining factor for long-term survival [5]. Pathologies that appear to be most effectively treated with CPB include shock and cardiac arrest secondary to hypothermia and drug toxicity (likely in the above case). Daubin et al. was able to discharge 76.5% of patients presenting with refractory shock or cardiac arrest resulting from acute drug intoxication despite mean CPR duration of 101 ± 55 minutes. Of the 17 cases reported, 15 patients had ingested cardiotoxic drugs [6]. Other successful reports using CPB include the setting of shock or cardiac arrest secondary to pulmonary emboli, acute MI, impassable airways, cardiomyopathies, myocarditis, and iatrogenic complications that occur in the cardiac catheterization laboratory [7-10]. Common contraindications to CPB include previous irreversible brain damage, terminal malignancy, age greater than 75 years, sepsis, out of hospital cardiac arrest, drowning, and trauma [2, 5, 9].

There are several complications associated with CPB; the most common are cannulation-related vascular injuries including lower extremity ischemia, dissecting aneurysm, and retroperitoneal hemorrhage. The inability of CPB to decompress the left ventricle has led to irreversible myocardial injury, significant pulmonary edema, and left ventricular overload leading to left ventricular distention. Inotropic support and percutaneous balloon technology can help reduce the complications related to left ventricular overload, particularly in patients with asystole or ventricular fibrillation [7, 8]. Additionally the frequent requirement of blood products adds some inherent risk to the patient.

There have been several reports of survival of bupivacaine toxicity thanks to the use of CPB [11-13]. Bupivicaine is a racemic mixture of levorotatory and dextrorotatory isomers, but its cardiotoxic properties are attributed to the dextrorotatory isomer. Levobupivacaine, a drug containing only the levorotatory molecule of bupivacaine, has been developed for similar anesthetic behavior with reduced cardiotoxicity. Levobupivacaine can be used at higher concentrations than bupivacaine before signs of central nervous system toxicity occur and escalate to cardiovascular toxicity. Furthermore, there is a much higher success rate of CPB in animals that received cardiotoxic doses of levobupivacaine compared to bupivacaine. Therefore, levobupivacaine should be considered when larger doses of anesthetic are required [14].

Recently lipid emulsion therapy has emerged as a successful method of resuscitating patients with anesthetic overdose. Since the mechanism of action is not fully understood nor a standard protocol established, lipid emulsion is seen as the last resort before initiating CPB. However, failure of lipid rescue in cases of anesthetic cardiotoxicity has not been reported [15].

In conclusion, emergency cardiopulmonary bypass can increase survival of patients suffering cardiogenic shock or cardiac arrest, especially in the setting of drug toxicity. The best outcomes are obtained when CPR is instituted immediately and mechanical support is initiated with little delay. Complications related to CPB can be reduced if measures are instituted immediately to ensure adequate leg perfusion and ventricular unloading. It may be useful for clinicians to consider the use of emergent CPB in selected settings.

Author Contribution

All authors contributed to the review of the patient's history, wrote and revised the report to ensure important content, and had final approval of the version submitted. This case has not been reported previously nor is it under consideration at another publication.

Conflicts of Interest

The authors do not have any conflicts of interest.

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