

Unsuccessful resuscitation after cardiac arrest in the intensive care unit: single center analysis

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Abstract. Background: The cardiac arrest events are a largely debated subject. Significant amount of data is available regarding the in-hospital and out-of-hospital cardiac arrest; while the cardiac arrest occurred in the intensive care unit have drawn less attention. Material and Methods: This is single center retrospective study concerning the unsuccessful resuscitations in “Carol Davila” Nephrology Hospital, a clinical, university affiliated hospital for chronic ill patients with nephrology issues and surgical patients. The clinical data of the 32 patients that died in our unit were analyzed. We determined the frequency of cardiac arrest in our sample. We assessed the underlying conditions of the patients, previous medical procedures: oro-tracheal intubation, hemodiafiltration (HDF), and complex surgical interventions, the first monitored cardiac rhythm, the time until first resuscitation maneuver was initiated, whether the cardiac arrest was witnessed or not, and the do not attempt resuscitation (DNAR) policies of our facility. Results: For the year of 2014 we had a group of 32 patients (4.61% of all admissions) who underwent cardiac arrest. The most frequent underlying diseases were: respiratory failure in 22 cases (68.8%), heart failure in 21 cases (65.6%), and renal failure in 19 cases (59.4%). Temporary return of spontaneous circulation (ROSC) was achieved for 5 patients (15.62%) but none of them survived to discharge. According to the DNAR policy of our unit, for 9 patients there was no resuscitation attempt. A strong correlation was noted between the patients receiving HDF and those with ROSC. Conclusions: The most frequent underlying conditions of patients undergoing cardiac arrest are respiratory failure, heart failure, and renal failure. In our case the first monitored rhythm was non-shockable.

Key Words: cardiac arrest, intensive care unit, resuscitation.

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Introduction

The cardiac arrest is the event that ends one's life; sometimes it can be prevented, often it is not. The outcome of the resuscitation depends on many factors, such as the prompt intervention of health-care professionals but also on the underlying disease that caused the cardiac arrest. Great concern had been given in the recent decades to the cardiopulmonary resuscitation and advanced protocols in order to restore life in cardiac arrest patients and to improve the quality of their life (Deakin et al 2010). Several factors affect the outcome, both out of hospital cardiac arrest (OHCA) and in hospital cardiac arrest (IHCA), such as the time between the arrest and the initiation of the resuscitation, the previous health issues of the patient and their severity, duration of resuscitation, time of the arrest and the initial monitored rhythm (Van Walraven et al 2001, Herlitz et al 2002, and Chien-Hua et al 2002). Data regarding the OHCA and the IHCA are accumulating, but data on the incidence and outcome of intensive care unit cardiac arrest are few, and appear to be of a highly variable quality (Efendijev et al 2014). In our country a few reports have been published regarding cardiac arrest events attended in the Emergency Department; they show outcomes, in recent years, of 11.53% survive to discharge (Tudorache et al 2015). The patients included in the mentioned study come from general population, with the sudden onset of their medical

complaints out of the hospital, so we can assume that the cardiac arrest event they suffered was the result of an acute issue, and not of a prolonged suffering. Nevertheless, facts considered potential factors for a poor outcome in OHCA, such as early recognition of the medical emergency, bystander CPR, early advanced life support, are not an issue for patients admitted in the ICU. The ICU represents a special medical facility with medical personnel of high expertise, nursing care and complex life sustaining medical equipment. The patients admitted in the ICU are in severe condition; therefore it is not unexpected for cardiac arrest to occur.

In the Intensive Care Unit (ICU) the patients are permanently monitored, and this fact lowers the possibility for an un-witnessed or unmonitored cardiac arrest to occur (Myrianthefs et al 2003). Nevertheless, the patients admitted in the ICU are already in poor condition, often with hemodynamic and/or respiratory impairment and the characteristics of the patients and their illnesses clearly influence the outcome of resuscitation in the ICU (Enohumah et al 2006).

The purpose of this study is to evaluate the demographic characteristics of patients who suffered cardiac arrest and failed resuscitation in our intensive care unit. The characteristics of the resuscitation protocol followed for the critical ill ICU patients were noted. We are also concerned about the cases in which not to initiate resuscitation is appropriate.

Material and methods

This is a retrospective study, using observational sheets of patients admitted in the Intensive Care Unit of the “Carol Davila” Clinical Hospital for the year of 2014. The “Carol Davila” Hospital is a clinical university affiliated unit with a specific medical profile, nephrology and surgery (general surgery, vascular and thoracic surgery). Consecutively, the patients admitted in the ICU may have end stage renal disease (ESRD) with severe complications, severe surgical conditions, or both. The ICU and Anesthesiology department is fully equipped for those matters, providing permanent perioperative care and primary ICU care for all patients in need of such. In addition, patients from the Nephrology ward are admitted in the ICU if their medical condition compels.

Although “Carol Davila” is not an emergency hospital the doctors approve transfers from other hospitals, at any given time, for matters concerning vascular access (for patients with ESRD) or surgical emergencies. The hospital benefits from 4 operating rooms and an intensive care ward of 15 beds. Our hospital cannot provide therapeutic hypothermia or coronary catheterization. For the cases that require emergency catheterization, a national program is available and all patients can be transferred to a specialized unit on call for these matters.

In case of cardiac arrest in the ICU, the resuscitation is initiated by the nurse or directly by the ICU doctor if present. However, the doctor on duty is called and conducts the resuscitation in all cases. If the cardiac arrest occurs in other ward of the hospital, the resuscitation is initiated by the medical personnel who certify the arrest until the arrival of the resuscitation team consisting of an ICU doctor and nurse.

All patients underwent resuscitation with the exception of the patients admitted in the ICU with a do not attempt resuscitation (DNAR) recommendation. The DNAR policy refers to the patients receiving maximal vasopressor and inotrop support with an underlying disease that cannot be treated furthermore. We defined the cardiac arrest event as being a state in which the patients show no clinical sign of blood flow (the absence of the central pulse) and apnea or agonal breathing (if not connected to the mechanical ventilator) (Cummins *et al* 1997).

The patients included in this study suffered cardiac arrest being admitted in the ICU. All patients with cardiac arrest outside the ICU facility were excluded from the study. If a patient suffered from several cardiac arrests, only the first episode was included in the study. The collected data included sex, age, underlying diseases, the initial monitored rhythm and the outcome of the resuscitation. Usually, the cerebral performance category (CPC) is used to assess the neurological outcome of the resuscitated patients, but for this study this assessment could not be used, as there were no patients to survive to discharge. All patients signed the informed consent upon admission in hospital. In the cases in which the medical status of the patients unlabeled them to sign the consent, a family member acting as a tutor signed all the forms.

We determined the frequency of cardiac arrest in our sample. We assessed the underlying conditions of the patients, previous medical procedures: oro-tracheal intubation, hemodiafiltration (HDF), and complex surgical interventions, the first monitored cardiac rhythm, the time until first resuscitation maneuver was

initiated, whether the cardiac arrest was witnessed or not, and the DNAR decisions in our sample.

The study has the approval from the “Carol Davila” Clinical Hospital Ethics Committee.

The data was analyzed using SPSS (version 21) and Numbers (version 3.5.3). Non-parametric tests, independent samples were used and two-tailed bivariate correlation to assess the scalar and nominal variables.

Results

For the year 2014, a number of 694 patients were admitted in the ICU of “Carol Davila” Nephrology Hospital. Most of the patients were admitted in the ICU due to the need of post-surgery care. Others were transferred from the Nephrology ward or from other hospitals. Many of the patients presented both renal failure due to autoimmune disease or metabolic disorders and a surgical emergency. All 694 patients received intensive care according to their needs.

For the year of 2014, a cardiac arrest event occurred in the case of 32 patients, which suffered a cardiac arrest during their stay in the ICU. This represents 4.61% of all admissions and a prevalence of 0.04.

The patients were aged between 30 and 85 years, the mean age being 66.13 ± 13.76 . Although we had equal numbers of males

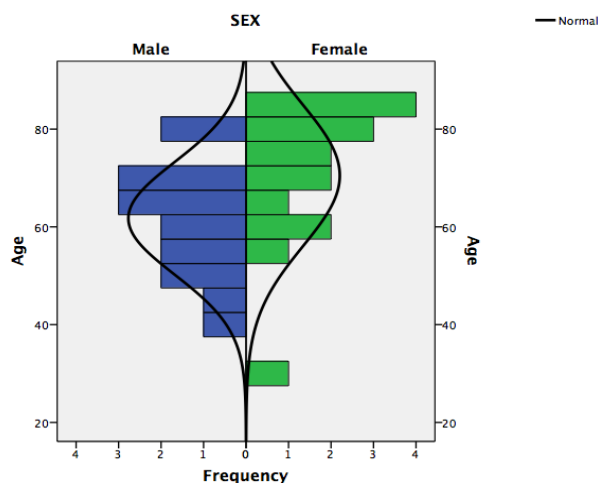


Figure 1. The distribution of age across the categories of sex

The place for arrest was the ICU for all the patients, all the events were witnessed and the CPR was initiated in less than 30 seconds, as shown in Table 1.

Table 1. Event data

Place of cardiac arrest	ICU
Witnessed cardiac arrest	all cases (32 patients)
Time to start CPR	less than 30 seconds
First monitored rhythm - nonshockable	31 cases (96.8%)
Temporary ROSC	3 cases (9.4%)

The first monitored rhythm was non-shockable for 31 patients (96.8%). Temporary return of spontaneous circulation (ROSC) was achieved for only 5 patients (15.62%) and all 32 patients of

our group eventually underwent irresuscitable cardiac arrests. One of the patients survived 6 days after the cardiac arrest, but due to the severity of the underlying disease she underwent another cardiac arrest, unresponsive to resuscitation maneuvers for that time. The other 4 patients which had ROSC died within 48 hours from the previous cardiac arrest, also due to the severity of their previous illnesses. As all patients suffered witnessed cardiac arrests in the ICU, it is reasonable to consider that the first monitored rhythm was the rhythm of the cardiac arrest.

As expected, these patients were in severe condition prior to the cardiac arrest. Being a hospital for chronic ill patients and not receiving general medical emergencies (only transfers from other hospitals) the patients from our group had complex medical investigation and appropriate treatment initiated. 22 patients from our group were oro-tracheal intubated prior to the cardiac arrest, due to respiratory failure, 11 patients benefited from hemodiafiltration (HDF) prior to the cardiac arrest and 8 of them underwent complex surgical intervention in order to restore or preserve vital functions. The underlying diseases of the patients are summered in Table 2.

A strong correlation was noted between the patients receiving HDF and those with ROSC (Sperman's rho 0.023), and furthermore there was a better response to resuscitation maneuvers in patients receiving HDF, meaning that patients who underwent HDF-therapy had a better outcome in resuscitation due to ROSC.

Table 2. Underlying diseases

Underlying disease	Number	Percent (%)
Autoimmune	3	9.4
Diabetes	4	12.5
Renal failure	19	59.4
Heart failure	21	65.6
Hepatic failure	11	34.4
Respiratory failure	22	68.8
End stage neoplasm	14	43.8

The reason for admission in the ICU for the non-surgical patients was respiratory failure in 10 cases (with the need of oro-tracheal intubation and mechanical ventilation) and hemodynamic instability for 14 patients, due to severe illnesses such as autoimmune, metabolic disorders, end stage neoplasm (including cerebral metastasis with neurologic manifestations). There were 8 cases in which an emergency surgical procedure had been done prior to the cardiac arrest. It is to be mention that 6 of these patients had renal failure, 4 of them being in dialysis program for a long period of time.

Regarding the DNAR policies for the "Carol Davila" Hospital, is to be mentioned that for the patients undergoing cardiac arrest on respiratory support (oro-tracheal intubation and mechanical ventilation) and maximal vasopressor and inotrope support the resuscitation was not attempted. This is the case of 9 patients out of the 32 patients of our study-group, the rest of them receiving resuscitation according to the European Resuscitation Council's guidelines.

Nurse certification of the cardiac arrest was noted in 25 of the 32 cases, but in all cases the doctor on duty eventually

conducted the resuscitation. The doctor on duty witnessed the 7 cases remaining.

Discussion

The cardiac arrest phenomenon is a legitimate largely debated subject. Significant amount of data is available regarding the in-hospital and out-of-hospital cardiac arrest; while the cardiac arrest occurred in the intensive care unit have drawn less attention. Most information regarding the ICU-CA originates from single center retrospective studies and show highly variable data regarding the incidence and outcomes (Efendijev et al 2014).

The prevalence of cardiac arrest in our group was 0.04, compared to 0.6 stated in the paper with the lowest prevalence found (Skrifvars et al 2012). This may be due to the specificity of our ICU, which cares for an important number of surgical patients requiring temporary intensive care.

The location of the cardiac arrest being in the ICU is important, as the literature states that patients resuscitated in the ICU have a better hospital discharge rate compared to the patients on general wards (Guimaraes et al 2001). However, for our study, none of the patients survived to discharge. CPR was initially successful in 5 patients out of 23 patients with resuscitation attempt. In our patients the mortality is related to the primary reason of admission in the ICU, condition caused by the severity of the underlying disease, such as the renal failure in hemodialysis program. It is well known that the survival of dialysis patients after cardiac arrest is poor and therefore means for reducing the risk of their cardiac arrest and improving the outcome are needed (12).

There are studies that note temporary ROSC up to 100% in the ICU, but the 24 hours survival lowers down at 9.2% and the survival to discharge was 0 (Myrianthefs et al 2003). Optimistic views were found in studies concerned by cardiac surgery patients who had discharge rates 60% to 79% (Guney et al 2009, Anthi et al 1998). It is to be mentioned that patients on maximum inotropic and/or intra-aortic balloon pump support and the patients with ventricular assistant devices were excluded from the study. Other data regarding the cardiac arrest in the ICU are available from units treating neurosurgical patients; that notes survival between 9% and 18%, with a mention that none of the patients having an initial infectious condition survived to hospital discharge (Yi et al 2006, Rabinstein et al 2004). A study conducted in the ICU of cancer center reported a survival to hospital discharge rate of 2% (Wallace et al 2002). These differences between the outcomes of ICU cardiac arrest may be attributed to patient factors, such as their medical condition prior to the arrest and illness severity. The reason for admission in the ICU may have significant role in the outcome of the resuscitation.

For this study we did not include data about the neurological status of the patients, as none of them regained consciousness and all eventually died. Lee et al (2013) report that 48% of the survivors have good neurological outcome (CPC of 1 or 2), while the other 52% have poor neurological condition, secondary to the cardiac arrest (CPC of 3 or 4).

The initiation of resuscitation in our group was less than 30 seconds, as expected in any ICU. The prompt intervention in cardiac arrest cases with all necessary equipment is not an issue in the ICU. Also, being a unit in which patients benefit from continuous monitoring, the rhythm of the cardiac arrest could

be determined, for 96.8% of the patients being a non-shockable rhythm. Most of the ICU cardiac arrest events have reported as initial cardiac rhythm to be a non-shockable one (Efendijev *et al* 2014).

There are few studies that mention DNAR decisions and DNAR policies regarding the cardiac arrest on the ICU. Some studies include mention of DNAR orders (Lee *et al* 2013), some are describing the practical implication of the resuscitation of a specific group of patients, cancer patients requiring admission in the ICU (Wallace *et al* 2002), some state that their hospital does not have an official DNAR policy, although CPR is not initiated in cases considered futile or with DNAR order (Enohumah *et al* 2006). In their paper, Myrianthefts *et al* (2003) had mentioned that patients who are already being on maximum vasopressor and inotropic support with underlying acute or chronic untreatable disease are subject to DNAR policy, this also being the case of the “Carol Davila” Hospital’s ICU.

There are several similarities between single center studies regarding the event characteristics and the outcome for cardiac arrest patients within the intensive care unit. Although there are studies that show good performance in the outcome of ICU resuscitation, it is to be mentioned that they refer to a group of patients with a specific medical condition. The American Heart Association suggested a set of recommendations to improve the outcome of IHCA, such as rapid defibrillation using automated external defibrillators, prompt initiation of chest compressions and strategies for post-resuscitation care (Morrison *et al* 2013). Not having data regarding the ICU cardiac arrest, these recommendations may not be applicable for this kind of units. This initiative should continue in order to identify the characteristics of cardiac arrest events in the ICU and to assess objective parameters that indicate whether a resuscitation attempt may be considered futile and encourage units to develop DNAR policies. This study states from the beginning the reference to cardiac arrest as a distinct notion, absolutely different from DNAR cases and encourages keeping in mind this difference, because the ICU is a place with a very high rate of mortality by itself and not all patients die from cardiac arrest. The cardiac arrest has to remain that state of morbidity that appears mostly when you do not expect it to appear, in the fully state of health, generally speaking, or in a patient with a favorable evolution and from causes that are less likely to occur in that moment. Even in these conditions, the lack of success of resuscitation at which this study relates is explained by the medical conditions associated to the main sufferance of each patient. This is important because it reduces the frustrations of medical personnel facing an unsuccessful event in their professional life, despite all efforts to preserve life, as Isaak&Paterson (1996) have also noted. This study is one of the few of its kind, the failure being forgotten in many cases.

The limitations of this study are mainly related to the fact that this is a single center study conducted on a short period of time. However there are analogies between other studies and our approach, and this is encouraging us to continue our work.

Conclusions

The most frequent underlying conditions of patients undergoing cardiac arrest are respiratory failure, heart failure, and renal failure.

In our case the first monitored rhythm was non-shockable. Even though cardiac arrests are witnessed, the outcome remains poor for patients suffering of severe underlying conditions. Despite achieving ROSC in patients with severe underlying conditions the outcome is poor, and unfortunately all patients die.

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