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CASE REPORT

Successful Primary Percutaneous Coronary Intervention during Cardiac Arrest utilizing an automated chest compression device

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ABSTRACT:

The overall prognosis of Out-of-Hospital cardiac arrest is poor; when combined with ventricular fibrillation and ST Elevation Myocardial Infarction (STEMI) the overall prognosis is extremely poor. Effective Cardiopulmonary Resuscitation (CPR) is essential in achieving Return of Spontaneous Circulation (ROSC). However, manual chest compression remains a drawback due to variability in compression quality. It, also, acts as an obstacle to performing primary percutaneous coronary intervention (PPCI) in patients with STEMI. This report presents a case of Ventricular Fibrillation (VF) & Pulseless Electrical Activity (PEA) treated with PPCI facilitated by the use of an automated chest compression device.

Key Words: Primary Percutaneous Coronary Intervention, Out-of-Hospital Cardiac Arrest (OHCA), Automatic Chest Compression Device.

Introduction

Cardiac arrest is a major public health problem, with more than 350,000 patients being treated for Out-of-Hospital Cardiac Arrest (OHCA) by the emergency medical services in the United States each year, of which only 9.8% survive to hospital discharge(1).

Effective chest compressions are one of the fundamental elements of successful cardiopulmonary resuscitation. Achieving a coronary perfusion pressure of more than 15 mmHg increases the possibility of obtaining return of spontaneous circulation (ROSC) following defibrillation. However, there are several drawbacks to performing manual chest compressions: inter- and intra-rescuer variability of compression quality, the repetitive interruptions for defibrillation and rescuer fatigue; leading to inadequate manual chest compression (2).The guidelines recommend changing the rescuer every two minutes (3), which often results in interruption of chest compressions which may adversely impact ROSC and neurological recovery.

In the past few years, different devices for automated chest compression or chest compression-decompression have been introduced. The LUCAS™ (Jolife AB/Physio-Control, Lund, Sweden) chest compression system and the Autopulse®Resuscitation System (Zoll, Chelmsford, MA) are currently in use. The LUCAS™device (Jolife AB/Physio-Control, Lund, Sweden) is a mechanical device that delivers sternal compression and decompression at a rate of around 100 per minute and a depth of around 4–5 cm by using a piston with a suction cup. Most of the parts in the LUCAS™(Jolife AB/Physio-Control, Lund, Sweden) devices are

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radiolucent. The first LUCAS-1™(Jolife AB/Physio-Control, Lund, Sweden)) device was gas-driven, whereas the newer version, LUCAS-2™((Jolife AB/Physio-Control, Lund, Sweden) is electrically driven.

These devices have been proven to be as effective as manual CPR. An autopsy study has shown that injuries after LUCAS™cardiopulmonary resuscitation (CPR) are comparable to those seen after manual CPR (4). However, animal studies have shown that the device resulted in higher cerebral blood flow and cardiac output (5), and higher coronary perfusion and fewer rib fractures (6) when compared to manual CPR. On the other hand, a recent randomized clinical trial comparing mechanical CPR and manual CPR did not result in improved 4-hour survival (7).Hence, the use of mechanical resuscitation devices has not been introduced into the European Resuscitation Guidelines (3).

In this report, we present the case of a patient who survived OHCA in the context of STEMI; PPCI was successfully performed with short door to balloon time, utilizing the Autopulse® Resuscitation System (Zoll, Chelmsford, MA) throughout the procedure.

Case Report

A previously healthy 48-year-old male, smoker, with family history of premature ischemic heart disease, developed chest pain while at work. A few minutes before reaching the hospital, he became unresponsive, chest compression was started by his colleagues; the initial rhythm in the Emergency Room was ventricular fibrillation (VF), with successful defibrillation. He developed recurrent VF requiring resuscitation and intravenous amiodarone, Electrocardiogram (ECG) post resuscitation showed anteroseptal ST segment elevation myocardial infarction (STEMI). He required high dose of inotropes (Dobutamine and Dopamine both at 20 microgram/kg/min) to maintain a blood pressure above 80/40; he was taken emergently to the Cardiac Catheterization Lab (CCL) for Primary Percutaneous Coronary Intervention (PPCI) after securing his airway.

On arrival in the CCL, he had a further VF Arrest, CPR was initiated and a further shock was delivered with developed of Pulseless Electrical Activity (PEA). The Autopulse® Resuscitation System (Zoll, Chelmsford, MA) was placed to provide CPR during PPCI achieving a BP of more than 120/80 mmHg. Femoral Access was established using a 6F sheath, EBU 3.5 guiding catheter (Medtronic, Dublin, Ireland) was used to engage the left coronary artery. Angiography revealed proximal total occlusion of Left Anterior Descending artery (Photo 1). A BMW wire (Abbott, Lake Bluff, IL, USA) was used to cross the lesion, and the lesion was dilated using a 2.0X 10mm compliant balloon and stented by a 3.0X 26mm drug eluting stent (Resolute Integrity® , Medtronic, Dublin, Ireland) at 16 atmospheres. Following PCI (Photo 2), the patient regained his pulse and blood pressure of 90/70, the machine was switched off and inotropes were weaned gradually during the rest of the procedure.

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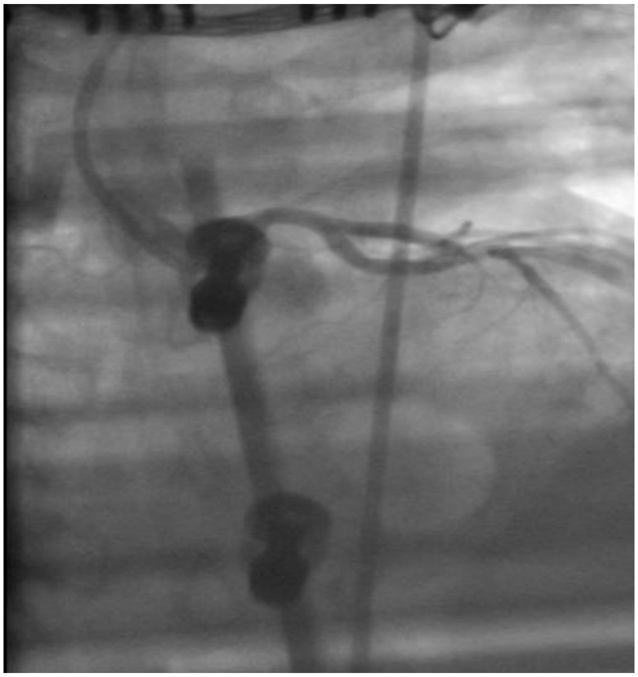

Photo 1. Coronary angiography revealing proximal LAD occlusion

Photo 2. Stented LAD

Coronary Angiography of the Right Coronary Artery (RCA) and Left Circumflex artery (LCX) revealed normal vessels. Finally, the patient developed brief bradyarrhythmia, post PCI requiring the placement of a temporary pacing wire via the right femoral vein and an intra-aortic balloon pump (IABP) was placed through the same femoral access site, and 1:1 diastolic augmentation was started. The Patient's heart rate and blood pressure improved and was stable on transfer to the Cardiac Care Unit (CCU) safely with lower doses of inotropes (Dopamine 5 and Dobutamine 7.5 microgram/Kg/min respectively).

Echocardiography was done which revealed mild anteroseptal wall hypokinesis with an ejection fraction of 47%. The patient developed ventilator associated pneumonia, but eventually made a good recovery, weaned of the ventilator, and discharged home in good condition. There was no rib fracture or any other complications related to the device.

The door to balloon time was 44 minutes despite his recurrent cardiac arrests. It took 14 minutes from femoral artery puncture to first balloon inflation and 4 minutes from first coronary contrast injection to balloon inflation and 26 minutes to the last coronary contrast injection. It took about 41 minutes for the whole procedure including the temporary wire and IABP.

Discussion

In this case of OHCA and anteroseptal STEMI, the use of an automated chest compression device allowed the definitive management of the reversible cause of cardiac arrest while the patient was still in cardiopulmonary arrest which would have been impossible when doing conventional CPR.

A number of case reports have been published outlining the advantages of the automated chest compression device during PCI. Libungan et al, used the LUCAS™

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device (Jolife AB/Physio-Control, Lund, Sweden) and PPCI was successfully performed in the RCA after refractory VF with a good neurological outcome(8). Ali et al, reported the first case of successful PPCI during ongoing VF and mechanical CPR in a patient with OHCA and STEMI(9). This is the first reported case, to the best of our knowledge, for using the Autopulse® Resuscitation System (Zoll, Chelmsford, MA) during PPCI during cardiac arrest with a short door to balloon time. It is common practice to believe that PPCI cannot be done during CPR, resulting in delaying the procedure till the patient is hemodynamically stable which is sometimes impossible as in this case unless the underlying cause of the cardiac arrest is addressed. Without the automated chest compression device, PPCI would not have been safely performed, and death would have been the likely outcome.

During conventional CPR, using manual compressions, it is difficult to proceed with PCI as the rescuer is exposed to a large radiation dose; performing effective CPR while wearing radiation protective gear is physically challenging. Furthermore, the rescuer obstructs the motion of the X-ray source and image intensifier. Moreover, in such patients with refractory VF, the rescuer can get fatigued quickly, diminishing the quality of CPR and reducing the patient's chances of survival. The use of mechanical chest compression device ensures that the patient is getting effective, reliable CPR, creates no barriers to the motion of the X-ray source and allows PPCI to proceed without interruption. It maintains satisfactory blood flow to the brain and increases the likelihood of a good neurologic outcome.

Wagner et al, described relatively favorable outcomes with the use of mechanical chest compression device in lengthy cardiac arrests in the CCL for patients undergoing PCI and pericardiocentesis(10). We believe the use of automated chest compression devices can save lives of patients in refractory VF due to acute myocardial infarction as it allows simultaneous PCI and effective CPR.

Most of reported cases in the literature were done using LUCAS™ device (Jolife AB/Physio-Control, Lund, Sweden). When compared with AutoPulse® Resuscitation System (Zoll, Chelmsford, MA), LUCAS™ (Jolife AB/Physio-Control, Lund, Sweden) device parts were more translucent resulting in better visualization. We managed to overcome this, by using straight oblique projections only, and a good outcome was achieved in spite of that limitation.

Conclusion

This case proves that PPCI during CPR in patients with refractory VF can be successfully performed using Autopulse® Resuscitation System (Zoll, Chelmsford, MA). In spite of limited views, PPCI was successful and the patient had a good clinical outcome. This experience encourages physicians to consider using this device in patients with refractory VF or PEA during elective or emergency PCI despite its' associated limitations.

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I, Dr Abdalla Eltayeb, on behalf of other authors certify that the manuscript is original. I undertake full responsibility for any ethical issue of medical activity or practice described in the manuscript.

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