Prolonged Cardiopulmonary Arrest Treated Successfully in the São Paulo's Subway

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Introduction

In Brazil, circulatory diseases, including CPA (Cardiopulmonary Arrests), were the leading cause of death in 2010[1]. Estimates are that, in Brazil, around 220,000 CPAs happen every year, including ventricular fibrillation, 180,000 in pre-hospital environment and 40,000 in-hospital[2].

Recent observational studies of victims of CPA in extra-hospital environment revealed that only CCC (Continuous Chest Compressions) – hands-only CPR – were equivalent or higher than conventional CPR (Cardiopulmonary Resuscitation) (using a 30:2 ratio of compressions/ventilations) in adult patients, mainly with regard to neurological benefits[3-5].

We present a case of PCA occurred in Companhia do Metropolitano de São Paulo (São Paulo's Subway) attended by lay rescuers who performed CCC and applied shocks by means of AED (Automatic External Defibrillator).

Case Report

Man, 55, Japanese origin, trader, with a history of hypertension. He was in one of the São Paulo's Subway stations when he felt sharp and constant pain in chest, accompanied by dizziness and progressing to loss of consciousness. The users triggered the subway employees (laypersons trained in CPR) who identified the CPA and started to assist him. They requested the AED and started applying CCC immediately. In two minutes, the AED was in place, with paddles applied to the chest of the victim. The rhythm (ventricular fibrillation) was analyzed and shock was indicated in less than 20 seconds. Chest compressions were immediately resumed and the AED showed four shocks over 8 minutes, all of them followed by CCC. After the fifth shock, the victim was breathing again, though unconscious, and defibrillation was no longer indicated in subsequent analyzes. Assessing the AED reading after the last shock, the patient evolved into sinus rhythm, which is the reason why no more shocks were indicated (Figure 1). Rescuers alternated at each two minutes of CCC. With the arrival of SAMU (Emergency Mobile Healthcare Service), tracheal intubation, medications and special care were administered.

The victim was sent to a secondary hospital, admitted unconscious in sinus rhythm with a heart rate of 130 bpm, blood pressure of 160 x 100 mmHg, respiratory rate of 16 rpm, and isochoric and reactive pupils, presenting vesicular murmur, flaccid abdomen on palpation and Glasgow of level 6. The acute myocardial infarction was confirmed by ST segment elevation in lower leads and elevation of troponin and CKMB. The patient underwent thrombolytic therapy with streptokinase, under myocardial reperfusion criteria. During hospitalization, he acquired pneumonia associated with mechanical ventilation. He was discharged after 19 days without neurological sequelae. After one year, the patient was asymptomatic, with active life and undergoing outpatient follow-up.

Discussion

The most common CPA rhythm in extra-hospital environment is the fibrillation[6]. The probability of success in resuscitation decreases significantly over time, from 7 to 10% by minute in which defibrillation is delayed[6,7]. The performance of chest compressions increases the time for effective defibrillation. Needless to say that training laypersons on CPR skills and structuring mobile emergency services is crucial for the approach and, although the response time of emergency services is critical to a successful resuscitation, the laypersons training in CPR and handling of AED boost the success possibilities[6-8].

Globally, the percentage of lay witnesses who initiate CPR ranges from 20 to 70%, averaging 50%. The lowest percentages are usually associated with delayed onset of resuscitation and a worse prognosis, whereas the early initiation of chest compressions results in higher number of hospital admissions and up to three times higher hospital discharges with survival[6-9].

New international recommendations allow the practice of CPR with CCC, without ventilation, in certain circumstances. This practice has been called cardiocerebral resuscitation[4]. It indicates that the quick start of CPR and early defibrillation are associated with better neurological prognosis[4,7,9].

Based on animal studies, the concept that the addition of ventilations to compressions, made by witnesses, does not increase the survival of ventricular fibrillation or myocardial infarction has been increasingly accepted. Clinical studies in humans have also shown the efficacy of CCC[7-9].

Keywords

Out-of-Hospital Cardiac Arrest; Ventricular Fibrillation; Cardiopulmonary Resuscitation; Heart Massage; Electric Countershock.

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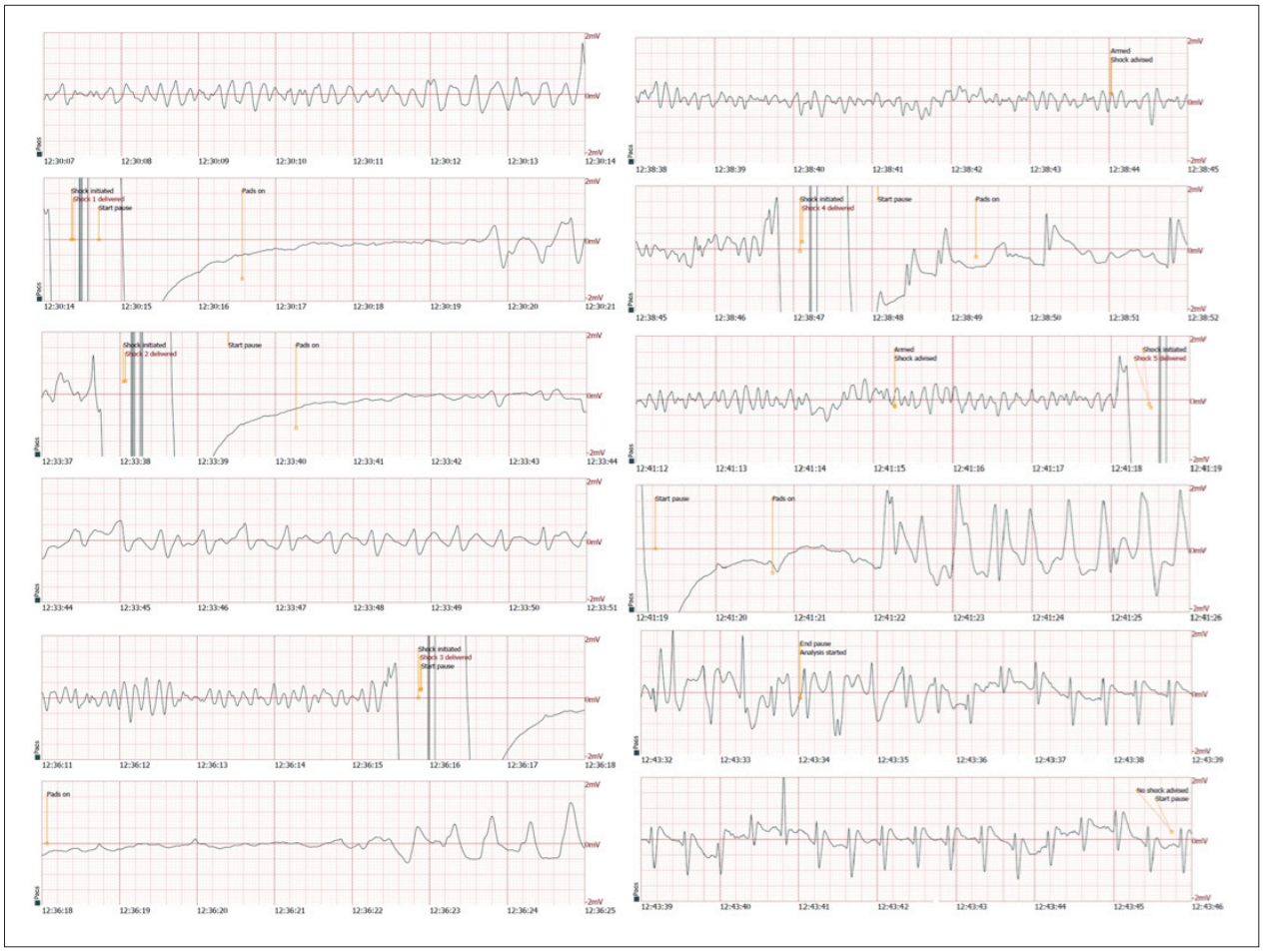

Figure 1 - *Application of five automated external defibrillator shocks followed by return of sinus rhythm and tachycardia.*

Regarding the characteristics of training, CPR only with compressions is associated with greater knowledge retention and greater willingness of laypersons to perform it. Furthermore, regardless of the cause and duration of CPA and the availability of AED on site, CPR with CCC is better than no CPR[7-9].

In São Paulo's Subway, staff is trained at least every two years in resuscitation skills attending a standardized course of AHA (American Heart Association), with practical training on mannequins and handling of AED. During training, only CCC is practiced without pauses for ventilation, according to international guidelines. Systematic training is necessary, as studies show that a larger number of courses and the short time interval between them are predictors for obtaining rapid and early compressions, thus improving the patient's prognosis. Public awareness programs should also be on the agenda of public policies for reducing mortality from sudden cardiac death[6].

Another link in the chain of the survival of out-of-hospital cardiac CPA is the easy access to AED by the rescuer. The early defibrillation, before the arrival of the emergency service, should be a priority[6,10]. The early defibrillation with use of AED can improve the prognosis of patients, including higher survival and better neurological between survivors. The use of AED is extremely simple, and a trained layperson can perform the defibrillation procedure with the same fitness and safety of a healthcare professional. Since 1991, AHA has encouraged the provision of easily accessible AEDs in public places, in addition to courses on CPR and on using AED[10].

According to large population studies, PAD (Public Access to Defibrillation), putting AEDs at the disposal of laymen trained in its use, has the potential to be the intervention which represents the greatest breakthrough in the treatment of CPA in ventricular fibrillation, since the development of CPR, as it allows the victims to be defibrillated within the first minutes of CPA[10]. There is evidence that the handling of AEDs, within PAD programs, may double the survival of victims compared to access to SAMU. The early defibrillation provided by PAD is still associated to better neurological prognosis[6,10]. The Brazilian precedents is gradually evolving to establish that the said devices be mandatory in several places.

In conclusion, as exemplified in this case, the implementation of programs of access to defibrillation, in concert with laypersons' training in CPR with CCC and in the use of AED actually contributes to reducing mortality and improves the neurological prognosis in out-of-hospital CPA. Programs like this should be mandatory in our country, especially in the coming years, when Brazil will host major events, such as the FIFA World Cup and the Olympics.

Author contributions

Conception and design of the research: Gianotto-Oliveira R, Liguori T; Acquisition of data: Gianotto-Oliveira R, Gonzalez MM; Analysis and interpretation of the data: Favarato MH; Writing of the manuscript: Gianotto-Oliveira R, Favarato MH, Gonzalez MM; Critical revision of the manuscript for intellectual content: Timerman S, Kalil Filho R.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

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