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Prolonged Cardiopulmonary Resuscitation with Favorable Neurological Outcomes after Cardiac Arrest

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Abstract **Case Report**

The case revolves around a 62-year-old male patient who was a smoker and had inadequately-controlled hypertension and dyslipidemia. He was admitted to the Medical Intensive Care Unit after having an emergency PCI (percutaneous coronary intervention) performed on his LMS (left main stem) and LAD (left anterior descending). The patient had gone into acute cardiogenic pulmonary edema, which immediately warranted intubation. He had been diagnosed with a case of anterolateral STEMI (an ST-elevation myocardial infarction) which had led him to develop this condition. A bedside ECHO carried out revealed problems with his heart as well, and particularly the left ventricle. This put him at a great risk of developing cardiac arrest, which could have fatal consequences if not appropriate interventions were not carried out. To resolve this condition, an IABP (an intra-aortic balloon pump) was inserted under the guidance of an ECHO, and only once the ROSC (return of spontaneous circulation) had been achieved. Once everything had been settled, an infusion of noradrenaline and vasopressin was started. The IABP was maintaining pressure at 100 mm Hg. The patient was extubated after six days and his IABP was removed four days later. To assess if there was any internal damage to his brain, a plain CT scan of the brain without contrast was ordered, which revealed cerebellar infarcts. This infarct had manifested itself in the form of hypophonia and wide-based ataxia. By the end of his stay at the hospital, the patient had started to walk and had greatly stabilized. The prognosis seemed favorable and the patient's life was saved on discharge medications protocol. This case study is an example of how cardiopulmonary resuscitation, if done correctly and promptly, can help save the life of a patient with very little hope. It can be a matter of seconds before a patient's condition deteriorates or turns fatal. The same applies to patients undergoing sudden cardiac arrest (SCD), which is responsible for 50% of all cardiovascular-related deaths. Therefore, this case study helps recognize the importance of lifesaving maneuvers and is a helpful guide for similar cases in the future. There is a special emphasis on the importance of cardiopulmonary resuscitation throughout, because it has proven to be greatly helpful in reducing mortality rates among the patients.

Keywords: percutaneous coronary intervention, ST-elevation myocardial infarction, intra-aortic balloon pump, cardiopulmonary resuscitation.

INTRODUCTION

Cardiopulmonary arrest (CPR) is one of the most common conditions that result in the death of patients suffering from coronary artery disease. In a very literal sense, 'cardiopulmonary arrest' refers to the complete cessation of both effective and adequate circulation and ventilation in a human being (Sharabi & Singh, 2022) [1].

Cardiopulmonary arrest (CPR) occurs due to the presence of a primary cardiac event in the patient. Among others, ventricular fibrillation is found to be the most common reason in the majority of all patients (*Ventricular Fibrillation - StatPearls - NCBI Bookshelf*, n.d.) [2]. If the condition is left unresolved or no immediate resuscitative measures are taken, then the patient might collapse, which can result in the fatal outcome that is feared by many.

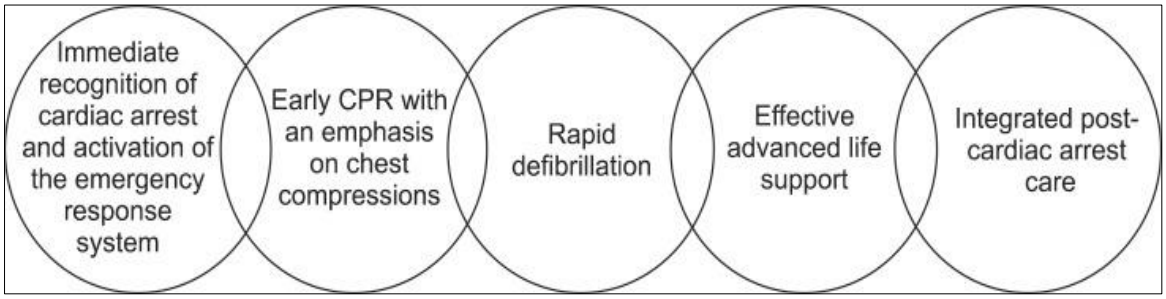
Sudden cardiac death (SCD) is a very important, growing problem in the United States. According to the latest statistics, it is estimated that SCD is responsible for 50% of all cardiac deaths, and among them, a majority are due to undiagnosed cardiac

diseases (*Cardiac Arrest - StatPearls - NCBI Bookshelf*, n.d.) [3].

Cardiopulmonary resuscitation, most commonly referred to as CPR, comprises a series of life-saving maneuvers that are usually done in emergency settings to save the life of an otherwise rapidly-deteriorating patient (Goyal *et al*., 2022) [4]. The protocol attempts to manually resuscitate a patient undergoing cardiac arrest and progressing towards immediate cardiac failure. CPR works towards providing sufficient oxygenation and ventilation to patients (*Cardiopulmonary Resuscitation: New Concept - PMC*, n.d.) [5].

For the purpose of providing a good and professional cardiopulmonary resuscitation maneuver, the guidelines provided by the American Heart Association are followed (Cheskes *et al*., 2017) [6]. The readings of an echocardiograph (ECG) are relied upon for assessing how effective a cycle of CPR has been (*ECG Changes during Resuscitation of Patients with Initial Pulseless Electrical Activity Are Associated with Return of Spontaneous Circulation - PubMed*, n.d.) [7].

Several attempts are made to save the life of the patient, depending on the severity of the situation and if the patient seems to be benefiting from the cycles of CPR. For the sake of simplicity and putting things into perspective, the following flow diagram shows the basic steps of the CPR cycle:



Source: PubMed

Therefore, based on the statistics on growing incidences of cardiac arrest, it is essential for healthcare professionals and emergency medicine technicians to realize the importance of giving people awareness regarding their impending heart problems, such as ventricular arrhythmias and ischemic heart diseases, so that they may consult the doctor when they feel any change or deterioration in their condition. Likewise, it is also important to teach all the new physicians and technicians basic skills such as CPR (Yow *et al*., 2022) [8].

Case Study

The case revolves around a 62-year-old male patient who had a history of smoking and inadequately-controlled hypertension and dyslipidemia. This patient had also recently been diagnosed with diabetes, with his HbA1c standing at a value of 7.8%. He was admitted to the MICU after having an emergency PCI to LMS and LAD performed. His initial complaints comprised acute chest pain that led to the ultimate diagnosis of anterolateral STEMI.

As an early and immediate form of treatment, a PCI was employed for LMS/LAD, which led to the patient developing cardiogenic pulmonary edema. Since this pulmonary edema was severe, it immediately necessitated emergency intubation. After successful intubation, the patient went into a state of cardiac arrest.

This led to a prolonged cycle of CPR for one hour, comprising three shockable rhythms, followed by an intermittent return of ROSC with CPR ongoing. The initial rhythm was not shockable as it was an asystole. For this, the patient received a total of 20 mg of Epinephrine. 1 mg of Epinephrine was delivered to him every three minutes, and an intravenous bolus of 300 mg Amiodarone was given, which was followed by 150 mg Amiodarone.

Eventually, ROSC was achieved. A bedside ECHO revealed that the patient had a poorly-functioning left ventricle. Moreover, a VBG done during CPR showed lactate levels at 5.2.

To resolve this condition, an IABP was inserted under the guidance of the ECHO, once ROSC had been achieved. The position of the tip was confirmed using a portable x-ray. This x-ray also helped in confirming the correct placement of the ETT.

Once everything was settled, the patient was started on an infusion of noradrenaline and vasopressin. The IABP maintained pressure at 100 mm Hg.

The patient was extubated after six days and his IABP was removed four days later. To assess if there had been any internal damage done to his brain, a plain CT scan of the brain without contrast was ordered.

CT Scan Findings:

This post-extubation CT scan revealed:

- The patient had suffered from a right cerebellar infarct, hence the development of obvious disabilities such as hypophonia and wide-based ataxia.
- A fairly defined cortical/sub-cortical area of low attenuation in the right cerebellar hemisphere, posteromedially suggestive of infarction.
- No acute lesion in the cerebral hemispheres.
- No intra or extra-axial acute blood density to suggest hemorrhage.
- No shift of the midline structures.
- Normal ventricles and basal cistern sizes.

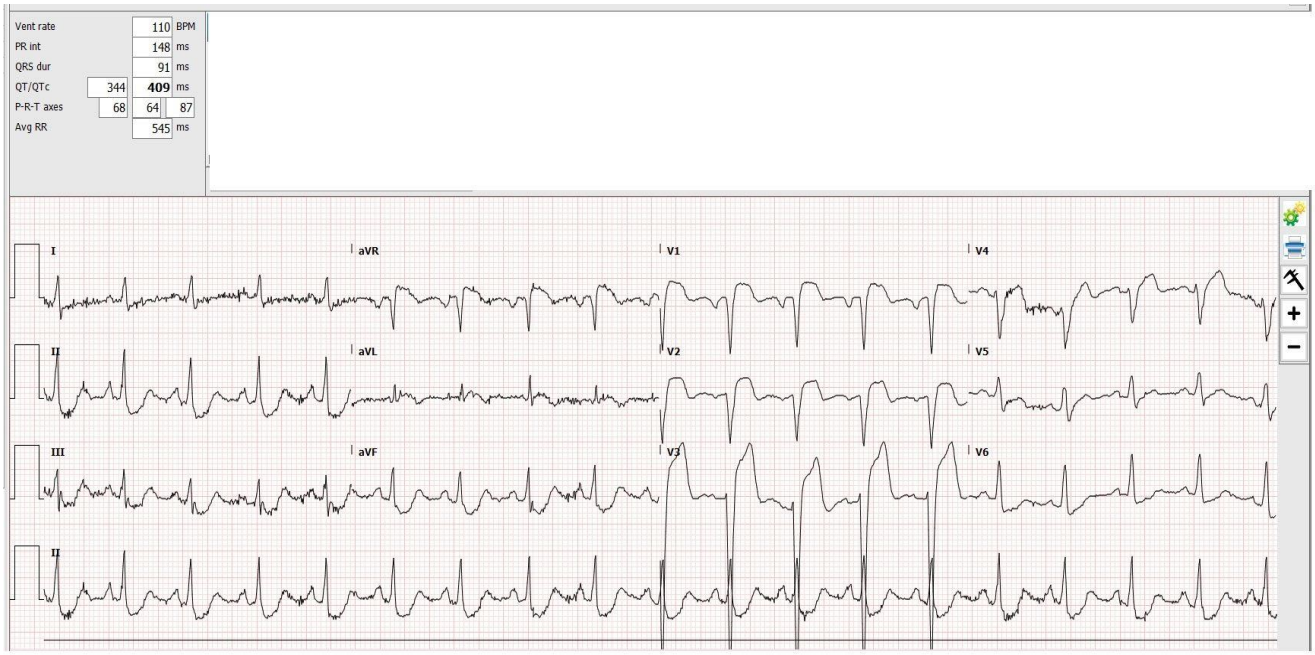


Fig 1: ECG showing an acute anteroseptal STEMI

Fig 2: CT brain showing a right cerebellar infarct

Soon afterward, another ECHO was performed by the patient's bedside.

ECHO Findings:

This ECHO showed:

- The patient's left ventricular ejection fraction was 30% with RWMA (Regional wall motion abnormality).
- The inferior vena cava was normal in size, and there was a normal respiratory response.
- The right coronary artery (RCA) showed mild proximal disease.
- The LMS was calcified along with a significant narrowing of the tubules.
- The LAD was partially occlusive thrombus in the ostio-proximal segment with TIMI 2 in the rest of the vessel. There was obvious calcified

anatomy with further critical disease in the mid-segment.

- An early medium-sized OM1/intermediate had arisen with bifurcation. There was mild proximal disease in the OM1 which was subdividing distally. The rest of LCx (circumflex branch of the left coronary) artery has minor atheroma.

Six days later, the patient was extubated. He was also later discharged when his vitals improved and his condition stabilized overall. Since this patient had been received in a very critical condition, he discharged only when it was clear and obvious that his ataxia was improving, his hypophonia was showing obvious signs of resolution, and he had resumed some of his daily activities.

At the end of his stay at the hospital, the patient was able to walk for five minutes, divided into three sessions a day. This was a remarkable performance and the prognosis was favorable overall.

Discharge Medications:

The patient was discharged with the following treatment and management plan:

- **Spironolactone:** 25 mg, PO, Daily
- **Lisinopril:** 2.5 mg, PO, Daily
- **Bisoprolol:** 5 mg, PO, Daily
- **Pantoprazole:** 40 mg, PO, Daily AC
- **Clopidogrel:** 75 mg, PO, Daily
- **Aspirin:** 100 mg, PO, Daily.
- **Gliclazide Modified Release**: 30 mg, PO, daily CC
- **Furosemide**: 40 mg, PO, Daily
- **Atorvastatin**: 40 mg, PO, Bedtime.

DISCUSSION

Cardiopulmonary arrest is one of the leading causes of death worldwide. It can occur suddenly and unexpectedly in some situations (*Cardiac Arrest - StatPearls - NCBI Bookshelf*, n.d.) [3]. Because of this and the several changes that take place when a person undergoes a cardiac arrest, namely the rapid ischemic damage to the body tissues including the brain, the doctor on duty must perform a speedy resuscitation in order to restore and save the life if the patient. It is expected that all the relevant departments and personnel working in an emergency setting are ready to encounter and deal with such a situation (Sharabi & Singh, 2022) [1].

In an ideal setting, intensive and integrated life-saving actions including CPR by a witness, prompt response from emergency medical services (EMS) systems, and professional treatment by the relevant department or emergency room will increase the survival potential of patients with cardiac arrest while minimizing any impending time delays (*A Method to Detect Presence of Chest Compressions During Resuscitation Using Transthoracic Impedance - PMC*, n.d.) [9].

Coronary artery disease is considered to be one of the most common causes of sudden cardiac death. It has been estimated to account for up to 80% of all cases (Hayashi *et al*., 2015) [10].

Cardiomyopathies and genetic channelopathies account for the remaining cases of sudden cardiac death in humans. The most common causes of non-ischemic sudden cardiac death are cardiomyopathy related to obesity, alcoholism, and fibrosis (*A Clinical Perspective on Sudden Cardiac Death - PubMed*, n.d.) [11].

In patients younger than 35, the most common cause of sudden cardiac death is a fatal arrhythmia, which may or may not be associated with an underlying heart disorder. In patients from birth up to 13 years, the primary cause is a congenital abnormality.

In patients aged 14 to 24 years, the main causes of sudden cardiac death are hypertrophic cardiomyopathy (HCM), right ventricular cardiomyopathy (ARVC), congenital coronary anomalies, myocarditis, Wolff-Parkinson-White syndrome, and Marfan syndrome (*Sudden Cardiac Death in the Young - PMC*, n.d.) 12].

To prevent dreadful consequences like these in emergency units, cardiopulmonary resuscitation or CPR is usually employed. Its importance is most appropriately brought to light by the American Heart Association: "cardiac arrest is the sudden cessation of cardiac activity so that the victim becomes unresponsive, with no normal breathing and no signs of circulation. If corrective measures are not taken rapidly, this condition progresses to sudden death. Cardiac arrest should be used to signify an event as described above, which may be reversed, usually by cardiopulmonary resuscitation (CPR) and/or defibrillation or cardioversion, or cardiac pacing" (Mitropoulou & Fitzsimmons, 2022) [13].

Resuscitation is an important topic and a maneuver that should be discussed with all individuals concerned. It is to be kept in mind at all times that, irrespective of increased risk of cardiac arrest or poor outcome in the event of cardiac arrest, it should be addressed along with other treatment decisions such as invasive mechanical ventilation and advance care plans (Vincent, 2003) [14].

Sometimes, it is only a matter of timely decision-making that saves the life of the patient, as in the case of the patient under discussion.

CONCLUSION

Cardiopulmonary arrest poses grave risks on the life of any patient who suffers from it. Although there is little that can be done to save the life of the patient if the damage has gotten out of hand, it is still crucial to administer whatever aid can be given to help save the life of the patient.

The patient in this case already had a history of poorly-controlled diabetes, smoking, and dyslipidemia. These factors did little to improve the outcome of his cardiopulmonary arrest. However, when CPR was administered on this patient in a timely and effective manner, it did have helpful effects and, at the end of the day, helped to revive the patient successfully.

This shows the importance of cardiopulmonary resuscitation in that it does indeed help revive patients undergoing cardiac arrest.

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