Initial Evaluation of the Mobile Emergency Medical Services in the city of Porto Alegre, Brazil

Gladis Semensato, Leandro Zimerman, Luis Eduardo Rohde

Serviço de Cardiologia do Hospital de Clínicas de Porto Alegre[1]; Programa de Pós-Graduação em Epidemiologia da UFRGS[2], Porto Alegre, RS - Brazil

Abstract

Background: **Little is known about the immediate outcomes of the Mobile Emergency Medical Services (SAMU) in Brazil.**

Objective: **To evaluate clinical predictors of survival of patients in cardiorespiratory arrest (CRA) in the nonhospital environment treated by the SAMU in the city of Porto Alegre.**

Methods: **The present study has a prospective and observational design. The evaluated outcomes were 30-day survival and hospital discharge, in addition to the Cerebral Performance Category (CPC) score I-II.**

Results: **From January to October 2008, a total of 593 patients in nontraumatic CRA were treated and 260 cardiopulmonary resuscitation (CPR) attempts were made. There was an initial successful outcome in 52 (20.0%) cases, with 16 patients (6.0%) alive on the 30th day and 10 being discharged from the hospital (3.9%), of which 6 (2.3%) presented CPC I-II score. The CPR at home was inversely associated with 30-day survival (p = 0.001) and hospital discharge survival (p = 0.02). An initial "shockable" rhythm (p = 0.008) was associated with 30-day survival. The response-time and collapse-time intervals until CPR start were significantly shorter in 30-day survivors. At multivariate analysis, independent 30-day mortality predictors were an initial shockable rhythm (odds ratio [OR] = 0.28 and 95% confidence interval [95%CI] = 0.10 - 0.81; p = 0.02) and CPR at home (OR = 3.0 and 95CI% = 1.04 - 8.7; p = 0.04).**

Conclusion: **The pre-hospital care of CRA in the city of Porto Alegre has limited results; however, they are comparable to the results from other international locations. It is necessary to reinforce each link of the survival chain to improve pre-hospital care, aiming at improving clinically relevant outcomes. (Arq Bras Cardiol 2011;96(3):196-204)**

Keywords: **Ambulances/utilization; air ambulance/utilization; emergency medical services; heart arrest; cardiopulmonary resuscitation.**

Introduction

Cardiac arrest is the abrupt cessation of the heart mechanical function, which is reversible if treated rapidly, or fatal when there is no prompt intervention[1]. The cardiovascular diseases are responsible for 30% of the deaths, according to data from the World Health Organization, which represented 17.5 million deaths in 2005[2]; it is estimated that more than half of these deaths are sudden. Two-thirds of these sudden events occur in the community[3], with an incidence of 0.55/1,000 inhabitants[4]. In Brazil, circulatory diseases are responsible for 31% of total mortality, with 302,817 deaths in 2006[5].

Cardiopulmonary resuscitation depends on a sequence of actions known as the Chain of Survival[6]. The links in this chain are the recognition of collapse and help request, start of the basic resuscitation procedure, defibrillation and advanced life support. Among the main predictors of survival in cardiac arrest occurring out of the hospital, the most important are the time until the start of basic maneuvers[7] and early defibrillation[7,8]. The individual in cardiac arrest has survival decreased between 7 and 10% with every minute without treatment[7]. The mean survival for cardiac arrest in nonhospital environment is 6.4%, ranging from 1.0% when the initial rhythm is asystole to 16.0% when the initial rhythm is ventricular fibrillation[9]. Such index is influenced by several factors and there have been reports of survival rates as low as 0.2% in the city of Detroit (USA)[10] or as high as 74.0% in patients with ventricular fibrillation defibrillated in less than three minutes[11].

The organization of the Mobile Emergency Medical Services (SAMU) in the city of Porto Alegre, state of Rio Grande do Sul, Brazil, started in 1993, through the technical cooperation between the Brazilian and French governments. The first patients were treated in 1995 and after 2002 the Brazilian government expanded the SAMU project to several locations in the country, encompassing more than 100 million inhabitants through 135 qualified services until 2009[12].

This system supplies the conditions for the early treatment of sudden death victims in the community; however, the results of this type of service are unknown in our country.

Mailing address: Luís Eduardo Rohde •
Serviço de Cardiologia do Hospital de Clínicas de Porto Alegre - Rua Ramiro Barcelos, 2350, Sala 2061, 2º andar - 90003-035 - Porto Alegre, RS - Brazil
E-mail: lerohde@terra.com.br
Manuscript received February 03, 2010; revised manuscript received May 11, 2010; accepted July 21, 2010.

The aim of the present study was to evaluate the survival of patients in cardiac arrest in a nonhospital environment, treated by the SAMU in the city of Porto Alegre, as well as to identify possible predictors of success in cardiopulmonary resuscitation (CPR) procedures. The knowledge of the outcomes of the pre-hospital CPR care can help to define health policies, proposing necessary changes to qualify this type of treatment strategy.

Methods

A prospective and observational study was carried out with patients in nontraumatic cardiorespiratory arrest (CRA), treated primarily by the SAMU in the city of Porto Alegre, state of Rio Grande do Sul, Brazil, from January 26 to October 21, 2008.

The city of Porto Alegre occupies an area of 497 Km^2 and has 1,420,667 inhabitants, according to the estimate made by the Brazilian Institute of Geography and Statistics (IBGE) in 2007[13]. The city has a public mobile emergency medical service - SAMU - as well as private ones. At the time of study, SAMU had 15 emergency mobile units, of which 3 are advanced ones, one that provides rapid support and the others that provide basic support.

The basic team consists of a driver and a nurse technician capable of providing basic life support and using an automated external defibrillator (AED). The advanced team consists of a driver, a nurse and a physician trained in advanced life support. The rapid support team consists of a driver, a physician and advanced support equipment to complement the basic unit team.

The choice of the team is made according to the criteria of proximity and presumable severity of the occurrence. When there is sustained spontaneous circulation return, the patient is taken to a hospital emergency department.

The treatment follows a standardized protocol, created by the service according to the guidelines published by the International Liaison Committee on Resuscitation (ILCOR) and by the American Heart Association (AHA) in 2005[14,15]. The questionnaire used for the data collection of the present protocol, the definition of the explanatory variables and outcomes and the report of results followed the Utstein model[16].

Measures and outcomes

The primary outcome was patient survival until hospital discharge and the secondary outcomes were: 1) 30-day survival; and 2) survival considered to be neurologically favorable, according to the score of the Cerebral Performance Category (CPC) I or II at hospital discharge[17].

The potential predictors of the analyzed clinical outcomes were:

1. Demographic data, such as the victim's age and sex;

2. Circumstances of the event, such as location (home, public or others), presence of witness (whether the collapse was seen or heard by someone), resuscitation maneuvers performed by bystander (performance of compression and/or ventilation by nonmedical individual witnessed by the emergency team upon arrival at the location); and

3. Characteristics of the emergency care, such as response-time (time interval between the call and the arrival of the team at the location); collapse time-maneuver start (time interval between the estimate collapse when witnessed and the start of resuscitation maneuvers by the SAMU team); initial emergency care team (basic or advanced) and initial cardiac arrest rhythm (first rhythm assessment through the AED or conventional monitor).

We defined as "shockable" the presumptive diagnoses of ventricular fibrillation and ventricular tachycardia. These presumptive diagnoses were considered when, at the first analysis of the AED rhythm, there was indication for "shock" by the operator ("shockable" rhythm); however, the AED equipment used in the present study did not inform directly whether the rhythm was ventricular fibrillation (VF) or ventricular tachycardia (VT). When the initial rhythm was verified in a conventional cardioverter-defibrillator, the physician made at the diagnosis the scene and wrote it down in the adequate form.

The CPR performed by a bystander was defined as that performed by someone that did not belong to the pre-hospital medical emergency system organized for CPR treatment. Healthcare professionals that were performing the maneuvers, but who did not belong to the team organized for that moment were included in this category.

Although there was a differentiation between VF and VT, both were considered as shockable rhythm for the purpose of analysis.

Other information obtained were the advanced support performed and the time intervals between the collapse and the telephone call, from regulation to the sending off, dispatch of the ambulance to the local of the event and until the start of the CPR.

The filling out of the questionnaire by the employee in charge of the team (physician, nurse or nurse technician, depending on the type of team), based on information supplied by witnesses and/or those responsible for the patient, was carried out soon after the treatment was finished. One researcher (G.S.) carried out the assessment of all 30-day survival and hospital discharge survival outcomes, verifying the functional neurological score through an interview with the patient and/or family members and/or physician in charge.

In case of death, the information was obtained from the hospital care team or by reviewing medical files.

Approval of the ethics committee

The project was approved by the Ethics Committee of Hospital de Clínicas de Porto Alegre, in agreement with the Mobile Medical Emergency Service of Porto Alegre and the Ethics Committee of the City Secretary of Porto Alegre. Informed Consent Form was obtained from a family member or the person responsible for the patient.

Statistical analysis

Medians and interquartile intervals were used to describe continuous variables, whereas categorical variables were described using total numbers and percentages. For bivariate analysis, Mann-Whitney's test, Chi-square test with Yates correction or Fisher's exact test were used when indicated.

The multivariate analysis was carried out for 30-day survival, as there were not enough predictors with statistical significance at hospital discharge. The model included the location, initial rhythm in VF and the response-time. The collapse time-start of the CPR was not used, as it was obtained in only 53.0% of the cases.

We calculated it was necessary to study 240 patients submitted to CPR for the detection of the population proportion with estimated survival rate of 6.0% ± 3.0%. *SPSS* software package release 16.0 was used for all analyses. Results were considered significant when p value was ≤ 0.05.

Results

During the study period (January to October 2008), a total of 593 patients were treated due to nontraumatic cardiac arrest, of which 260 patients were submitted to cardiopulmonary resuscitation (CPR). In cases that were not treated with CPR, the main reason was the presence of evident signs of death (Figure 1). One patient was excluded from the general group due to lack of data on the treatment and a second was excluded from the evaluation of the 30-day survival outcome and hospital discharge survival because there was no follow-up data, after initial successful

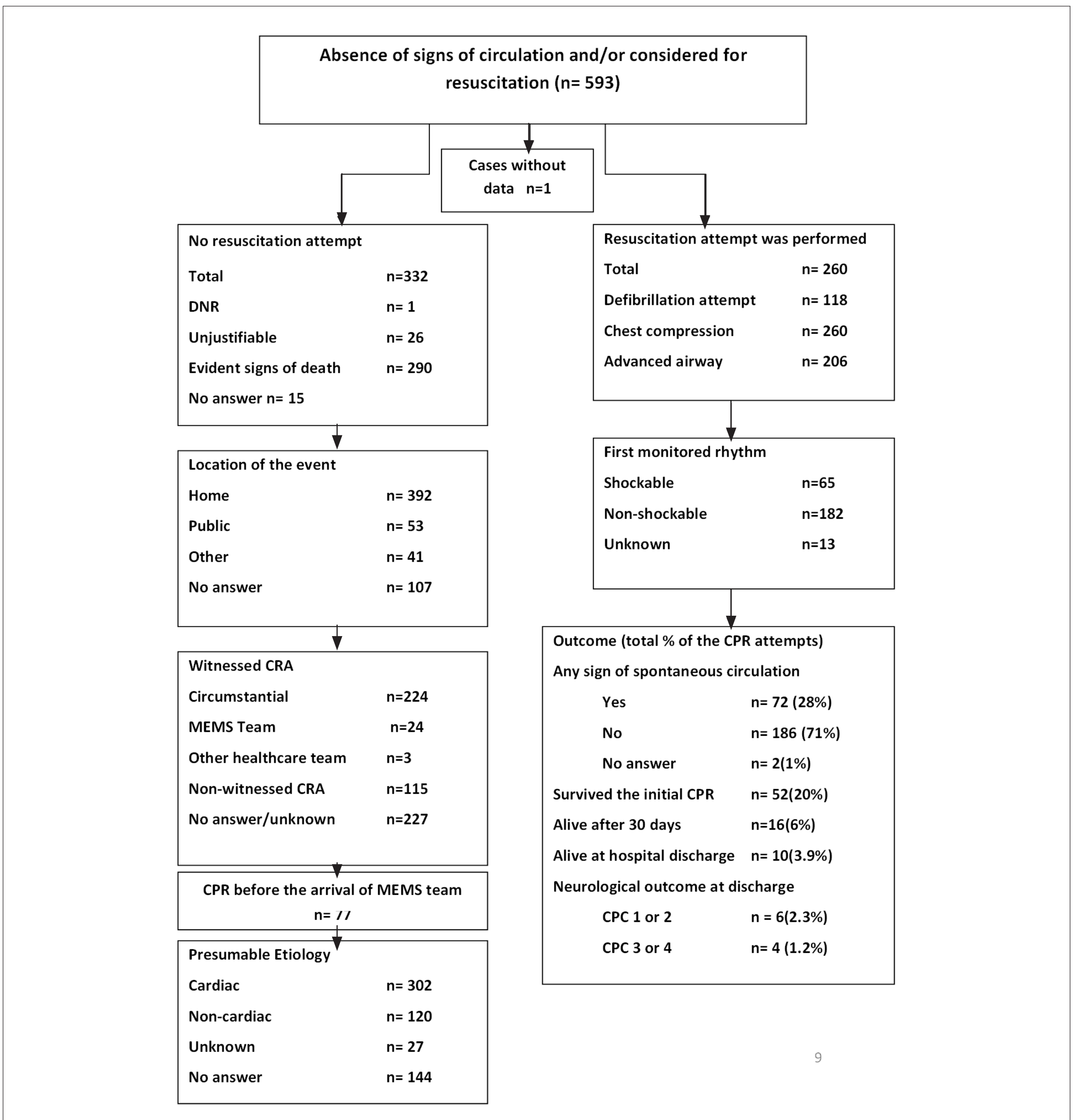

Figure 1 - Flowchart of patients treated in CRA by the MEMS of Porto Alegre, according to the Utstein model.

resuscitation. The remaining 259 patients were included in the analysis.

Of the patients initially submitted to the CPR, 52 (20%) had initial successful resuscitation, of which 16 were alive on the 30th day (6%) and 10 were discharged from the hospital (3.9%). The functional neurological assessment at discharge verified CPC score I or II in 6 patients, totaling 2.3% of the group that received CPR.

Table 1 describes the basal characteristics of patients with a diagnosis of cardiac arrest. A higher proportion of male patients, public environment, presence of witness, cardiac origin and resuscitation by non-medical individual were observed among the cases submitted to CPR. This group also presented a significantly younger mean age and shorter response-time than those that were not submitted to CPR.

Tables 2 and 3 describe the characteristics of the groups that were submitted to CPR in relation to the outcomes 30-day survival and hospital discharge survival, respectively. Patients that were alive on the 30th day and at hospital discharge were younger than those who died; however, this difference was not statistically significant.

Male sex, presence of symptoms, witnesses, cardiac cause and initial team were not predictors of 30-day survival post-hospital admission or survival at hospital discharge. The occurrence of cardiac arrest at home was inversely associated with survival, both 30-day ($p = 0.001$) and hospital discharge survival ($p = 0.02$). Approximately one third of the patients was submitted to CPR by a bystander, through isolated chest compression in 62.0% and chest compression associated with ventilation in 38.0% of the cases. There was a higher proportion of resuscitation attempts by nonmedical individuals among 30-day survivors ($p = 0.13$) and at hospital discharge ($p = 0.07$), albeit without statistical significance. The initial rhythm allowed the use of external electric shock in 25.0% of the cases and was associated with 30-day survival ($p = 0.008$), but not with hospital discharge survival. The CPR by a bystander was not a predictor of survival in any of the outcomes considered in the study.

Advanced airway was established in 84% of the cases, venous access and use of intravenous medication were used in 90.0% of the patients and 46.0% were defibrillated by the advanced team during the emergency treatment. There was no association between such procedures an 30-day survival or hospital discharge survival.

On the 30th day, both the response-time interval and the collapse time until the start of the CPR were significantly lower in the survivors. At the hospital discharge, only the collapse time until the start of the CPR was associated with survival. Regarding the 6 patients with adequate functional neurological score - CPC I or II - at the hospital discharge (Table 4), predictors that were associated with this outcome were the collapse time until the start of the CPR of 7 minutes, compared with 18 minutes in the other 134 patients ($p = 0.01$) and public location of the cardiac arrest in 67.0% of the patients ($p = 0.04$).

At the multivariate analysis, only the presence of a shockable initial heart rhythm (odds ratio [OR] = 0.28 and 95% confidence interval [95%CI] = 0.10 to 0.81; $p = 0.02$) and CPR at home (OR = 3.0 and 95%CI = 1.04 to 8.7; $p = 0.04$) remained as independent predictors of 30-day mortality. Table 5 describes the time intervals between the collapse until the start of the CPR.

Discussion

The present study prospectively evaluated the rate of success of a cardiopulmonary resuscitation strategy in a nonhospital environment of patients treated consecutively by the Mobile Emergency Medical Services (SAMU) in the city of Porto Alegre, state of Rio Grande do Sul, Brazil, for approximately 10 months. We observed that around 20.0% of the patients submitted to the CPR were successfully reanimated and were alive at hospital admission; 6.0%

Table 1 - **Basal characteristics of patients treated for cardiorespiratory arrest by the MEMS of Porto Alegre**

Clinical characteristics	No CPR n = 332	With CPR n = 260	P value
Age (years) mean median	65 ± 17 66 (54-78)	62 ± 17 63 (53-75)	0.04
Male sex	167 (50.0%)	168 (65.0%)	0.001
Home *	202/236 (86.0%)	190/250 (76.0%)	0.028
Preceding Symptom *	45/125 (36.0%)	129/242 (53.0%)	0.002
Witnessed by non-medical individual *	58/133 (46.0%)	169/243 (69.0%)	0.0001
Cardiac cause *	107/179 (60.0%)	195/242 (81.0%)	0.0001
CPR by non-medical individual *	9/152 (6.0%)	68/241 (28.0%)	0.0001
Initial advanced team (%)	141/332 (42.0%)	123/259 (47.0%)	0.25
Response-time of the first team at the location (min)			
Mean ± SD	18.5 ± 11	14.7 ± 9	0.001
Median (25.0% - 75.0%)	16 (12 – 22)	13 (9 – 18)	

** Data not available for all patients, expressed as % of the available information (n/ total n [%]). CPR - cardiopulmonary resus*

Original Article

Table 2 - **Clinical characteristics of patients that underwent cardiopulmonary resuscitation between survivors and non-survivors, 30 days after hospital admission**

Clinical characteristics	Survivor n = 16	Non-survivor n = 243	P value
Age (years), mean ± SD median (25-75%)	56 ± 17 57 (51-68)	62 ± 17 64 (53-75)	0.1
Male sex*	12/16 (75.0%)	156/243 (64.0%)	0.5
CRA at home*	7/16 (44.0%)	182/233 (78.0%)	0.001
CRA witnessed by bystander*	13/16 (81.0%)	156/227 (71.0%)	0.12
Preceding symptom*	6/16 (37.0%)	123/226 (65.0%)	0.09
Presumable cardiac cause*	14/16 (87.0%)	181/226 (80.0%)	0.74
CPR performed by non-medical individual*	8/16 (50.0%)	60/225 (27.0%)	0.13
Initial advanced team*	10/16 (62.0%)	112/242 (46.0%)	0.3
First monitored rhythm VT/VF*	9/16 (56.0%)	55/230 (24.0%)	0.008
Defibrillation performed*	11/16 (69.0%)	100/227 (44.0%)	0.1
Advanced airway*	13/16 (81.0%)	192/227 (85.0%)	0.72
Venous access*	15/16 (93.0%)	205/228 (90.0%)	1
Medications*	13/15 (87.0%)	206/228 (90.0%)	0.65
Response-time of the first team at the location (min)			
Mean ± SD	11 ± 4	15 ± 9	
Median (25.0% - 75.0%)	10 (9 - 12)	13 (10 - 18)	0.02
Time between collapse - start of CPR (minutes)			
Mean ± SD	8 ± 6	18 ± 13	
Median (25.0% - 75.0%)	11 (1-12)	17 (12-23)	0.001

**Data expressed as n/total n of valid data in absolute number (percentage). CRA - cardiorespiratory arrest; VT/VF - ventricular tachycardia or ventricular fibrillation; CPR - cardiopulmonary resuscitation.*

remained alive 30 days after the event and 3.9% were discharged from the hospital, of which only 2.3% presented a neurological status considered adequate. Although these findings can be considered inadequate, they reflect the results found by other mobile emergency medical services (MEMS) worldwide[11,18,19]. In our analysis, the main determinant factors of survival were the presence of an initial cardiac rhythm that allowed electrical shocks and CPR at home.

The mean proportion of patients discharged from the hospital after the CPR in a nonhospital environment is close to 6%, ranging from 1.0% when the initial rhythm is asystole, to close to 16.0% when the rhythm is VF[10]. Our data show a relatively low survival, although it is comparable to several other MEMS worldwide[20]. Recently, for instance, a randomized clinical trial compared the use of adrenalin with vasopressin as the initial vasopressor drug in the advanced CPR maneuvers by MEMS in France[21]. In that study, the rate of survival at hospital discharge was only 2.0% and only 0.9% of the cases adequate neurological recovery.

It is important to mention, however, that prognostic factors such as sex, age, cardiac etiology, place where the event occurred, presence of witness, resuscitation by nonmedical individual and initial rhythm were similar to those in other locations with better outcomes[22-24]. It is possible that this phenomenon is explained by the presence of other factors, such as demographic profile, comorbidities and socioeconomic level, which were not adequately evaluated by the present protocol. However, it has been well established that survival in cardiac arrest outside a hospital environment is linked to the presence of VF rhythm, as well as how fast the defibrillation shock was applied after the collapse.

In our study, the presence of VF as the initial rhythm was associated with survival on the 30th day and hospital discharge. A shockable rhythm increases 5-fold the chance of survival[25] and is detected as the initial rhythm in 20.0% to 40.0% of the events[8,26,27]. A trend towards a decrease in the incidence of this rhythm has been observed in the last decades and it might be due to the decrease in mortality due to ischemic cardiopathy[26]. From a less favorable persperctive, the higher proportion of "non-shockable" rhythms might be due to a delay between the collapse and the start of resuscitation and it is possible that this factor determined in part the detection of VF in only 26.0% of our sample, a finding suggested by the prolonged response-time.

Regarding the survival of patients presenting VF, the time until the defibrillation shock is a crucial factor. A series of cases carried out in casinos in the USA showed a survival at hospital discharge of 74.0% when the CPR was witnessed, caused by VF and treated within the first three minutes[12]. Due to the imprecise notation of the moment of collapse, the response-

Table 3 - Clinical characteristics of patients that underwent cardiopulmonary resuscitation between survivors and non-survivors at hospital admission

Clinical characteristics	Survivor n = 10	Non-survivor n = 249	P value
Age (years), mean ± SD Median (25.0% -75.0%)	52 ± 21 53(49-68)	62 ± 17 64 (54-75)	0.06
Male sex	7/10(70.0%)	161/249 (65.0%)	1
CRA at home*	4 /10(40.0%)	185/239 (77.0%)	0.02
CRA witnessed by bystander	8/10 (80.0%)	161/233 (69.0%)	0.28
Preceding symptom*	4/10 (40.0%)	125/232 (54.0%)	0.15
Presumable cardiac cause*	8/10 (80.0%)	187/232 (81.0%)	1
CPR performed by non-medical individual*	6/10 (60.0%)	62/231 (27.0%)	0.07
Initial advanced team*	6/10 (60.0%)	116/248 (47.0%)	0.5
First monitored rhythm VT/VF*	5/10 (50.0%)	59/236 (25.0%)	0.13
Defibrillation performed*	5/10 (50.0%)	106/233 (45.0%)	1
Advanced airway*	7/10 (70.0%)	198/233 (85.0%)	0.2
Venous access*	9/10 (90.0%)	211/234 (90.0%)	1
Medications*	8/10 (80.0%)	211/233 (91.0%)	0.25
Response-time of the first team at the location (min)			
Mean ± SD	12 ± 5	15 ± 9	
Median (25.0% - 75.0%)	11 (10 – 13)	13 (9 – 18)	0.38
Time between collapse - start of CPR (minutes)			
Mean ± SD	9 ± 6	18 ± 12	0.01
Median (25.0% - 75.0%)	11 (1-12)	16 (12-23)	

** Data expressed as n/total n of the valid data in absolute numbers (percentage). CRA - cardiorespiratory arrest; VT/VF - ventricular tachycardia or ventricular fibrillation; CPR - cardiopulmonary resuscitation.*

time is used, as it is more easily obtained and it is suggested as being a key information by the Utstein Committee[17]. This interval does not take into account the time between the collapse and the telephone call and between the arrival of the vehicle at the location of the event and the start of the resuscitation, which can affect its association with survival. Nevertheless, it is the most frequently reported temporal marker in resuscitation outside the hospital environment and efforts must be made to obtain it with precision.

The OPALS II study showed an increase of 33% in the proportion of patients that were alive at hospital discharge after the optimization of the response-time, as 92% of the teams with AED presented a response-time < 8 minutes[28]. Herlitz et al[25], in a prospective cohort of more than 19,000 patients, estimated a 3.6-fold increase in the chances of survival when the response-time was < 6 minutes[25].

According to our data, the median of the response-time was 13 minutes and, among the survivors, it was 11 minutes, much higher than the recommended time for CPR treatment. It is likely that the prolonged time resulted in the deterioration of rhythms that were "shockable" into "non-shockable" ones, thus decreasing the chances of survival and the impact of other predictive factors, such as the presence of witnesses, resuscitation by nonmedical individuals and cardiac cause.

The possibility of discharge with good neurological status is also associated with the delay in treatment time, considering the concept that "time is brain". We observed that all patients that presented neurological CPC score I or II on the first days were discharged from the hospital, in contrast with only 4 of those with CPC score III or IV. Among the latter, death occurred early due to multiple organ failure, or later, due to complications of prolonged hospital stay. Although the response-time did not show a significant association with survival, the estimate of the interval between the collapse and the start of the resuscitation by the SAMU team showed a strong association with the 30-day survival and survival at the hospital discharge. Moreover, in the group of survivors with CPC score I or II, this time was only 7 minutes. With an adequate response time, the other factors associated with the patient, the circumstances of the event and the organization of the MEMS emerge as significant factors related to the chance of patient survival[29].

Another important factor to be emphasized in our results is that the estimated time between the collapse and the telephone call for help was 4 minutes. This phase corresponds exactly to the electrical phase in the model of Weisfeldt[30] and would be the phase with the best response to CPR maneuvers. Furthermore, the performance of CPR by a nonmedical individual was carried

Table 4 - Clinical characteristics of the patients which, at hospital discharge, presented neurological score CPC I or II

Clinical characteristics	CPC I or II n = 6	CPC III and IV or non-survivors n = 253	P value
Age (years), mean ± SD Median (25-75%)	48 ± 25 51 (49 - 68)	62 ± 17 63 (54 - 75)	0.08
Male sex	4/6 (67.0%)	164/253 (65.0%)	1
CRA at home*	2/6 (33.0%)	187/244 (77.0%)	0.04
CRA witnessed by bystander*	4/6 (67.0%)	167/237 (70.0%)	0.15
Preceding symptom*	3/6 (50.0%)	126/236 (51.0%)	0.5
Presumable cardiac cause*	4/6 (67.0%)	191/236 (81.0%)	0.3
CPR performed by non-medical individual*	4/6 (67.0%)	64/235 (27.0%)	0.1
Initial advanced team*	3/6 (50.0%)	119/253 (47.0%)	1
First monitored rhythm VT/VF*	3/6 (50.0%)	61/241 (25.0%)	0.18
Defibrillation performed*	3/6 (50.0%)	108/237 (46.0%)	1
Advanced airway *	3/6 (50.0%)	202/237 (85.0%)	0.05
Venous access *	4/6 (67.0%)	215/238 (90.0%)	0.46
Medications*	4/6 (67.0%)	215/237 (91.0%)	0.1
Response-time of the first team at the location (min)			
Mean ± SD Median (25.0% - 75.0%)	13 ± 6 12 (10 - 14)	15 ± 9 13 (9 - 18)	0.67
Time between collapse - start of CPR (minutes)			
Mean ± SD Median (25.0 - 75.0%)	7 ± 6 11 (1 -11)	18 ± 12 16 (12-23)	0.01

** Data expressed as n/total n of the valid data in absolute numbers (percentage). CRA - cardiorespiratory arrest; VT/VF - ventricular tachycardia or ventricular fibrillation; CPR - cardiopulmonary resuscitation.*

Table 5 - Time intervals until emergency medical care

Time (minutes)	Median (25.0% - 75.0%)
Collapse - telephone call, n = 111/227 (1)	4 (1-12)
Regulation until decision to send team, n = 589/593 (2)	3 (2-4)
Ambulance dispatch, n = 536/593 (2)	11 (8-16)
Ambulance team dispatch up until the start of CPR, n = 189/260 (3)	2 (1-3)
Collapse until start of CPR, n = 139/260 (3)	16 (11-22)

(1) Denominator refers to patients with CRA witnessed by non-medical individual. (2) Denominator is the total group of occurrences per CRA. (3) Denominator is the total group of patients with CRA submitted to CPR.

out in only 28% of the population, which was subsequently submitted to CPR by the SAMU and which, most probably, was initiated in most cases after the end of the telephone call.

Most episodes of cardiac arrest in the community occur at home; however, it is the public place that is associated with the best immediate and 6-month survival[31], doubling the chances of being discharged from the hospital alive[25]. In our sample, the public location was associated with a better 30-day and hospital discharge outcome, confirming previous reports. The response-time and the performance of CPR by a nonmedical individual were similar in both locations.

It is probable that one of the factors responsible for this association is the higher proportion of events witnessed in public places, which might have determined a faster contact with the emergency service and even the start or the quality of the CPR performed by the bystander. Another factor suggested as being associated with a better prognosis in public places and that cannot be ruled out is the better health status of the victim[31]. The lower rate of survival among patients with CRA at home suggests difficulties in the first link of the Chain of Survival, such as the recognition of signs of cardiac arrest and the contact with emergency service. These are phases that are sensitive to modification though educational campaigns directed at the population.

Among the limitations of the present study, we recognize the relatively small sample size, thus decreasing the statistical power to identify small differences. It is noteworthy the fact that there was no standardization in the post-resuscitation care in the hospitals which the patients were taken to. Most patients remained, during the first 12 hours, at the emergency unit of large hospitals in the city and were subsequently transferred to Intensive Care Units. It is worth mentioning that we did not observe conducts that were different from those usually recommended for the support of critically-ill patients, such as hemodynamic and ventilatory stabilization, in addition to the etiological investigation. No hypothermia was carried out in the first 24 hours post-CPR.

Among the variable studied by the present protocol, we acknowledge that the measurement of the response-time might have been imprecise, as the arrival at the location of the event was informed by radio, which was of common use for all teams. The presence of CPR by a nonmedical individual was verified by the team; however, we did not verify either the quality or the moment when the procedure was started, which are important factors for the effectiveness of the maneuvers, albeit rarely reported in the literature. The simple presence of this factor is generally correlated with improved survival[32,33].

Our data allow us to conclude that the pre-hospital care of patients that are victims of cardiac arrest in the community treated by the SAMU of Porto Alegre has limited results, albeit comparable to the results found in many other locations. The monitoring of these results is the crucial initial step to improve this healthcare system. For that purpose, it is necessary to integrate the community, the MEMS and the hospital care, aiming at optimizing the current outcomes.

Within the community, it is fundamental to educate the individuals to recognize the signs of the severity of a collapse, in order to establish contact the with emergency services and for the performance of basic reanimation maneuvers, in addition to establishing AED programs in areas where large numbers of people circulate, along with the training of first-responder teams.

For these measures to result in adequate outcomes, it is important to inform several systems on the results obtained in practice.

Much can and must be done so that cardiac arrest victims in the community can go back having a satisfactory and productive life and, in Brazil, the introduction of MEMS was the initial fundamental step to attain this objective.

Potential Conflict of Interest

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

Sources of Funding

There were no external funding sources for this study.

Study Association

This article is part of the thesis of master submitted by Gladis Semensato, from *Universidade Federal do Rio Grande do Sul*.

References

1. Myerburg RJ, Castellanos A. Cardiac arrest and sudden cardiac death. In: Zippes DP, editor. Braunwald's heart disease: a textbook of cardiovascular medicine. 7th ed. Philadelphia: Elsevier Saunders; 2005. p. 865-907.

2. World Health Organization. Cardiovascular diseases. [Acessed on 2009 Jan 22]. Available from: http://www.who.int/cardiovascular_disease/en/

3. Zheng ZJ, Croft JB, Giles WH, Mensah GA. Sudden cardiac death in the United States, 1989 to 1998. Circulation. 2001;104(18):2158-63.

4. Rosamond W, Flegal K, Friday G, Furie K, Go A, Greenlund K, et al. Heart disease and stroke statistics--2007 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation. 2007;115(5):e69-e171.

5. Ministério da Saúde. Datasus. Indicadores e dados básicos. [Acessed on 2009 Jan 18]. Available from: http://w3.datasus.gov.br/datasus/datasus.php

6. Cummins RO, Ornato JP, Thies WH, Pepe PE. Improving survival from sudden cardiac arrest: the "chain of survival" concept. A statement for health professionals from the Advanced Cardiac Life Support Subcommittee and the Emergency Cardiac Care Committee, American Heart Association. Circulation. 1991;83(5):1832-47.

7. Larsen MP, Eisenberg MS, Cummins RO, Hallstrom AP. Predicting survival from out-of-hospital cardiac arrest: a graphic model. Ann Emerg Med. 1993;22(11):1652-8.

8. Holmberg M, Holmberg S, Herlitz J. Incidence, duration and survival of ventricular fibrillation in out-of-hospital cardiac arrest patients in sweden. Resuscitation. 2000;44(1):7-17.

9. Cooper JA, Cooper JD, Cooper JM. Cardiopulmonary resuscitation: history, current practice, and future direction. Circulation. 2006;114(25):2839-49.

10. Dunne RB, Compton S, Zalenski RJ, Swor R, Welch R, Bock BF. Outcomes from out-of-hospital cardiac arrest in Detroit. Resuscitation. 2007;72(1):59-65.

11. Valenzuela TD, Roe DJ, Nichol G, Clark LL, Spaite DW, Hardman RG. Outcomes of rapid defibrillation by security officers after cardiac arrest in casinos. N Engl J Med. 2000;343(17):1206-9.

12. Ministério da Saúde. Portal da Saúde: notícias. [Acesso em 2009 jan 18]. Disponível em http://portal.saude.gov.br/portal/aplicacoes/noticias/noticias_detalhe.cfm?co_seq_noticia=49258

13. Instituto Brasileiro de Geografia e Estatística. Cidades. [Acesso em 2009 Jan 26]. Disponível em http://www.ibge.gov.br/cidadesat/

14. Proceedings of the 2005 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation. 2005;67(2-3):157-341.

15. 2005 International Consensus on Cardiopulmonary Resuscitation and emergency cardiovascular care science with treatment recommendations. Part 4: advanced life support. Resuscitation. 2005;67(2-3):213-47.

16. Jacobs I, Nadkarni V, Bahr J, Berg RA, Billi JE, Bossaert L, et al. Cardiac arrest and cardiopulmonary resuscitation outcome reports: update and simplification of the Utstein templates for resuscitation registries. A statement for healthcare professionals from a task force of the international liaison committee on resuscitation (American Heart Association, European Resuscitation Council, Australian Resuscitation Council, New Zealand Resuscitation Council, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Southern Africa). Resuscitation. 2004;63(3):233-49.

17. Cummins RO, Chamberlain DA, Abramson NS, Allen M, Baskett PJ, Becker L, et al. Recommended guidelines for uniform reporting of data from out-of-hospital cardiac arrest: the Utstein Style. A statement for health professionals from a task force of the American Heart Association, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, and the Australian Resuscitation Council. Circulation. 1991;84(2):960-75.

18. Stiell IG, Wells GA, Spaite DW, Nichol G, O'Brien B, Munkley DP, et al. Advanced cardiac life support in out-of-hospital cardiac arrest. N Engl J Med 2004 Aug 12;351(7):647-56.

19. Citerio G, Galli D, Cesana GC, Bosio M, Landriscina M, Raimondi M, et al. Emergency system prospective performance evaluation for cardiac arrest in Lombardia, an Italian region. Resuscitation. 2002;55(3):247-54.

Original Article

20. Becker L, Gold L, Eisenberg M, White LJ, Hearne T, Rea T. Ventricular fibrillation king county, Washington: a 30-year perspective. Resuscitation. 2008;79(1):22-7.

21. Gueugniaud PY, David JS, Chanzy E, Hubert H, Dubien PY, Mauriaucourt P, et al. Vasopressin and epinephrine vs. epinephrine alone in cardiopulmonary resuscitation. N Engl J Med. 2008;359(1):21-30.

22. Rudner R, Jalowiecki P, Karpel E, Dziurdzik P, Alberski B, Kawecki P. Survival after out-of-hospital cardiac arrests in Katowice (Poland): outcome report according to the "Utstein style". Resuscitation. 2004;61(3):315-25.

23. Estner HL, Gunzel C, Ndrepepa G, William F, Blaumeiser D, Rupprecht B, et al. Outcome after out-of-hospital cardiac arrest in a physician-staffed emergency medical system according to the Utstein style. Am Heart J. 2007;153(5):792-9.

24. Steinmetz J, Barnung S, Nielsen SL, Risom M, Rasmussen LS. Improved survival after an out-of-hospital cardiac arrest using new guidelines. Acta Anaesthesiol Scand. 2008;52(7):908-13.

25. Herlitz J, Engdahl J, Svensson L, Angquist KA, Young M, Holmberg S. Factors associated with an increased chance of survival among patients suffering from an out-of-hospital cardiac arrest in a national perspective in Sweden. Am Heart J. 2005;149(1):61-6.

26. Cobb LA, Fahrenbruch CE, Olsufka M, Copass MK. Changing incidence of out-of-Hospital ventricular fibrillation, 1980-2000. JAMA. 2002;288(23):3008-13.

27. Nichol G, Thomas E, Callaway C, Hedges JR, Powell J, Aufderheide T, et al. Regional variation in out-of-hospital cardiac arrest incidence and outcome. JAMA. 2008;300(12):1423-31.

28. Stiell IG, Wells GA, Field BJ, Spaite DW, De Maio V, Ward R, et al. Improved out-of-hospital cardiac arrest survival through the inexpensive optimization of an existing defibrillation program: OPALS study phase II. Ontario Prehospital Advanced Life Support. JAMA. 1999;281(13):1175-81.

29. Pell JP, Sirel JM, Marsden AK, Ford I, Cobbe SM. Effect of reducing ambulance response times on deaths from out of hospital cardiac arrests: cohort study. BMJ. 2001; 322(7299):1385-8.

30. Weisfeldt ML, Becker LB. Resuscitation after cardiac arrest: a 3-phase time-sensitive model. JAMA. 2002;288(23):3035-8.

31. Eisenburger P, Sterz F, Haugk M, Scheinecker W, Holzer M, Koreny M, et al. Cardiac arrest in public locations--an independent predictor for better outcome? Resuscitation. 2006;70(3):395-403.

32. Herlitz J, Svensson L, Holmberg S, Angquist KA, Young M. Efficacy of bystander CPR: intervention by lay people and by health care professionals. Resuscitation. 2005;66(3):291-5.

33. Nordberg P, Hollenberg J, Herlitz J, Rosenqvist M, Svensson L. Aspects on the increase in bystander CPR in Sweden and its association with outcome. Resuscitation. 2009;80(3):329-33.