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Complete Neurological Recovery after Prolonged Resuscitation in a Young Patient with Non-Shockable Rhythm

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Abstract

Background: Out-of-hospital cardiac arrest (OHCA) with ongoing CPR on arrival to emergency department still a challenge to decide how long the resuscitation should continue or when to terminate it. **Case Summary:** A patient with a 1-week history of difficulty in breathing suffered from an OHCA. The electrocardiogram upon arrival to the hospital showed pulseless electrical activity. Cardiopulmonary resuscitation was initiated and continued for a total of 90 minutes without any interruption until return of spontaneous circulation (ROSC) was achieved. Post-cardiac care was offered, and the patient was discharged with complete neurological recovery. **Discussion:** In non-shockable rhythms, the powerful defibrillator machine is not used during resuscitation. In such cases, identifying the offending cause, performing high quality CPR and administering epinephrine are the only effective tools in resuscitating a patient.

Keywords

Cardiac Arrest, Out of Hospital Cardiac Arrest, Resuscitation

1. Introduction

Patients with longer code durations have a higher likelihood of ROSC and survival to discharge, particularly when the arrest is due to asystole or PEA [1]. One decision aid found that, in the absence of an initial rhythm of ventricular fibrillation or ventricular tachycardia or return of a pulse within 10 minutes of chest compressions, there was a negative predictive value of 98.9% for being discharged alive [2]. The quality of the chain-of-survival intervention and the clinical characteristics of the patient determine survival and the neurological

outcome of the patient, regardless of the length of resuscitation which can be prolonged especially in situations of non-shockable rhythms [2] [3]. Bystander-performed CPR had more value compared to defibrillation for patients with a non-shockable rhythm [4]. The case report we have described demonstrates how the integration of a multidisciplinary team with a high-quality resuscitation protocol in a timely manner helps to achieve a positive post resuscitation outcome.

2. Case Description

A 24-year-old man with a known history of hypertension, not on any medication, was rushed to our emergency care unit at 00:15 hrs after an OHCA. The patient was received in our unit with ongoing CPR into the 25th minute, on bag and mask ventilation, with no IV-line inserted. The ECG showed pulseless electrical activity. A week prior to this presentation, the patient complained of difficulty in breathing. The patient had recently started drinking alcohol heavily.

Upon arrival to the resuscitation room, ACLS Protocol was initiated. Arterial blood gas showed severe acidosis with pH 6.7, $PaCO_2$ 91 mmHg, HCO_3 14 mEq/L and potassium 7 mmol/L suggestive of hyperkalaemia. The patient received a bolus of calcium gluconate and sodium bicarbonate, many cycles of resuscitation continued to the patient in ED, The first ROSC at 01:01 h with a blood pressure of 139/90, SpO_2 93% and a heart rate of 140 bpm. However, the patient collapsed immediately once again. The cycles of achieving ROSC for a few seconds and arresting again repeated thrice. After 65 minutes of continuous CPR, when ROSC was achieved, the patient was finally maintaining his vitals. At this point, post-ROSC management was initiated.

Repeat ABG showed pH of 6.9, HCO_3 14 mEq/L, potassium 4 mmol/L. The ECG after achieving the final ROSC showed ischemic changes in the anterolateral leads (**Figure 1**). Another dose of bicarbonate was given, after which the patient was shifted to ICU in a haemodynamically stable state for further management. The vitals were BP 119/54, HR 145 bpm and SpO_2 100%. The patient was discharged with complete neurological recovery after an in hospital stay of around 2 months.

3. Discussion

In the above discussed case, from initiation of basic life support by standers at the site of OHCA till achievement of ROSC with hemodynamic stability took a total of 90 minutes. Numerous studies performed in the past have shown that longer resuscitation durations carry the risk of cerebral hypoperfusion, are associated with lower survival rates and poor neurological outcomes. This has also been the popular belief among healthcare providers. In a report by Ballew *et al.*, 45% of the patients who were discharged after being treated for cardiac arrest underwent resuscitation for less than 5 minutes, while < 5% were discharged

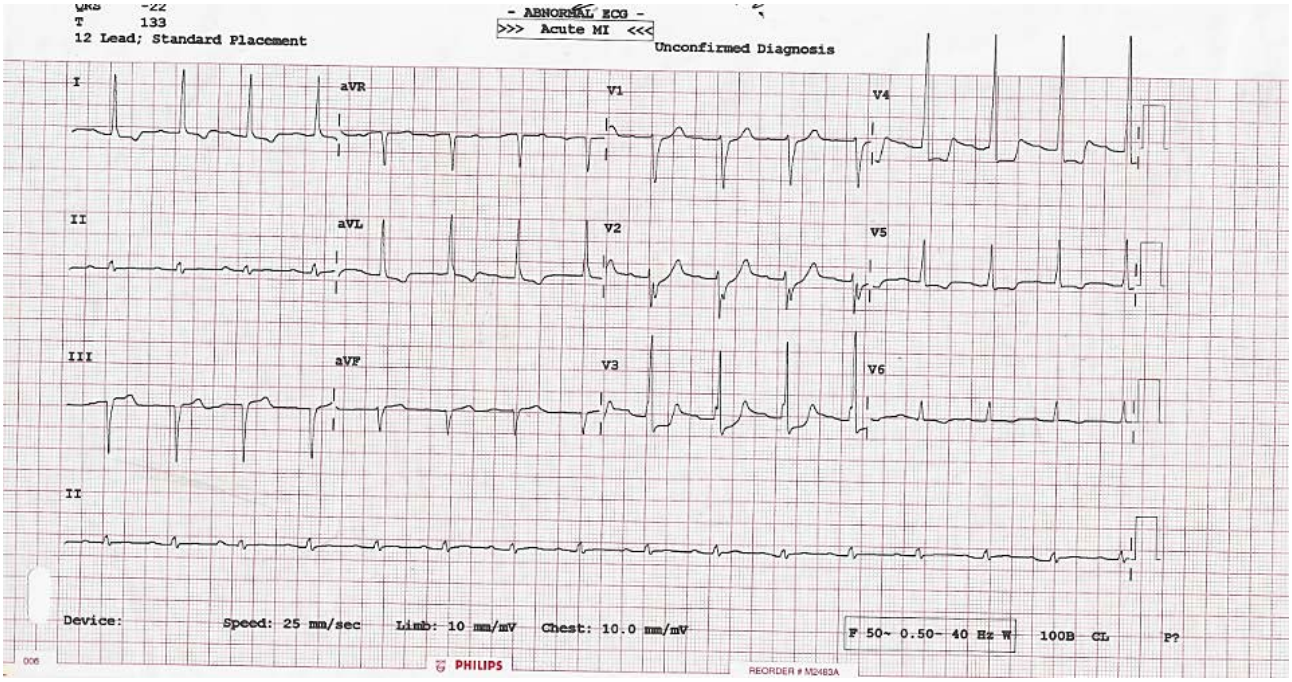

Figure 1. ECG obtained after achieving the final ROSC: ST depression and T wave inversion noted in leads I, aVL, V5, V6, V2 - V4.

when resuscitation continued beyond 20 minutes. Furthermore, an observational study conducted by Cha *et al.*, evaluating the duration of CPR demonstrated that the resuscitation rate was 25.5% and the survival rate was 5.6% when the duration of ACLS code surpassed half an hour. In a retrospective analysis of OHCA patients, the probability of decent functional outcome after 15 minutes of CPR was as low as 2%, in contrast to 75% for patients resuscitated for 10 - 15 minutes.

However, recent studies have shown that patients with longer resuscitation durations in hospital have higher rates for achieving ROSC with positive outcome upon discharge [1]. We found that in the case described above, the patient attained complete neurological recovery after in hospital stay of 2 months despite being resuscitated for a total duration of 90 minutes. In a study conducted in Taiwan, more than 30% of patients achieving ROSC did so only after a minimum of half an hour of resuscitation. Our case further supports this conclusion through the continuous resuscitative efforts maintained by the corrected hyperkalaemia, ongoing management of the metabolic acidosis and the repeated ROSC.

A major dilemma that physicians are faced with is knowing when the ideal time is to terminate CPR. Ceasing resuscitation is an emotionally and cognitively difficult task. As such, there are no clear rules for CPR termination, but several literature reviews suggest that the decision to continue or halt CPR efforts should not be solely based on the period of resuscitation but rather based on clinical judgment involving subjective and objective parameters [2]. Factors that affect the decisions made during the ACLS algorithm include the patient's age and baseline condition, co-existing comorbidities, reversibility of the cause of

arrest, latency to starting CPR and the adequacy of chest compressions [5].

In our case, several factors contributed to the ongoing CPR. The first contributor was the PEA rhythm on the ECG. In a review by Goldberger, a longer span of cardiopulmonary resuscitation was associated with a higher survival rate, notably in patients with an initial rhythm of PEA or asystole [1]. Secondly, in patients with non-shockable rhythms, the continuity of resuscitation is mainly determined by the failure of ROSC. Our patient achieved ROSC on four separate occasions which further drove our resuscitative efforts.

The quality of resuscitation interventions in the entire chain determines the arrest outcome [2]. By-stander performed CPR is more important than defibrillation for patients with a non-shockable rhythm and the CPR begun at the site of OHCA proved very beneficial for our patient. It is crucial to continue proper resuscitative efforts and minimize CPR interruptions in an arrest of such prolonged duration. Also, return of spontaneous pulse should only be verified at the recommended intervals to minimize brain damage from ischaemia because cerebral perfusion is the universal goal for physicians providing ACLS.

Ebell *et al.* found that good neurologic function prior to hospital admission is associated with a good neurologic outcome after resuscitation. Trauma, stroke and age more than 85 years of age are associated with neurological impairment [2]. Although age alone is not a good predictor of post resuscitation outcome, a large multicentric cohort study of OHCA patients suggested that younger patients below 45 years of age had better chances of survival associated with good neurological outcomes [6]. Our patient's age therefore played a part in the success of our resuscitative efforts.

4. Conclusions

The underlying disease causing the cardiac arrest significantly affects the outcome of the resuscitation. Acute myocardial infarction, hypothermia, pulmonary embolism and drug overdose contribute to 67% of all OHCA. Drug overdoses include alcohol. This etiology should deserve special consideration by the treating physician for prolongation of CPR duration. OHCAs of cardiac origin have better outcome than OHCA due to non-cardiac origin [5].

The maximal duration for continuing CPR is not determined by a set of specific factors, but rather by the clinical picture of each patient and the assessment of the patient by the physician leading the code. The duration of the code is not the main determinant of the neurological outcome or chance of recovery of the patient.

In patients with non-shockable rhythms, an unbroken chain-of-survival with quality of resuscitation and a rapid management of the abnormal blood parameters indicates the neurological outcome regardless of the length of resuscitation, as was apparent in our patient, who recovered after 90 minutes of CPR [3].

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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