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Sara Dharmisha Fernandes da Silva Ranchordás

In-hospital cardiac arrest: predictive factors and outcome

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In-hospital cardiac arrest: predictive factors and outcome

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Abstract

Aim: To assess comorbidities of patients who suffer a cardiac arrest in the hospital; immediate clinical antecedents of arrest and outcomes for all patients and to compare between monitored vs. unmonitored and dead vs. alive at discharge.

Methods: Patients admitted to the hospital in 2009, ≥ 18 years old, with in-hospital cardiac arrest >24hours after admission were included. T student test was performed for continuous variables; χ2 tests for categorical data and Mann—Whitney U-test for non-normal, continuous data.

Results: A total of 66 patients were included. The survival to discharge was 30.3%. Return of spontaneous circulation occurred in 88% of patients. One year survival of those discharged alive was around 55-85%. Only 6% did not have pre-existing morbidities. Over 80% of patients had clinical anomalies <24h prior to arrest. Forty (60.6%) patients were monitored and 26 (39.4%) were unmonitored. Most patients with a cardiac illness were monitored at the time of the event (p=0.02). Forty-six (69.7%) patients died in-hospital and 20 (30.3%) were discharged alive. The mean in-hospital days after cardiac arrest was significantly higher in survivors than in non-survivors (p=0.01). Non-survivors received defibrillation more frequently than survivors (*p*= 0.02).

Conclusion: Most patients that suffer in-hospital cardiac arrest have pre-existing morbidities and abnormal observations preceding cardiac arrest. There were no significant differences between monitored and unmonitored patients, except for illness category. We could not find distinctive characteristics between patients who died in-hospital and those who survived, except for a longer in-hospital stay for survivors and more frequent defibrillation in non-survivors.

Keywords: in-hospital cardiac arrest, outcome, morbidity, Charlson score, clinical antecedents, monitored.

Introduction

The history of modern cardiopulmonary resuscitation (CPR) dates back to the 1960s, when methods of closed chest cardiac massage were first described.[1] In 1963, the American Heart Association formally endorsed CPR, which became an integral part of care in all patients facing imminent death.[2] In Portugal, the Portuguese Resuscitation Council was established in 1998.[3]

CPR is an attempt to restore spontaneous circulation by performing chest compressions with or without ventilations.[4]

Cardiac arrest can be defined as the cessation of cardiac mechanical activity as confirmed by the absence of signs of circulation.[4] According to the Utstein criteria, a cardiac arrest is classified as 'in-hospital' if it occurs in a hospitalised patient who had a pulse at the time of admission.[5]

In 1977, the survival to discharge after in-hospital cardiac arrest was 8.7%.[6] Nowadays, survival remains low, typically ranging from 15 to 23%.[7] Among those who are successfully resuscitated, between 25% and 67% die during the first 24 hours after return of spontaneous circulation (ROSC). One year after the arrest, reported survival of the originally discharged patients ranges between 53% and 86%.[5]

The three most common reasons for in-hospital cardiac arrest in adults are cardiac arrhythmia, acute respiratory insufficiency, and hypotension.[8] Studies have shown evidence of abnormal clinical signs in up to 80% of patients during the hours preceding the cardiac arrest.[5,7] The observation of deterioration in clinical condition of patients prior to cardiac arrest supports the idea that it is neither a sudden nor unpredictable event.[9]

Furthermore, three-quarters of adult survivors of CPR have one or more co-existing conditions, such as cardiac disease, cancer or diabetes.[10]

The main goals of this study were to assess: comorbidities of patients who suffer a cardiac arrest in the hospital; immediate clinical antecedents of arrest and the outcomes for all patients and to compare between monitored vs. unmonitored and dead vs. alive at discharge.

Methods

Data collection

All patients admitted to the hospital in 2009 and which were attributed the code "cardiac arrest" were included and their files were reviewed as well as copies of the death certificates of patients who died in the hospital, and, whenever available, charts of the medical emergency team (MET) were also analyzed. The post-discharge data was obtained through consultation of registries of later admissions or appointments at the hospital. The ethics committee of the Hospital S. João approved this study.

The information was collected according to the Utstein style guidelines, developed for reviewing, reporting, and conducting research on in-hospital resuscitation.[8]

In addition, the records were reviewed in order to allow the calculation of the Charlson age-comorbidity index, which is the most extensively studied comorbidity index. It encompasses 19 medical conditions selected and weighted 1–6 on the basis of the strength of their association with mortality, with total scores ranging from 0–37.[11-13]

Inclusion criteria:

All adult (≥18 years of age) patients, who experience a resuscitation event were eligible for inclusion. A resuscitation event is defined as an acute respiratory compromise that requires emergency assisted ventilation leading to cardiopulmonary arrest that requires chest compressions and/or defibrillation, or cardiopulmonary arrest that requires chest compressions and/or defibrillation, and elicits an emergency resuscitation response by facility personnel, and a resuscitation record is completed for the event.[8]

Exclusion criteria:

The following events were excluded: individuals who did not fulfil the inclusion criteria above and events that occurred less than 24hours after admission in the hospital, because the medical records, especially of those who die are generally incomplete and it is not possible to evaluate objectively clinical anomalies that occurred during the hours that preceded the arrest and which constituted a point of interest to this study.

For statistical purposes when a patient had more than one cardiac arrest, only the first episode was considered.

Definition of end of event

The end of an event is defined as ROSC lasting >20 min or the termination of the resuscitation event with the patient declared dead due to being unresponsive to resuscitative efforts or a medical futility advance directive (DNR - Do Not Resuscitate).[8] Sustained ROSC is defined as the single, continuous presence of palpable pulses for > 20 minutes.[14]

Definition of monitored events

Monitored events were those for which the patient had electrocardiographic or pulse oximetry monitoring in place at the time of arrest.

Statistical analysis

Descriptive statistics were computed for patient and event characteristics. Frequencies and percentages are presented for categorical data; medians with inter-quartile ranges are reported for non-normal, continuous data; t student test was performed to compare between pairs of continuous variables. Differences among the categories of monitored status were tested using $\chi 2$ tests for categorical data and Mann—Whitney U-test for non-normal, continuous data. Ninety-five percent confidence intervals were calculated for odds ratios (OR) and for relative risk (RR). Analyses were performed in GraphPad Prism 5 ®. Statistical significance was defined as $p < 0.05$.

Results

A total of 149 results were retrieved from the codification centre search and the respective files were analyzed. Among these, 31 were excluded because the arrests had occurred outside the hospital or in patients younger than 18 years old, 1 was excluded because the diagnosis in the medical records was of peri-arrest, with no evidence of an actual arrest. Finally, 55 patients had been in the hospital for less than 24 hours prior to the arrest and were, therefore, excluded. In the end, 66 medical files were reviewed. There were only 3 MET´s charts available for the included patients.

Hospital characteristics

Hospital São João is a tertiary hospital in Porto, Portugal. The hospital has a total of 53 intermediate/intensive care unit beds. In 2009, 42,990 patients were released from the various hospital departments and the mortality rate was 3.17%.

A MET was created in 1999. The team consists of a doctor and a nurse, both with training in advanced life support (ALS) as well as experience in management of critical patients. The MET is activated around 480 times a year, with 35-40% of these calls being for cardiac arrest.

Patient characteristics

The mean age was 69 years (table 1). Thirty eight (57.6%) were male and 28 (42.4%) were female. Fifty five percent were admitted to the hospital due to medical reasons, 35% due to surgical reasons and 10% due to trauma.

Regarding pre-existing morbidities, about 15% had history of myocardial infarction, 32% of heart failure, 33% had renal insufficiency, 20% respiratory insufficiency and 38% had diabetes mellitus (DM).

Five patients had two cardiac arrests, all but one on the same day. Three of them died during the second event and the other two survived to discharge. Only two patients had a history of cardiac arrest in previous hospital admissions.

Event characteristics

About 30% of patients had cardiac arrest in the Intensive Care Unit and 36% in the general inpatient area (table 1). Only 12% of patients had a shockable rhythm and it was not possible to ascertain the first rhythm in 24% of cases.

The mean inpatient days between admission and cardiac arrest was 15.5 days and between cardiac arrest and discharge was 22 days.

There were clinical abnormal observations in 83% of patients during the 24 hours prior to cardiac arrest, namely acute respiratory insufficiency or compromise in 42% and haemodynamic instability/hypotension in 49%.

Outcomes

It was possible to restore spontaneous circulation in 88% of patients (table 2). Twenty patients were discharged alive. Three of them died within one year after the event and 6 were lost in follow up. Therefore, one year survival after arrest of those discharged alive could be considered between 55% and 85%.

All patients with shockable rhythms had ROSC, but only 25% survived until discharge. Only one patient with ventricular fibrillation (VF) did not have a record of having received defibrillation.

The Charlson score did not differ significantly in patients with/without ROSC, although it was lower for patients without ROSC. The initial rhythm observed in cardiac arrest did not influence the ROSC after ALS or the proportion of patients who survived to hospital discharge (table 6). The rhythm did not influence the time of death and neither the crude OR nor the RR was statistically significant.

Monitored vs. unmonitored

In order to evaluate the differences between patients which were monitored at the time of event and those who were not, various parameters were compared between them (tables 3 and 4). Forty patients (61%) were monitored and 26 (39%) were unmonitored.

Most patients with a cardiac illness were monitored at the time of event (*p*=0.02), as were trauma patients. Pre-existing conditions did not differ between the two groups (p=0.25) and the Charlson score was not significantly different either.

Shockable rhythms occurred only in monitored patients, but asystole occurred in equal proportions (35% in both groups).

There were no significant differences in ROSC (OR=2.9, 95% CI: 0.637-13.54), survival 24hours past event (OR=1.12, 95% CI: 0.412-3.023) and at discharge (OR= 1.8, 95% CI: 0.586-5.503) between the monitored and unmonitored groups.

Death in hospital vs. alive at discharge

In order to identify possible predictive factors of poor prognosis after cardiac arrest, the patients who died in the hospital and those who survived until discharge were compared (table 5).

Mean age was not significantly different between the two groups. Cardiovascular risk factors and pre-existing conditions were not different either. The mean Charlson score was equal for the two groups. The monitored status was not related with better outcome.

The mean in-hospital days after cardiac arrest was significantly higher in survivors (45 days) than in non-survivors (13 days) (p=0.01).

Discussion

Schein et al.[9] considered that one of the central questions of resuscitation research so far should be to what degree do in-hospital cardiopulmonary arrests represent predictable events. In this study, various possible predictive factors of cardiac arrest were analysed: previous morbidities, reason for admission and clinical anomalies preceding the event.

We also tried to compare the groups of monitored and unmonitored patients and of those who died in-hospital and those who survived to discharge, in order to, in the former case, uncover if monitoring could be a relevant factor for survival after arrest or if patients monitored and unmonitored that experience an arrest have different features; and in the latter, to make an attempt at describing predictors of survival and risk factors to poor outcome.

Patient characteristics

Approximately a third of the patients had a history of congestive heart failure or renal insufficiency or DM, three important comorbidities. In a study conducted on another Portuguese hospital, the prevalence of these comorbidities was somewhat different (40% cardiac disease, 16% chronic renal disease, 16% diabetes).[15] Concerning diabetes, it is regarded as a common feature in patients suffering in-hospital cardiac arrest and is considered a strong predictor of mortality.[16]

Event characteristics

Most patients (> 80%) had clinical anomalies related to airway, breathing, circulation or neurologic dysfunction, which is the ABCD of approach to a cardiac arrest.

The ACADEMIA study[17] also reported that 79.4% of cardiac arrests studied had evidence of abnormal physiology prior to the event, the most frequently reported abnormalities being low systolic blood pressure and a fall in Glasgow Coma Scale. Furthermore, a review of interventions aimed at anticipating and preventing in-hospital cardiac arrests concluded that critical physiological changes had been described in 51–86% of patients who had suffered a subsequent cardiopulmonary arrest in the general wards, often several hours before the arrest. The physiological changes described in the studies reviewed included respiratory insufficiency, change in mental status, hypotension, among others,[2] which is consistent with the results of this study.

The most common initial rhythm was asystole and almost 2/3 of the patients had an initial non-shockable rhythm, which is in agreement with other studies.[8,18]

Outcomes

The survival to discharge in this study was 30.3%. A previous study conducted also in Hospital São João in 1992 revealed a survival rate of only 5%,[19] however, the differences in the methodology do not permit making comparisons concerning a decrease in mortality after cardiac arrest in this hospital. Another study in a general nonteaching Portuguese hospital presented survival rates of 31% in a 2005-2006,[20] which is similar to our study.

In two studies from the USA based on the NRCPR (National Registry of Cardiopulmonary Resuscitation) the survival to discharge was around 17%[8] and 15.9%.[21] The difference between these figures and ours is probably mainly related to differences in methodology and sample size.

Furthermore, ROSC occurred in about 88% of patients, whereas in other studies it was only 44%.[1,8] This could translate an absence or lack of use of DNR, through the performance of resuscitation manoeuvres in patients that would otherwise not have an indication for such an aggressive treatment.

In relation to survival according to initial rhythm, our study reveals distinct results comparing to other studies, having a higher survival rate for non-shockable rhythms (21.7% for asystole and 42.1% for pulseless electrical activity (PEA) vs. 10% for asystole and PEA in the NRCPR study).[8] It is not possible to draw any specific conclusions from this difference, given that almost 25% of the patients in our study did not have a record of the initial rhythm, which reinforces the need for better registries concerning in-hospital cardiac arrests.

One year survival was about 55-85%, which is comparable with the 80% survival at one year obtained in another study.[22]

Monitored vs. unmonitored

The illness category is relevant in the monitored vs. unmonitored status at the time of event, given that all patients in the "surgical cardiac" and 9 out of 11 in the "medical cardiac" category were monitored, which demonstrates that these are usually considered critical patients. Brady et al.[23] also obtained significant differences in illness category between monitored and unmonitored patients.

Nevertheless, there were no statistically significant differences between the two groups when comparing for pre-existing conditions, cardiovascular risk factors or the Charlson score. This could just be a consequence of a small sample. In fact, Brady et al.[23] found differences in pre-existing conditions between monitored and/or witnessed and unmonitored/unwitnessed patients for pre-existing conditions such as myocardial infarction, history of heart failure, DM, respiratory insufficiency, pneumonia, renal insufficiency, cancer and major trauma, among others.

The outcomes were not different either. However, Brady et al.[23] described that patients who are witnessed and/or monitored at the time of cardiac arrest demonstrate a significantly higher rate of survival to hospital discharge compared to those patients who are neither monitored nor witnessed. Again, the small sample in this study could explain why there were no differences in outcome between the groups.

All patients that have an initial shockable rhythm were monitored, which could represent the earliest recognition of cardiac arrest and evaluation of rhythm. This preferable occurrence of shockable rhythms in monitored patients is in agreement with the study of Brady et al.,[23] where pulseless ventricular tachycardia and VF were also seen with increased frequency in the monitored units. It should be noted that there was a lack of registration of initial rhythm in 25% of monitored patients.

Death in hospital vs. alive at discharge

The average hospital length of stay after an index event was about 12 days for those who died in the hospital and about 45 days for survivors, which is considerably more than in the NRCPR study, which accounted an average hospital length of stay of 13.4 days for survivors and 1.5 days for those who died in the hospital.[8] This difference could, at least in part, be explained by our exclusion of patients who had an index event <24hours after admission in the hospital.

In this study, the registration of clinical anomalies before cardiac arrest was not significantly different between survivors and non-survivors. This might just be the result of a small sample, as, in another study, survival to hospital discharge was lower in those with abnormal vital signs (9%) compared to those with normal vital signs (20%) and those with no documentation of vital signs (14%).[7]

Regarding the Charlson score, there were no statistically significant differences between the two groups. It was not possible to find other studies evaluating the Charlson score in cardiac arrest patients, however a study comparing pre-arrest morbidity and outcome[24] found that there was no difference in survival associated with the presence or absence of morbidity before hospital admission, although there were differences between the morbidities.

Moreover, in this study, it does not appear to be any differences in pre-existing conditions between the group of patients who died and those who survived to discharge. Nevertheless, a meta-analysis of pre-arrest predictors of failure to survive[25] concluded that any malignancy, 'end-stage disease' and impaired renal function were co-morbid conditions significantly associated with non-survival. Non-cardiac diagnoses, pneumonia and trauma on admission were also associated with failure to survive to discharge, whereas cardiovascular diagnosis and co-morbidities were associated with a greater likelihood of survival. Larkin et

al.[21] also described a higher risk of death at the event and at discharge in patients with pre-existing hypotension, respiratory insufficiency, acute stroke, pneumonia and trauma.

The patients who died received defibrillation more frequently than those who survived (p= 0.02). This could just translate better registries for the patients who died or those patients had a worst clinical situation from the beginning.

Limitations

This study suffers from the typical problems associated with retrospective studies: the potential inaccuracy of data and its absence. The sample size is also small and may not be representative. Moreover, the MET´s compliance in obtaining more rigorous records in accordance with the Utstein model needs to be improved.

Conclusions

This study, due to its small sample size, did not retrieve many results that can be transposed. However, it is possible to conclude that survival to discharge after in-hospital cardiac arrest in Hospital S. João in 2009 was 30.3% and one year survival was between 17% and 26%. It was not possible to find significant predictive factors for cardiac arrest. There were no significant differences between monitored and unmonitored patients regarding pre-existing conditions, characteristics of event and outcome. We could not find distinctive characteristics between patients who died in-hospital and those who survived, except for a longer in-hospital stay for survivors and more frequent defibrillation in non-survivors.

Conflict of interest

The author has no conflicts of interest to declare.

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References

1. Saklayen M, Liss H, Markert R. In-hospital cardiopulmonary resuscitation: Survival in 1 hospital and literature review. Medicine 1995;74:163-75.
2. Naeem N, Montenegro H. Beyond the intensive care unit: A review of interventions aimed at anticipating and preventing in-hospital cardiopulmonary arrest. Resuscitation 2005;67:13-23.
3. Granja C, Cabral G, Vieira A. Outcome of cardiac arrests in a Portuguese hospital-evaluation of a hospital cardiopulmonar resuscitation program at one year. Rev Port Cardiol 2001;20:943-56.
4. Jacobs I, Nadkarni V, Bahr J, 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. Circulation 2004;110:3385-97.
5. Sandroni C, Nolan J, Cavallaro F, Antonelli M. In-hospital cardiac arrest: Incidence, prognosis and possible measures to improve survival. Intensive Care Medicine 2007;33:237-45.
6. Peatfield RC, Taylor D, Sillett RW, McNicol MW. Survival after cardiac arrest in hospital. The Lancet 1977;309:1223-5.
7. Skrifvars MB, Nurmi J, Ikola K, Saarinen K, Castrén M. Reduced survival following resuscitation in patients with documented clinically abnormal observations prior to in-hospital cardiac arrest. Resuscitation 2006;70:215-22.
8. Peberdy M. Cardiopulmonary resuscitation of adults in the hospital: A report of 14 720 cardiac arrests from the National Registry of Cardiopulmonary Resuscitation. Resuscitation 2003;58:297-308.
9. Schein RM, Hazday N, Pena M, Ruben BH, Sprung CL. Clinical antecedents to in-hospital cardiopulmonary arrest. Chest 1990;98:1388-92.
10. Pearn J. Successful cardiopulmonary resuscitation outcome reviews. Resuscitation 2000;47:311-6.
11. Hall WH, Ramachandran R, Narayan S, Jani AB, Vijayakumar S. An electronic application for rapidly calculating Charlson comorbidity score. BMC Cancer 2004;4:94.
12. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40:373-83.
13. de Groot V, Beckerman H, Lankhorst GJ, Bouter LM. How to measure comorbidity: a critical review of available methods. Journal of clinical epidemiology 2003;56:221-9.
14. Cummins RO, Chamberlain D, Hazinski MF, et al. Recommended guidelines for reviewing, reporting, and conducting research on in-hospital resuscitation: The in-hospital 'Utstein style'. Circulation 1997;95:2213-39.
15. Mendes A, Carvalho F, Dias C, Granja C. In-hospital cardiac arrest: factors in the decision not to resuscitate. The impact of an organized in-hospital emergency system. Rev Port Cardiol 2009;28:131-41.
16. Petursson P, Gudbjörnsdottir S, Aune S, et al. Patients with a history of diabetes have a lower survival rate after in-hospital cardiac arrest. Resuscitation 2008;76:37-42.
17. Kause J, Smith G, Prytherch D, Parr M, Flabouris A, Hillman K. A comparison of antecedents to cardiac arrests, deaths and emergency intensive care admissions in Australia and New Zealand, and the United Kingdom--the ACADEMIA study. Resuscitation 2004;62:275-82.
18. Nadkarni VM, Larkin GL, Peberdy MA, et al. First documented rhythm and clinical outcome from in-hospital cardiac arrest among children and adults. JAMA 2006;295:50-7.

19. Granja C, Marinho L, Abelha F, Morujão N, Castro-Tavares J. Ressuscitação cardio-pulmonar - estudo prospectivo. Revista Portuguesa de Medicina Intensiva 1994;4:22-7.
20. Campello G, Granja C, Carvalho F, Dias C, Azevedo L-F, Costa-Pereira A. Immediate and long-term impact of medical emergency teams on cardiac arrest prevalence and mortality: A plea for periodic basic life-support training programs *. Critical Care Medicine 2009;37:3054-61
21. Larkin GL, Copes WS, Nathanson BH, Kaye W. Pre-resuscitation factors associated with mortality in 49,130 cases of in-hospital cardiac arrest: A report from the National Registry for Cardiopulmonary Resuscitation. Resuscitation 2010;81:302-11.
22. Skrifvars MB, Castren M, Nurmi J, Thoren AB, Aune S, Herlitz J. Do patient characteristics or factors at resuscitation influence long-term outcome in patients surviving to be discharged following in-hospital cardiac arrest? Journal of Internal Medicine 2007;262:488-95.
23. Brady WJ, Gurka KK, Mehring B, Peberdy MA, O'Connor RE. In-hospital cardiac arrest: Impact of monitoring and witnessed event on patient survival and neurologic status at hospital discharge. Resuscitation 2011;82:845-52.
24. de Vos R, Koster RW, de Haan RJ, Oosting H, van der Wouw PA, Lampe-Schoenmaeckers AJ. In-hospital Cardiopulmonary Resuscitation: Prearrest Morbidity and Outcome. Arch Intern Med 1999;159:845-50.
25. Ebell MH, Afonso AM. Pre-arrest predictors of failure to survive after in-hospital cardiopulmonary resuscitation: a meta-analysis. Family Practice 2011;28:505-15.

Tables

Table 1. Patient and index event characteristics.

N	66
Age (years)	
Mean± S.D.	69.3 ± 15.0
Median (25th, 75th)	73 (62.5, 80.0)
Range	25 – 92
Sex *N* (%)	
Male	38 (57.6%)
Female	28 (42.4%)
Subject type – Inpatient *N* (%)	
General Surgery	6 (9.1%)
Cardiothoracic Surgery	5 (7.6%)
Vascular Surgery	2 (3.0%)
Orthopaedics – Trauma	4 (6.1%)
Urology	3 (4.6%)
Otorhinolaryngology	1 (1.5%)
Burn Unit	1 (1.5%)
Emergency Department	2 (3.0%)

Internal Medicine	11 (16.7%)
Intensive Care Unit	18 (27.3%)
Infectious Diseases	1 (1.5%)
Stroke Unit	1 (1.5%)
Cardiology – Coronary Unit	7 (10.6%)
Nephrology – Transplant Unit	3 (4.7%)
Haematology	1 (1.5%)
Illness category *N* (%)	
Medical, cardiac	11 (16.7%)
Medical, noncardiac	25 (38.0%)
Surgical, noncardiac	19 (28.9%)
Surgical, cardiac	4 (6.1%)
Trauma	7 (10.6%)
Pre-existing conditions * *N* (%)	
Acute myocardial infarction	8 (12.1%)
History of myocardial infarction	10 (15.2%)
Arrhythmia	9 (13.6%)
History of congestive heart failure	21 (31.8%)
Acute neurologic event (nonstroke)	6 (9.1%)

Acute stroke	3 (4.7%)
Respiratory insufficiency	13 (19.7%)
Pneumonia on admission	4 (6.1%)
Sepsis on admission	5 (7.7%)
Other infection on admission	8 (12.1%)
Hepatic insufficiency	3 (4.7%)
Renal insufficiency	22 (33.3%)
Cancer (last 5 years)	12 (18.2%)
Diabetes mellitus	25 (37.9%)
Major trauma	6 (9.1%)
Toxicological problem	0 (0.0%)
None reported	4 (6.1%)
Event location *N* (%)	
ICU	20 (30.3%)
Inpatient	24 (36.4%)
Emergency room	7 (10.6%)
Diagnostic area	1 (1.5%)
Operating room	1 (1.5%)
Intermediate- Care Unit	5 (7.7%)

Other	3 (4.7%)
Discovery status at time of event *N* (%)	
Monitored	40 (60.6%)
Unmonitored	26 (39.4%)
Cardiac arrest initial rhythm *N* (%)	
VF/pulseless VT	8 (12.14%)
PEA	19 (28.8%)
Asystole	23 (35.0%)
Unknown by documentation	16 (24.2%)
Inpatient days before cardiac arrest	
Mean± S.D.	15.5 ± 16.2
Median (25th, 75th)	8.5 (4.0, 24.3)
Range	1.0 – 75.0
Inpatient days after cardiac arrest	
Mean± S.D.	22.3 ± 48.4
Median (25th, 75th)	7.5 (0.5, 19.3)
Range	0 – 342
ROSC *N* (%)	
Restored	58 (87.8%)

Non sustained	8 (12.2%)
Advanced life support time procedures (minutes)	
Mean± S.D.	8.6 ± 10.4
Median (25th, 75th)	6.0 (2.0 – 10.0)
Range	2.0 – 60.0
Reason to suspend ALS *N* (%)	
Re-established circulation	50 (75.8%)
DNR/dead	4 (6.1%)
Not possible	1 (1.2%)
Not known (not registered)	11 (16.7%)
Clinical abnormal observations 24hours prior to cardiac arrest *N* (%)	55 (83.3%)
Airway obstruction	4 (6.1%)
Acute respiratory insufficiency or compromise	28 (42.4%)
Hypotension	21 (31.8%)
Haemodynamic instability	11 (16.7%)
Arrhythmia	14 (21.2%)
CNS depression	10 (15.2%)
Acute myocardial infarction or ischemia	1 (1.5%)

Destination after cardiac arrest *N* (%)	
ICU	26 (39.4%)
Emergency room	28 (42.4%)
Ward	2 (3.0%)
Dead	8 (12.1%)
Unknown/not registered	2 (3.0%)
Interval time between cardiac arrest and death (days)**	
Mean± S.D.	19.5 ± 36.6
Median (25th, 75th)	6.0 (1.0, 16.5)
Range	0.0 – 160.0

ALS: Advanced Life Support; *CNS*: central nervous system; *DNR:* do not resuscitate; *ICU:* Intensive Care Unit*; PEA:* pulseless electric activity; *ROSC:* return of spontaneous circulation; *VT:* ventricular tachycardia; *VF:* ventricular fibrillation.

*** Several patients had more than one pre-existing condition.

** It includes follow up until 12 months after cardiac arrest.

Table 2. Overall survival rate for index events and Charlson score for patients with/without ROSC

Cardiac arrest initial rhythm	***N* (%)**	**ROSC after ALS *N* (%)**	***p***	**Survival to hospital discharge *N* (%)**	***P***
VF/pulseless VT	8 (12.1%)	8 (100.0%)		2 (25.0%)	
PEA	19 (28.8%)	17 (89.5%)		8 (42.1%)	
Asystole	23 (35.0%)	20 (87.0%)		5 (21.7%)	
Unknown by documentation	16 (24.2%)	13 (81.3%)		5 (31.3%)	
			0.97 (1)		0.77 (2)
Overall	66	58 (87.9%)		20 (30.3%)	

Charlson score (age adjusted)

	ROSC	**Without ROSC**	***p* value**
	***N*= 58 (87.9%)**	***N*=8 (12.1%)**	
Mean ± S.D.	5.7± 2.9	4.0 ± 3.3	0.18
Median (25th, 75th)	6.0 (4.0, 7.0)	3.0 (1.3, 7.0)	
Range	0.0 – 17.0	0.0 – 9.0	

ALS: advanced life support; *PEA:* pulseless electric activity; *ROSC*: return of spontaneous circulation; *VF*: ventricular fibrillation; *VT*: ventricular tachycardia.

(1) *p*=0.97 – cardiac arrest initial rhythms (asystole; PEA; VF/VT) and proportion of patients with ROSC.

(2) *p*=0.77 – initial rhythms (asystole; PEA; VF/VT) and proportion of patients surviving until hospital discharge.

Table 3. Monitored and Unmonitored patients. Characteristics.

Demographic characteristics, illness category, pre-existing conditions, cardiovascular risk factors, Charlson score (comorbidity index), cardiac arrest initial rhythm, time of arrest, drug therapy at the time of arrest, duration of event and in-hospital days after cardiac arrest.

	Monitored	**Unmonitored**	***p* value**
	***N* = 40 (60.6%)**	***N* = 26 (39.4%)**	
Age (years)			
Mean± S.D.	68.3 ± 15.5	70.9 ± 14.4	0.52
Median (25th, 75th)	73.0 (64.0 – 80.0)	72.0 (60.0 – 80.3)	
Range	25 – 88	26 – 92	
Male sex *N* (%)	24 (60.0%)	14 (54.0%)	
Age, mean ± SD (years)	65.9 ± 16.8	75.5 ± 11.5	0.06
Female sex *N* (%)	16 (40.0%)	12 (46.2%)	
Age, mean ± SD (years)	72.1 ± 13.3	65.3 ± 15.9	0.23
Male vs. Female			0.62
Illness category *N* (%)			0.04
Medical, cardiac	9 (22.5%)	2 (7.8%)	
Medical, non-cardiac	11 (27.5%)	14 (54.0%)	
Surgical, cardiac	4 (10.0%)	0 (0.0%)	
Surgical, non-cardiac	10 (25.0%)	9 (34.6%)	

Trauma	6 (15.0%)	1 (3.9%)	
Cardiac / non-cardiac	13/27	2/24	0.02
Pre-existing conditions *N* (%)			0.25
Acute myocardial infarction	5 (12.5%)	3 (11.5%)	
History of myocardial infarction	7 (17.5%)	3 (11.5%)	
Arrhythmia	7 (17.5%)	2 (7.8%)	
History of congestive heart failure	11 (27.5%)	10 (38.6%)	
Acute neurologic event (nonstroke)	6 (15.0%)	0 (0.0%)	
Acute stroke	1 (2.5%)	2 (7.8%)	
Respiratory insufficiency	9 (22.5%)	4 (15.4%)	
Pneumonia on admission	1 (2.5%)	3 (11.5%)	
Sepsis on admission	2 (5.0%)	3 (11.5%)	
Other infection on admission	4 (10.0%)	3 (11.5%)	
Hepatic insufficiency	2 (5.0%)	1 (3.9%)	
Renal insufficiency	15 (37.5%)	7 (26.9%)	
Cancer (last 5 years)	7 (17.5%)	5 (19.2%)	
Major trauma	6 (15.0%)	0 (0.0%)	
None reported	1 (2.5%)	3 (11.5%)	

Cardiovascular risk factors *N* (%)			0.75
Diabetes mellitus	15 (37.5%)	10 (38.5%)	
Tobacco	6 (15.0%)	8 (30.8%)	
Obesity	2 (5.0%)	3 (11.5%)	
Dislipidemia	9 (22.5%)	5 (19.2%)	
High blood pressure	16 (40.0%)	17 (65.4%)	
Without risk factors	9 (22.5%)	6 (23.1%)	
Charlson score (age adjusted)			
Mean ± S.D.	5.3 ± 3.3	5.8 ± 2.5	0.28 (1)
Median (25th, 75th)	5.0 (2.0, 7.0)	6.0 (4.0, 7.0)	
Range	0.0 – 17.0	0.0 – 11.0	
Cardiac arrest initial rhythm *N* (%)			
Ventricular fibrillation	6 (15.0%)	0 (0.0%)	
Pulseless ventricular tachycardia	2 (5.0%)	0 (0.0%)	
Pulseless electrical activity	8 (20.0%)	11 (34.6%)	
Asystole	14 (35.0%)	9 (34.6%)	
Unknown	10 (25.0%)	6 (23.1%)	
Time of event (*)			0.64
8:00 AM to 5:59 PM	11 (27.5%)	11 (34.6%)	

6:00 PM to 10:59 PM	6 (15.0%)	5 (19.2%)	
11:00 PM to 7:59 AM	10 (25.0%)	4 (15.4%)	
Weekend	10 (25.0%)	8 (30.8%)	
Drugs administered during ALS			
***N* (%)**			0.37 (2)
Adrenaline (Epinephrine)	14 (35.0%)	13 (50.0%)	
Dobutamine	1 (2.5%)	0 (0.0%)	
Dopamine	0 (0.0%)	0 (0.0%)	
Noradrenaline (Norepinephrine)	3 (7.5%)	1 (3.9%)	
Amiodarone	8 (20.0%)	0 (0.0%)	
Lidocaine	2 (5.0%)	0 (0.0%)	
Atropine	9 (22.5%)	14 (53.9%)	
Calcium chloride/calcium gluconate	4 (10.0%)	3 (11.5%)	
Fluid bolus for volume expansion	0 (0.0%)	4 (15.4%)	
Magnesium sulfate	2 (5.0%)	0 (0.0%)	
Sodium bicarbonate	3 (7.5%)	8 (30.8%)	
None/not registered	25 (62.5%)	9 (34.6%)	
Event duration (minutes)			
Mean ± S.D.	7.4 ± 7.0	10.4 ± 13.9	0.24

Median (25th, 75th)	5.0 (2.0 – 10.0)	6.0 (4.0 – 10.0)	
Range	2.0 – 30.0	2.0 – 60.0	
In-hospital days after cardiac arrest (mean ±S.D.)	25.3 ± 57.7	17.7 ± 29.5	0.54

ALS: Advanced Life Support

* Periods of time are according to usual nurse shifts.

1) Mann-Whitney U test

2) Considering only the use of adrenaline and atropine

Table 4. Monitored and Non-Monitored patients. Outcomes.

	Total *N*=66	**Monitored *N*= 40 (60.6%)**	**Unmonitored *N* = 26 (39.4%)**	***p***	**OR (95% CI)**
ROSC >20 min *N* (%)	58 (87.9%)	37 (56.1%)	21 (31.8%)	0.15	2.9 (0.637- 13.54)
Survived 24 h past event *N* (%)	29 (43.9%)	18 (27.3%)	11 (16.7%)	0.83	1.12 (0.412 - 3.023)
Survived to discharge *N* (%)	20 (30.3%)	14 (21.2%)	6 (9.1%)	0.70	1.8 (0.586 - 5.503)
Death in-hospital *N* (%)	46 (69.7%)	26 (65.0%)	20 (76.9%)	0.30	
Death during CPR manoeuvres *N* (%)	8 (12.1%)	6 (15.0%)	5 (19.2%)	0.65	
Death in-hospital after CPR manoeuvres *N* (%)	38 (57.6%)	23 (57.5%)	15 (57.7%)	0.18	

Post-discharge cumulative *N* (%)	3 (4.5%)	2 (5.0%)	1 (3.9%)	
0-3 months	2 (3.0%)	1 (2.5%)	1 (3.9%)	
0-6 months	3 (4.5%)	2 (5.0%)	1 (3.9%)	
0-12 months	3 (4.5%)	2 (5.0%)	1 (3.9%)	
Cause of death *N* (%)				
Cardiac	8 (12.1%)	6 (15.0%)	2 (7.7%)	
Other medical cause	36 (54.6%)	19 (47.5%)	17 (65.4%)	
Trauma	3 (4.6%)	3 (7.5%)	0 (0.0%)	
Surgical cause	2 (3.0%)	0 (0.0%)	2 (7.7%)	
Other	1 (1.2%)	1 (2.5%)	0 (0.0%)	
Cardiac/non-cardiac cause		6/23	2/19	0.29
Alive at discharge *N* (%)	20 (30.3%)	14 (35.0%)	6 (23.1%)	
Alive after 12 months *N* (%)	11 (16.7%)	7 (17.5%)	4 (15.4%)	
Lost in follow up *N* (%)	6 (9.1%)	5 (12.5%)	1 (5.0%)	

OR: odds ratio; *ROSC:* return of spontaneous circulation.

Table 5. Death in-hospital and patients alive at discharge.

Demographic characteristics, illness category, pre-existing conditions, cardiovascular risk factors, Charlson score (comorbidity index), previous heart disease, monitored and unmonitored patients, infectious diseases, in-hospital days after cardiac arrest, cardiac arrest initial rhythm, defibrillation, time of event and duration, clinical abnormal observations prior to cardiac arrest.

	Death in-hospital	**Alive at discharge**	***p* value**
	***N* = 46 (69.7%)**	***N* =20 (30.3%)**	
Age (years)			
Mean± S.D.	68.6 ± 16.0	70.8 ± 12.9	0.59
Median (25th, 75th)	73 (59.8, 80.0)	82 (64.8, 80.8)	
Range	25 – 92	29 – 86	
Sex			0.79
Male	26 (56.5%)	12 (26.1%)	
Female	20 (43.5%)	8 (17.4%)	
Illness category *N* (%)			
Medical, cardiac	7 (15.2%)	4 (8.7%)	
Medical, non-cardiac	21 (45.8%)	4 (8.7%)	
Surgical, cardiac	12 (26.1%)	7 (15.2%)	
Surgical, non-cardiac	2 (4.4%)	2 (4.4%)	
Trauma	4 (8.7%)	3 (6.5%)	

Cardiac / non-cardiac	19/27	11/9	0.30
Pre-existing conditions *N* (%)			0.70
Acute myocardial infarction	5 (11.0%)	3 (15.0%)	
History of myocardial infarction	6 (13.0%)	4 (20.0%)	
Arrhythmia	4 (8.7%)	5 (25.0%)	
History of congestive heart failure	15 (32.6%)	6 (3.0%)	
Acute stroke	2 (4.4%)	1 (5.0%)	
Respiratory insufficiency	7 (15.2%)	6 (3.0%)	
Pneumonia on admission	2 (4.4%)	1 (5.0%)	
Sepsis on admission	5 (11.0%)	0 (0.0%)	
Other infection on admission	5 (11.0%)	2 (10.0%)	
Hepatic insufficiency	3 (6.5%)	0 (0.0%)	
Renal insufficiency	17 (37.1%)	5 (25.0%)	
Cancer (last 5 years)	9 (19.6%)	3 (15.0%)	
Major trauma	3 (6.5%)	3 (15.0%)	
None reported	2 (4.4%)	2 (10.0%)	
Cardiovascular risk factors *N* (%)			0.77
Diabetes Mellitus	16 (34.8%)	9 (45.0%)	

Tobacco	7 (15.2%)	7 (35.0%)	
Obesity	3 (6.52%)	2 (10.0%)	
Dislipidemia	8 (17.4%)	6 (3.0%)	
High blood pressure	23 (50.0%)	10 (5%)	
Without risk factors	11 (23.9%)	4 (20.0%)	
With/ Without cardiovascular risk factors	35/11	16/4	0.73
Charlson score (age adjusted)			
Mean ± S.D.	5.5 ± 3.2	5.5 ± 2.6	0.91 (1)
Median (25th, 75th)	5.0 (3.0, 7.0)	6.0 (4.3, 7.0)	
Range	0.0 – 17.0	0.0 – 11.0	
Previous heart disease *N* (%)	16 (34.8%)	12 (60.0%)	0.06
Monitored *N* (%)	26 (56.5%)	14 (70.0%)	
Unmonitored *N* (%)	20 (43.6%)	6 (3.0%)	
Monitored/unmonitored			0.30
Infections (admission + in-hospital) *N* (%)			0.50
Pneumonia	19 (41.3%)	9 (45.0%)	
Sepsis/septic shock	20 (43.6%)	5 (25.0%)	
Bacteraemia	8 (17.4%)	6 (3.0%)	
Other	15 (32.6%)	6 (3.0%)	

In-hospital days after cardiac arrest			
Mean ±S.D.	12.7 ± 26.3	44.6 ± 75.2	0.01
Median (25th, 75th)	2.8 (0.1, 14.1)	17.5 (8.0, 52.0)	
Range	0.0 – 121.0	5.0 – 342.0	
Cardiac arrest initial rhythm *N* (%)			0.54
VF/ pulseless VT	6 (13.1%)	2 (10.0%)	
Pulseless electrical activity	11 (23.9%)	8 (40.0%)	
Asystole	18 (39.1%)	5 (25.0%)	
Unknown	11 (23.9%)	5 (25.0%)	
Defibrillation *N* (%)			
Patients who received defibrillation	15 (37.5%)	1 (3.9%)	0.02
Time of event (*) *N* (%)			
8:00 AM to 5:59 PM	15 (32.6%)	7 (35.0%)	
6:00 PM to 10:59 PM	9 (19.6%)	2 (10.0%)	
11:00 PM to 7:59 AM	11 (23.9%)	3 (15.0%)	
Weekend	15 (32.6%)	3 (15.0%)	
Event duration (minutes)			
Mean ± S.D.	7.5 ± 7.2	10.7 ± 14.2	0.23
Median (25th, 75th)	5.0 (2.0, 10.5)	8.0 (4.0, 10.0)	

Range	2.0 – 35.0	2.0 – 60.0	
Clinical abnormal observations			
	40 (87.0%)	15 (75.0%)	0.57
24hours prior to cardiac arrest *N* (%)			
Airway obstruction	2 (4.3%)	2 (10.0%)	
Acute respiratory insufficiency or compromise	18 (39.1%)	10 (50.0%)	
Hypotension	15 (32.6%)	6 (30.0%)	
Haemodynamic instability	9 (19.6%)	2 (10.0%)	
Arrhythmia	10 (21.7%)	4 (20.0%)	
CNS depression	9 (19.6%)	1 (5.0%)	

CNS: central nervous system; *VF*: ventricular fibrillation; *VT*: ventricular tachycardia.

* Periods of time are according to usual nurse shifts.

(1) Mann-Whitney U test

Table 6. Pre-resuscitation facts and association with outcome (*N*=66)

Event specific data	Prevalence % (*N*)	% (*N*) Died at event	% (*N*) Died at discharge	Crude OR of discharge mortality; 95% CI	RR of discharge mortality ; 95% CI *
Monitored	60.6% (40)	15.0% (6)	65.0% (26)	0.56 (0.18-1.71)	0.85 (0.62-1.15)
First documented pulseless rhythm					
Asystole	34.9% (23)	13.0% (3)	78.3% (18)	1.93 (0.60-6.23)	1.20 (0.88-1.64)
PEA	28.8% (19)	5.3% (1)	57.9% (11)	0.47 (0.15-1.45)	0.78 (0.51-1.18)
VF or pulseless VT	12.1% (8)	0.0 % (0)	75.0% (6)	1.35 (0.25-7.35)	1.09 (0.70-1.68)
Missing/unknown	24.2% (16)	25.0% (4)	68.8% (11)		

OR: odds ratio*; PEA:* pulseless electric activity; *RR:* relative risk; *VF*: ventricular fibrillation; *VT*: ventricular tachycardia;

*All values of $p>0.05$

Anexo

Normas da revista: Resuscitation

Guide for Authors

An interdisciplinary journal for the dissemination of clinical and basic science research relating to cardiopulmonary resuscitation.

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The following are sample references:

<u>Articles in Journals</u>

1. Ross P, Nolan J, Hill E, Dawson J, Whimster F. The use of AEDs by police officers in the City of London. Resuscitation 2001;50:141-6.

2. Bernard SA, Gray TW, Buist MD, et al. Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia. N Engl J Med 2002;346:557-63.

Books

3. Armitage P. Statistical methods in medical research. London, Blackwell Scientific Publications, 1971.

Chapters

4. Phillips SJ, Whisnant JP Hypertension and stroke. In Laragh JH, Brenner BM, editors. Hypertension: Pathophysiology, diagnosis, and management. 2nd ed. New York, Raven Press, 1995: 465-78.

References to electronic publications

Working Group of the Resuscitation Council (UK). Emergency treatment of anaphylactic reactions. Guidelines for healthcare providers. London, Resuscitation Council (UK), 2008. (Accessed 11 August 2008, at http://www.resus.org.uk/pages/reaction.pdf)

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