DOI: 10.4025/cienccuidsaude.v13i4.18936

ORIGINAL ARTICLES

VICTIMS ATTENDANCES OF OUT-OF-HOSPITAL CARDIAC ARREST WITH AUTOMATIC EXTERNAL DEFIBRILLATOR IN BASIC SUPPORT UNITS

Allana dos Reis Corrêa*
Dacle Vilma Carvalho**
Daniela Aparecida Morais***
Bruna Figueiredo Manzo****

ABSTRACT
The use of automated external defibrillators (AED) may be beneficial for patients with cardiopulmonary arrest (CPA), even if used by individuals trained to handle it or lay. This study aimed to characterize care to victims of cardiac arrest, probable cardiac etiology conducted by teams of the Mobile Emergency Care Service in Belo Horizonte after the incorporation of AED in the Basic Support Unit (BSU). This is a retrospective, epidemiological study. The variables used were based on the Utstein style data submitted to descriptive statistics. Of the 543 calls, 58.4% of victims were male and the median age was 56 years. Asystole was identified in 86.7% of cases. In 39,0% of cases a BSU and an Advanced Support Unit were engaged, and in 86.6% of those, the BSU arrived first in 15,5 minutes on average. In 46.6% of the calls there was no indication of cardiopulmonary resuscitation (CPR). Of the 112 people who received CPR measures with a defibrillator, the majority (75.0%) of them was with the AED. Shock was given to 14.3% and more than half (58.3%) had a return of spontaneous circulation. This result demonstrates the importance of the AED, allowing access to early defibrillation to victims of cardiac CPR.

Keywords: Out-of-hospital Cardiac Arrest. Defibrillators. Cardiopulmonary Resuscitation. Emergency Medical Services. Prehospital Care.

INTRODUCTION

Diseases of the circulatory system nowadays still represent the leading cause of death in developed and developing countries[1]. Coronary heart diseases are the leading cause of cardiopulmonary arrest (CPA) in Brazil, being the cardiac ischemia responsible for up to 80% of the sudden death cases[2,3].

The sudden death is defined as unexpected and resulting from a cardiac cause which happens immediately or within one hour after the onset of ischemic heart disease symptoms[1]. The clinical condition that characterizes the sudden death is the CPA, defined as cessation of mechanical cardiac activity, i.e. the absence of circulation signs, lack of responsiveness and pulse, apnea or agonic respiration[4].

Approximately 80% of the CPAs occur in non-hospital environments and require appropriate and urgent intervention strategies[5]. Among these stands the early access to defibrillation out because the main rate of CPA in non-hospital environment is ventricular fibrillation (VF) and the definitive treatment for the reversal of this rate is defibrillation[1].

Defibrillation consists in the therapeutic use of direct current electric shock, not synchronized to the electrocardiogram, applied to the chest or directly on the myocardium in order to promote the simultaneous depolarization of an essential mass of ventricular cells thus allowing for the resumption of the normal cardiac cycle[1].

Using the manual defibrillator requires the rescuer to diagnose the heart rate of the CPA and decide if the case requires defibrillation shock or not. The automated external defibrillators (AEDs) are composed of sophisticated computer systems that analyze the patient's heart rate,

*Nurse. PhD in nursing, Adjunct Professor, School of Nursing, Federal University of Minas Gerais (UFMG), Belo Horizonte, MG, Brazil. E-mail: allanareiscorrea@gmail.com
**Nurse. PhD in nursing, Associate Professor, School of Nursing, Federal University of Minas Gerais (UFMG). E-mail: dacle@enf.ufmg.br
***Nurse. PhD in nursing, RN, Serviço de Atendimento Móvel de Urgência de Belo Horizonte, Belo Horizonte, MG, Brazil. E-mail:dam.morais@gmail.com
****Nurse. PhD in nursing, Adjunct Professor School of Nursing, Federal University of Minas Gerais (UFMG). E-mail: brunaamancio@yahoo.com.br

using an algorithm to identify "shockable rates", which is a VF or a ventricular tachycardia (VT) without pulse. When one of these rates is detected, the AED, by voice command, directs the rescuer to apply the electric shock. In this way, the use of the equipment does not require any skill in recognizing the rate of the CPA, and can be handled by laymen and non-medical professionals[1,5].

Studies show an increase in the chances of survival of CPA victims in non-hospital environment when early attended by a non-professional in health acting as first responder like cops and firefighters, properly trained and familiar with the AED[6-8].

In addition to the early defibrillation, the existence of a structured medical emergency service which promotes early operations of cardiopulmonary resuscitation (CPR) is essential for the proper caregiving to the patient with CPA in a non-hospital environment[5].

By means of the National Policy for Urgency Attention in Brazil, the Mobile Emergency Care Service called *Serviço de Atendimento Móvel de Urgência* (SAMU) was established in 2004[9]. This service has equipment and trained professionals for various emergency situations. Among the attended cases, the CPA is a relatively common clinical emergency but very serious because, if CPR measures are not initiated soon after the occurrence, it can lead to death[10].

The SAMU offers two modes of ambulances: basic support units (BSUs) and advanced support units (ASUs). Due to the population coverage determined for each type of ambulance, the BSUs are available in greater numbers than the ASUs[9].

A study on services for CPA victims, performed in the Mobile Emergency Care Service Belo Horizonte (SAMU-BH) in 2005, showed that the BSUs arrived before the ASUs and most victims with CPA of likely cardiac etiology presented a shockable rate upon arrival of the advanced support team[10]. At the time the study was conducted, the AED was not available in the BSUs and the presence of such equipment could have increased the survival chances of the victims due to early access to defibrillation[6,8].

With the purpose of improving the efficaciousness in attendance to sudden death, in November 2007, the SAMU/BH equipped all the BSUs with the AED. The training of the teams was given at the workplace and in December of the same year all professionals were already able to use the AED when called to people with CPA and a study about this new reality became necessary.

So, considering the aspect of morbidity and mortality from cardiovascular disease and the presence of AED in the USBs of SAMU/BH, this study was accomplished with the aim to characterize the attendances of cardiac arrest victims carried out by teams of the Mobile Emergency Care Service Belo Horizonte after incorporation of the AED in the basic support units.

METHOD

This is an epidemiological study, retrospective, accomplished at the SAMU in the municipality of Belo Horizonte that has an area of 331.4km^2 and a population of 2,479,165 inhabitants[11].

In specific cases such as CPA, the service goes beyond the population of Belo Horizonte and attends the municipalities of the metropolitan region which do not have a local pre-hospital care service available. In the studied period, the SAMU/BH had 16 BSUs and four ASUs. A BSU team consists of a nursing professional and a driver; and the ASU team of a doctor, a nurse and a driver.

As criteria for inclusion, pre-hospital attendance sheets (PHAS) of people served by the teams of SAMU/BH after the incorporation of the AED by the service were listed, of both sexes who showed CPA, likely of cardiac origin. It was considered that every CPA is presumed to be of cardiac origin unless resulting from trauma or other causes identified by the attendance team[4].

The study comprises 543 (2.4%) people who were CPA victims of likely cardiac origin, attended by the MECS-BH, which accomplished 22,635 attendances within 4 months (December 2007 - March 2008).

The return of spontaneous circulation, the for servicing responsible unit, the response time (TR) of the ambulance, the gender, the age, testified CPA, basic CPR before the arrival of

the SAMU, the initial heart rate, the accomplishment of CPR measures and the use of defibrillators were the used variables, based on the Utstein Style[4], an method created in the 90's with the goal of collecting data and standardize the definitions of terms related to CPA aiming at standardization and therefore comparison of studies on this topic.

The project was approved by the Research Ethics Committee of the Federal University Minas Gerais, with the Protocol nº 049.0.410.203/09 ETIC.

The data were collected through the transcription of information contained in the PHAS into an electronic form prepared by the program Access® 2007, being the data submitted to descriptive analysis using software R version 2.15.1 for the calculation of absolute and relatively simple frequencies, measures of central tendency, dispersion by age and ambulance time-response.

RESULTS

Of the 543 people who were CPA victims of likely cardiac origin, the majority (58.4%) were men. The age of the victims ranged from one to 104 years with an average of 56 years.

In relation to the CPA rate, it is to highlight that in 148 (27.3%) cases of PHAS the record did not contain the first heart rate identified by the team. In 231 (42.6%) cases the CPR indication was registered, so the pace was evaluated but not registered. The heart rate was identified as asystole in 471 (86.7%) of the cases by the team at the time of the initial evaluation.

The attendance of people with CPA occurred in 261 districts of the municipality of Belo Horizonte and in seven cities in the metropolitan region (Caeté, Contagem, Pedro Leopoldo, Ribeirão das Neves, Sabará, Santa Luzia and Vespasiano).

More than half of the attendances (277 - 51.0%) were performed by the ASUs and in 54 (10.0%) cases there was the sole presence of a BSU. In 212 (39.0%) of attendances there were concomitant participation of the two ambulance types (ASU and BSU). However, in these cases only in half of them there was a record of the RT from both teams.

The average response time (RT) in the metropolitan region was higher (BSU: 14.6 min and ASU: 19.6 minutes) than the average time in the municipality of Belo Horizonte (BSU: 9.7 min and ASU: 10.4 min). Through the records of the further attendance sheets the BSUs arrived on average 15.5 minutes before the ASUs.

Before the arrival of the BSU or ASU team at the place of occurrence, in 36 (6.6%) cases the CPA occurred in the presence of a person. In 3 (8.3%) of these cases the CPA was witnessed by people trained in basic life support (BLS) and CPR measures were initiated by the witnesses and continued by the SAMU teams. The other 33 (91.7%) cases were witnessed by laymen and none of them took another measure than calling the SAMU.

The record on the accomplishment or non-accomplishment of CPR measures was present in 526 (96.9%) cases. In 273 (51.9%) of these, there was no indication of CPR measures.

Of the 253 (48.1%) people who received CPR measures, 148 (58.5%) were male, aged from 1 to 97 years with an average of 57 years; 141 (55.7%) received basic and advanced life support measures without the use of a defibrillator and 12 (8.5%) of them had return of spontaneous circulation (ROSC).

A defibrillator was connected to 112 (44.3%) people. The AED was connected in 84 (75.0%) of the cases and did not indicate a shock to most of them 72 (85.7%), however 2 (2.7%) people presented ROSC.

The clinical outcomes of patients who had an indication for manual defibrillator shock and AED are presented in Table 1.

Table 1 - Return of spontaneous circulation in people with CPA, attended by the MECS teams, secondly the type of defibrillator used. Belo Horizonte, MG, 2007/2008.

Used type of defibrillator	Return of Spontaneous Circulation				Total	
	Yes		No			
	N	%	N	%	N	%
AED	7	58,3	5	41,7	12	100,0
Manual	12	42,9	16	57,1	28	100,0
Total	19	47,5	21	52,5	40	100,0

It is to observe that the 28 (25.0%) patients who received the shock through a manual defibrillator, 12 (42.9%) had ROSC and of the

12 who were firstly attended by a BSU and received the shock through the AED, 7 (58.3%) presented ROSC.

Thus, with this additional result it totals in 33 (13.0%) people who had ROSC after receiving CPR measures through the SAMU teams, as represented in Figure 1. Of these, 21 (63.6%) were male, aged between 18 and 79 years with an average of 53 years, the average RT was 5min and nearly half, 16 (48.5%), had as first recorded rate the ventricular fibrillation. All records were conducted within a hospital unit, being 21 (63.6%) in public hospitals. In 7 (21.2%) sheets there was no record of the name of the institution the patient was sent to.

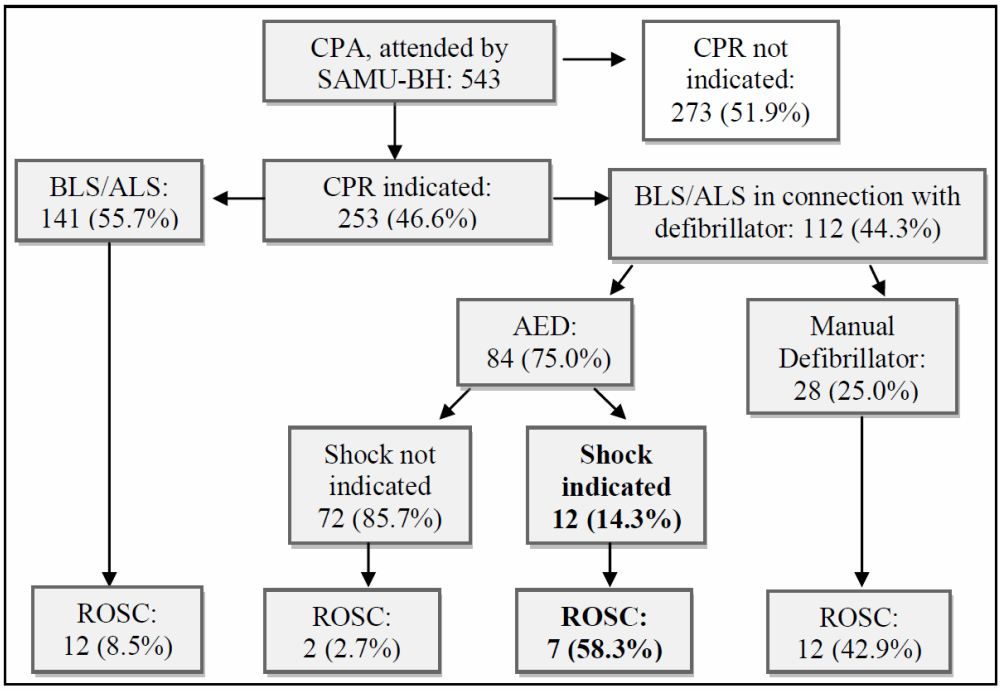

Figure 1 - Results of attendances of people with CPA, accomplished by the SAMU teams after the incorporation of the AED. Belo Horizonte, MG, 2007/2008.

DISCUSSION

In the studied group of people, the occurrence of CPA was greater in males. A similar result was detected in three other studies developed in Brazil[10,12-13].

Two multicenter studies, one in the United States[14] from October 2005 to December 2010 which examined the attendance records of people who were CPA victims in a non-hospital environment and another one in Japan[15] also found the prevalence of male CPA victims in a non-hospital environment.

The average of 56 years of age found in this study was lower than that found in Brazilian studies developed in Araras/São Paulo[16], Porto Alegre[12] and Belo Horizonte[13] which have found averages of 66, 63 and 64 years respectively.

A study developed in Spain[17] in order to evaluate the CPA cases in non-hospital environment attended by basic life support units of pre-hospital care in the country found that patients with age ≤ 65 years, especially those who had cardiac CPA etiology, presented a higher likelihood of immediate survival.

The failure to register the heart rate in 27.3% of the PHAS and the greater prevalence of asystole followed by VF/VT and PEA was also reported in two other studies accomplished in the SAMU/BH[10,13]. At the initial approach to the people who are CPA victims, the SAMU/BH team checks the victim's heart rate in CPA. This rate may not coincide with the initial one since it is evaluated after the arrival of the teams, except in CPA cases witnessed by these.

Studies which evaluated outcomes of the attendance of patients that presented CPA in non-hospital environment in the United States[8],

Osaka/Japan[15] and Spain[17] show that the incidence of VF/VT as firstly registered pace has diminished in recent decades and represents today around 23% of the cases. The authors argue that the delays in aid applications may be responsible for the low frequency of VF/VT as initial rate, but don't rule out that the incidence is actually decreasing as the response times are much better when compared to those found in Brazilian studies.

In Milwaukee (State of Wisconsin, United States), a study that assessed the changes in the incidence of VF/VT as initial rate in people who had CPA outside the hospital was developed. The results showed that the incidence of CPA with a shockable initial rate reduced from 37.1/100,000 inhabitants in 1992 to 19.4/100,000 inhabitants in 2002 and asystole, considering the same evaluation period, increased from 27.3/100,000 to 44.9/100,000 inhabitants. The multivariate regression analysis showed that males < 80 years of age, Caucasian and prior cardiac surgery were the factors associated to the occurrence of CPA with an initial pace of VF/VT without pulse[18].

The record of the presence of a basic support team during the attendance in 39.0% of the situations was determined. On the presence or suspicion of a CPA victim, the MECS regulation center, according to service protocol, usually commits the victim to the nearest BSU location as to the victim receives CPR and early defibrillation measures by the AED until the arrival of the ASU. The attendance by both teams mostly facilitates the reciprocation recommended by the authorities in charge of the realization of external chest compressions[17,18].

In this study, the average response time for the attendance accomplished in Belo Horizonte was 9.7 minutes for calls made by BSU and 10.4 minutes when performed by the ASU. Similar results were found in attendances of people with CPA performed by the ASUs of MECS/BH in 2005 that showed the average RT of 10.3 min for occurrences within the municipality[10].

A study conducted in Porto Alegre[12] showed a RT of 13 minutes and the authors report that although there are other factors, this high RT may have compromised people's survival of CPA. The shorter the travel time of the mobile units with trained professionals for attending the people with CPA, the faster the victim is assisted which can make a difference in their survival[14,15].

The CPA was witnessed by someone in 6.6% of the attendances. Studies carried out in Porto Alegre[12] and Belo Horizonte[13] reported a percentage of 28.0% and 30.0% respectively, showing an increase in frequency in the number of cases of witnessed CPA. CPA identification at the time of the collapse allows for emergency medical services, increasing the chances of early initiation of the treatment[19].

The realization of RCP measures before the arrival of the SAMU-BH teams occurred only in 3 cases, by people trained in CPR. This data indicates that although doctors of this service guide, by phone, how people should proceed until the arrival of the ambulance, the procedure was rarely initiated. Recent studies claim that CPR measures and the use of AEDs by laymen until the arrival of the medical emergency service can increase the chance of survival by as much as two times[6,7,19].

The early and effective implementation of RCP measures helps to maintain the VF pace, increasing the chances of success in defibrillation once in patients that show VF as initial CPA rate, the chance of survival decreases by 7.0 to 10.0% every minute that passes between the CPA and the defibrillation because the pace evolves into asystole[1,19].

Because it is an important public health problem, one of the proposals made by the American Heart Association[1], already developed in other countries, is the dissemination and implementation of programs for public access to defibrillation, which includes recognition of the CPA, beginning of chest compressions and early AED use, contributing to increase the survival chances of victims of this disorder[1,19].

In this study, 84 people had access to the AED, the shock was indicated for 12 and 7 (58.3%) presented ROSC and, of the 28 defibrillated people through the manual equipment, 12 (42.9%) had ROSC. These results point to possible benefits of the incorporation of the AED in BSUs of the SAMU/BH. If the

BSUs weren't equipped with an AED, it would be necessary to await the arrival of an ASU to identify the CPR rate and start the definitive measures of reversal that had not been taken early and these seven people could not have presented a ROSC as to survive.

A study conducted in Rochester/Minnesota analyzed the incidence of people who presented CPA outside the hospital with VF as initial pace and the results of the attendances at the local EMS over a period of more than 18 years and showed that rapid defibrillation was the main factor associated to survival and hospital discharge that reached a percentage of 46.3%. The average time between the request for help and the administration of the shock was 6.5 minutes and this variable was statistically significant for survival with preserved neurological state. The patients had 1.4 times less chance of survival every minute that passed between the request for help and the defibrillation[20].

As for the outcome of the attendances, 13.0% of the studied people presented ROSC and were sent to hospital units. It is to understand that this percentage is smaller to the one identified in studies accomplished in the same municipality[13] and in a study conducted in Porto Alegre[12], which showed ROSC percentages of 20.5 and 20.0 respectively. Probably the most critical factor for patients with CPA is the time between the start of the collapse and the beginning of the treatment and the chance of survival is less if this event is not witnessed by anyone. Studies show that the determining factors for the more frequent ROSC occurrence are the RT, the CPA being witnessed, VF/VT as initial rate and access to ALS[8,10,13,15,16].

This study has limitations as the short period of time studied, causing an "N" which did not allow for establishing correlations between variables and the outcome. For being retrospective, the pursuit of data after the occurrence of the events and the sole access to information described in the attendance sheets were points that may have contributed to the absence of accurate information of important variables such as: exact location of the CPA occurrence (home, public street or other), time of the request of help via phone call, duration of the reanimation, time between collapse and defibrillation.

FINAL CONSIDERATIONS

Of the 543 people with CPA, attended by the SAMU/BH teams, the majority was male, the average age was 56 years and asystole was the first identified rate in 86.7% of the people with CPA. 46.6% received CPR measures and of these, 13.0% showed return of spontaneous circulation. The BSU showed shorter RT than the ASU both in attendance accomplished in Belo Horizonte and in the metropolitan region.

In the four months referring to the period of accomplishment of this study the importance of the incorporation of the AED in BSUs becomes evident, once that 58.3% of people who received shock through AED had ROSC, which could not have taken place considering the BSU arrived in average 15.5 minutes earlier than the ASU in 86.6% of the attendances in which both units were called.

CPA identification, early beginning of CPR measures and AED access are essential measures to increase the chances of survival of people who show CPA outside the hospital. The reduction of the ambulance response time of the SAMU-BH can be achieved through investment aimed at the expansion of the pre-hospital care services for the municipalities of the metropolitan region, traffic education and urbanization of suburbs with precise identification of public areas among other measures.

It is of great importance to promote empowerment of the lay population in basic life support and availability of AED for the population at strategic access locations as in basic health units and neighborhood associations.

Possibly these measures, justified through the dimension of this real public health problem, can contribute to not only an increase in the immediate survival of the CPA victim in pre-hospital environment but as well to a better life quality for people who survive this occasion when attended early.

CARACTERÍSTICAS DOS ATENDIMENTOS A VÍTIMAS DE PARADA CARDÍACA EXTRA-HOSPITALAR APÓS INCORPORAÇÃO DO DESFIBRILADOR EXTERNO AUTOMÁTICO EM UNIDADES DE SUPORTE BÁSICO

RESUMO

O uso de Desfibriladores Externos Automáticos (DEAs) pode ser benéfico para pacientes com Parada Cardiorrespiratória (PCR), mesmo se utilizado por indivíduos treinados a manuseá-lo ou leigos. Este estudo teve o objetivo de caracterizar atendimentos às vítimas de PCR, de provável etiologia cardíaca realizados pelas equipes do Serviço de Atendimento Móvel de Urgência de Belo Horizonte após a incorporação do DEA nas Unidades de Suporte Básico (USB). Trata-se de um estudo epidemiológico, retrospectivo. As variáveis utilizadas foram baseadas no estilo Utstein e os dados submetidos à estatística descritiva. Dos 543 atendimentos, 58,4% das vítimas eram do sexo masculino e a mediana da idade foi de 56 anos. Em 39,0% das ocorrências houve o acionamento e atendimento conjunto de uma USB e uma Unidade de Suporte Avançado (USA) e, em 86,6% destes as USBs chegaram, em média, 15,5 minutos primeiro. Em 46,6% dos atendimentos houve indicação de manobras de Ressuscitação Cardiopulmonar (RCP). Das 112 pessoas que receberam manobras de RCP com um desfibrilador, a maioria (75,0%) delas foi pelo DEA. O choque foi indicado para 14,3% e mais da metade (58,3%) teve retorno da circulação espontânea. Esse resultado demonstra a importância do DEA, permitindo acesso à desfibrilação precoce às vítimas de PCR.

Palavras-chave: Parada Cardíaca extra-hospitalar. Desfibriladores. Ressuscitação Cardiopulmonar. Serviços Médicos de Emergência. Assistência Pré-hospitalar.

CARACTERÍSTICAS DE LLAMADAS A VÍCTIMAS PARO CARDÍACO EXTRA-HOSPITALARIO DESPUÉS DE LA INCORPORACIÓN DE UN DESFIBRILADOR EXTERNO AUTOMÁTICO EN UNIDADDES DE SOPRTE BÁSICO

RESUMEN

El uso de Desfibriladores Externos Automáticos (DEAs) puede ser beneficioso para los pacientes con Paro Cardiorrespiratorio (PCR), incluso si se utiliza por personas capacitadas para manejarlo o laicos. Este estudio tuvo como objetivo caracterizar la atención a las víctimas de PCR, de probable etiología cardíaca llevada a cabo por los equipos del Servicio de Atención Móvil de Urgencia en Belo Horizonte después de la incorporación del DEA en Unidades de Soporte Básico (USB). Se trata de un estudio epidemiológico, retrospectivo. Las variables utilizadas se basaron en el estilo Utstein y los datos fueron sometidos a la estadística descriptiva. De las 543 atenciones, 58,4% de las víctimas eran del sexo masculino y el promedio de edad fue de 56 años. En un 39,0% de los casos hubo el llamamiento y la atención en conjunto de una USB y una Unidad de Soporte Vital Avanzado (UVI) y en un 86,6% de ellos, las USBs llegaron, más o menos, unos 15,5 minutos primero. En un 46,6% de las atenciones hubo indicación de maniobras de Reanimación Cardiopulmonar (RCP). De las 112 personas que recibieron las maniobras de RCP con un desfibrilador, la mayoría (75,0%) de ellas fue con el DEA. El choque fue indicado a 14,3%, y más de la mitad (58,3%) tuvo un retorno de la circulación espontánea. Este resultado demuestra la importancia del DEA, permitiendo el acceso a la desfibrilación precoz a las víctimas de PCR.

Palabras clave: Paro Cardíaco Extra-hospitalario. Desfibriladores. Resucitación Cardiopulmonar. Servicios Médicos de Urgencia. Atención Prehospitalaria.

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Corresponding author: Allana dos Reis Corrêa. Av. Alfredo Balena, 190 – Campus Saúde. Santa Efigênia. Belo Horizonte. MG. Brasil. CEP: 30130.100. E-mail: allanareiscorrea@gmail.com.

Submitted: 22/10/2012
Accepted: 24/03/2014