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Survival After Recurrent Cardiac Arrest and Prolonged Hours of Resuscitation: A Case Report

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Abstract

The maximum duration of cardiopulmonary resuscitation remains unknown. Hyperkalemia, hypokalemia, hypovolemia, acidosis, hypoxia, hypothermia, thrombosis-coronary and pulmonary, cardiac tamponade, toxins, and tension pneumothorax are the reversible causes of cardiac arrest. We report a case of successful prolonged resuscitation for cardiac arrest due to severe hyperkalemia and severe metabolic acidosis in a patient with diabetic ketoacidosis. Our patient is unique in that he had multiple long-standing comorbidities in prolonged cardiac arrest with multiple reversible causes, such as hyperkaliemia and severe metabolic acidosis, and was successfully resuscitated. Patients who undergo prolonged CPR can survive with good outcomes. Young age, myocardial infarction, and potentially reversible causes of cardiac arrest such as hypothermia and pulmonary emboli predict favorable results, especially when the arrest is witnessed, followed by prompt and good resuscitative efforts.

Keywords: *Acidosis, CPR, Cardiac arrest, ECHO, Hyperkalemia.*

Introduction

Sudden cardiac arrest (SCA) is the leading worldwide cause of death [1]. It is estimated that annually about 7-lakh SCA cases occur annually in India. Cardiopulmonary resuscitation (CPR) is associated with a high mortality rate and poor neurological recovery. Cardiopulmonary resuscitation can cause ischemia–reperfusion injury to the whole body and brain. CPR with standard techniques after CA (Cardiac Arrest) restores normal cerebral and myocardial function, provided that it occurs within the first 3 to 5 minutes after circulatory standstill. Attempts to start CPR after 10 minutes of CA will result in mortality rates greater than 70%. Although successful resuscitation is possible in 20–40% of patients, hospital discharge after initial successful resuscitation is only approximately 10%.

Another 25–40% of patients experience an unwitnessed arrest with prolonged periods of Cardiac Arrest only approximately 1–2% of patients can be discharged from the hospital [2]. Time is a critical factor in determining patient outcomes after CPR, as long as normal blood is restored under normal conditions. In general, outcomes after cardiac arrest remain poor, especially inpatients with risk factors such as unwitnessed arrest, unfavorable initial rhythm, older age and prolonged resuscitation without return of spontaneous circulation (ROSC) [3,4]. Guidelines therefore exist for terminating resuscitative efforts in cases of cardiac arrest that are deemed futile [5]. Nonetheless, successful resuscitation and good recovery after recurrent arrest have been documented [6]. As the field of cardiopulmonary resuscitative medicine evolves, new techniques are being implemented to improve outcomes in patients with cardiac arrest [7]. We present a case of how recent research findings in resuscitative medicine improved a patient's chances of survival.

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Case Report

A 51-year-old Chinese male patient was brought by paramedics from the airport to the emergency department with ongoing CPR, intubated, and connected to a ventilator in an ambulance. He was seizing & unresponsive and had an episode of seizures on the way to the hospital. He was shifted to bed with ongoing CPR. He was diagnosed with end-stage kidney disease leading to hypertension at the age of 41 years and was on a 2-weekly hemodialysis (HD) regimen, but skipped dialysis for 2 weeks prior to the incident. He had hyperthyroidism and was administered carbimazole three times daily. No relevant family history was observed. As soon as the patient arrived, blood samples were collected for routine investigations. He had a history of triple vessel disease diagnosed 2 weeks prior, had undergone CAG, and was later advised to undergo CABG; however, the patient refused.

The patient's vital signs were as follows: pulse rate, 81 beats/min; respiratory rate: 20 breaths/min, blood pressure 148/79 mmHg , temperature: 97.5 °F, SpO 2 : 100%. On arrival to the hospital, his creatine level were 26, Potassium 8 mmol/L , HCO 3 was 10 mEq/L and taken for respectively. There was no gag or cough reflexes , and CT Brain sowed calcified focus in the left centrum semiovale with no perifocal edema, possibly representing a calcified granuloma.

CPR was administered as per AHA Guidelines with multiple shocks more than 100 times (50 in the ICU within 3 h of arrival to the emergency department and countless shocks from the airport to arrival and many times thereafter). Transthoracic Echocardiography revealed a left ventricular ejection fraction (LVEF) of approximately 30% beats that was moderately impaired, abnormal, or reduced, and it was difficult to assess the view of frequent extra. Septal hypokinesia with moderate mitral valve regurgitation (MR), right ventricular dilation, and absence of pericardial effusion were noted.

His Blood Gas Analysis (ABG) showed acidosis with hyperkalemia (8 mmol/L); hence, the reversible causes of cardiac arrest, such as severe metabolic and lactic acidosis and hyperkalemia with a creatinine level of 26, were considered and treated after carefully excluding others with Sodium Bicarbonate, IV Calcium and Insulin dextrose intravenous. After the ROSC (Return of Spontaneous Circulation), patient who was ventilator sedated with Continuous infusions of Inj.Fentanyl (50µg/mL) and midazolam (Versed) (1-15 mg/hr) to keep the Ramsay score of 5-6. Inj.Norepinephrine (Levophed) at 0.01-1µg/kg/min to keep the MAP more than 65 mmHg , sodium bicarbonate at 50 mEq/h, and 0.9% sodium chloride at 40 mL/h were administered. He had a normal sinus rhythm (NSR) with a central pulse. Insulin dextrose, calcium (30mL) and daily dialysis were initiated. Started with piperacillin/tazobactam (Tazocin) 2.25 gm 3 times a day. He had multiple episodes of unstable ventricular tachycardia (VT) and about 14 VT shocks were administered. In view of the history of triple-vessel disease, patients were advised to continue aspirin (75 mg) unless any contraindication was present.

On the 2nd day of his hospital stay, the patient complained of chest pain, ECG was performed, and ischemic changes were observed, as previously seen on ECG. Cardiac markers and troponin levels were also analyzed. The patient was maintained on oral renal diet. On the 5 th day of the patient's hospital stay, coronary angiography was performed, which showed critical stenosis of the proximal left anterior descending coronary artery, involving the origin of the first diagonal artery (bifurcation lesion), chronic total occlusion of the ostium of the small first obtuse marginal coronary artery, critical stenosis of the ostium of the ramus intermedius coronary artery, and chronic total occlusion of the proximal right coronary artery.

On 6th day of the patient's hospital stay, his ECHO report showed mildly dilated LV cavity dimensions with markedly impaired left ventricular (LV) systolic function. An ejection fraction (EF) of 30-35% with prominent trabeculations was seen in the apex, normal LV mass indexed to body surface area was 101 gms/m2, and Grade I and LV diastolic dysfunction was observed. The left atrial (LA) size and right ventricular (RV) cavity dimensions were normal with normal RV systolic function, mild MR, sclerotic aortic valve with trace aortic regurgitation (AR), inadequate tricuspid regurgitation (TR) to calculate pulmonary arterial (PA) pressure, intact with no evidence of a shunt on Doppler studies, no clot, no vegetation, and normal aortic arch. The patient was advised to undergo CABG but refused to say that he wanted to do it in his home country and was discharged from the hospital on day 8, when he was ambulatory.

Discussion

Prolonged cardiac arrest is associated with poor outcome. A systematic and effective team approach in performing CPR and early recognition and treatment of reversible causes of cardiac arrest is vital in achieving the best outcome in the event of cardiac arrest [8]. Unwitnessed, out of hospital cardiac arrests with non-shockable cardiac rhythm (Asystole and PEA) has the worst out come when compared to the witnessed, in the hospital cardiac arrests with shockable rhythm (VF and pulseless VT).

In our reported case, the patient survived resuscitation for as long as 1:30 hours. We recently found a few published reports of survival after prolonged resuscitation for cardiac arrest. A59-year-old male patient who was at bed rest for several days due to trauma, which resulted in femoral and rib fractures and a lung contusion. The patient was scheduled for femoral fracture reduction and internal fixation under general anesthesia. After disinfection and surgical towel laying, there was a sudden occurrence of severe PE and cardiac arrest; the patient was successfully resuscitated [9].

A 49-year-old male who suffered from myocardial infarction with subsequent cardiac arrest. The emergency medical team began cardiopulmonary resuscitation, including defibrillation of the ventricle. Although a return of spontaneous circulation was achieved after approximately 30 min of continued effort, the patient went back into cardiac arrest on the way to the hospital, and resuscitation had to be resumed. The patient survived with good neurologic outcome with myocardial infarction, cardiac arrest, and pH of under 6.7 on admission at the clinic [10]. In Okamoto case series observed that in case 1, a 58-year-old man presented with cardiac arrest and ventricular fibrillation (VF). Gasping was observed when the patient arrived at hospital. Extracorporeal cardiopulmonary resuscitation (ECPR) was initiated 82 minutes after cardiac arrest. Therefore, the patient was diagnosed with hypertrophic cardiomyopathy. Extracorporeal membrane oxygenation (ECMO) was discontinued on day 4, and the patient was discharged without neurological impairment [11]. In Case 2, a 49-year-old man experienced cardiac arrest with VF, and his gasping was preserved during transportation. On arrival, VF persisted, and gasping was observed; therefore, ECMO was initiated 93 min after cardiac arrest. The patient was diagnosed with acute myocardial infarction. ECMO was withdrawn on day 4 and he was discharged from the hospital without any neurological impairment [12].

As the field of cardiopulmonary resuscitative medicine develops, new techniques have been implemented to improve survival outcomes in patients with cardiac arrest [13]. The following are some of the techniques that we believe contributed to our patients successful outcomes. All rescuers, whether trained or not, should administer chest compressions to victims of cardiac arrest. High-quality compression involves pushing hard to a depth

of at least 2 in (5 cm) at a rate of at least 100 compressions/min, allowing full chest recoil after each compression and minimizing the interruption of the process. In addition, trained rescuers should provide ventilation at a compression–ventilation ratio of 30:2. Compression should resume immediately after defibrillation, without pauses, to analyze rhythm. Evidence suggests that minimizing pauses during CPR improves the chance of recovery from shock.

Multiple case reports have described successful resuscitation when thrombolytic agents are used after other interventions fail. The rationale behind this therapy is the high prevalence of cardiopulmonary arrest triggered by pulmonary embolism or acute coronary syndrome [14, 15]. Early prospective controlled trials associated this technique with low complication rates. However, subsequent larger trials have revealed no such benefit. As a result, the current American Heart Association guidelines report no convincing evidence that routine use of thrombolytic agents during resuscitation improves survival rates.

A meta-analysis associated out-of-hospital cardiac arrest with survival rates of 24% for the time of hospital admission and 8% for hospital discharge [16,17]. Higher survival rates were associated with daytime cardiac arrest, younger age, shorter CPR duration, primary cardiac disease as the cause, cardiac monitoring, no intubation requirement, favorable initial rhythm, and witnessed arrest. Sex differences were not significantly associated with mortality rates.

The survival rates after cardiac arrest remain low. However, despite poor overall outcomes, case reports of successful resuscitation after prolonged cardiac arrest provide hope for improved overall outcomes (18). Several factors contributed to our patient's recovery, and the obvious preservation of his neurological function throughout the arrest period was pivotal in our decision to continue resuscitative efforts and pursue advanced cardiopulmonary support (19,20).Our case is different from previously described cases of prolonged cardiac arrest, and the hope for patient survivability without substantial morbidity should be tempered with realistic expectations on an individual-patient basis. We submit our case report as an example of how advances in resuscitative medicine can be used to promote survival in an appropriate setting.

Conclusion

The efficiency of resuscitation depends largely on the time elapsed between the point of cardiac arrest and return of spontaneous circulation, and the quality of post-resuscitation care. New technologies promise to improve the resuscitation process: mechanical devices standardize chest compressions, capnography guides resuscitation efforts and signals the return of spontaneous circulation, and intraosseous devices minimize interruptions to gain vascular access. This reinforces the need for training and certification of all healthcare workers, ranging from paramedics and nursing to doctors on basic and advanced life support, and periodic retraining. Hospitals should be equipped with a dedicated rapid response team to attend to cardiac arrests, prearranged equipment such as airway equipment, emergency drugs, and provisions for quick and accurate laboratory services to avoid any delay in commencing and delivering effective cardiopulmonary resuscitation.

Conflict of Interest

None.

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