Original Research

Nicosia General Hospital Cardiac Arrest Team: First Year's Practice and Outcomes of In-Hospital Resuscitation

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Introduction: In 2007, Nicosia General Hospital implemented a resuscitation policy. 378 nurses and 120 doctors were successfully trained in advanced life support (ALS) in order to staff cardiac arrest teams. The aim of this study was to assess the frequency of cardiac arrest and resuscitation outcomes in Nicosia General Hospital and assess any associations between the survival rate and the patient's characteristics. We also aimed to evaluate the effectiveness of in-hospital resuscitation in order to detect ways of improvement.
Methods: We prospectively analyzed the data on all cardiac arrest calls in Nicosia General Hospital between January and December 2007. Data were collected using the Utstein style.
Results: The cardiac arrest team (CAT) was called 83 times, of which 10 were false alarms. Cardiac arrest was identified in 69 calls, while 4 calls were respiratory arrests. The patients' mean age was 70.8 years (95% CI: 66.6-75.1). In 86% the initial rhythm was asystole/pulseless electrical activity (PEA) and in 14% ventricular fibrillation/tachycardia (VF/VT). Return of spontaneous circulation was achieved in 52% of the cases. Survival to discharge was achieved in 17.8% of the patients with arrest and in 14.5% of cardiac arrests. Patients with an initial rhythm of asystole/PEA were discharged in 5% and patients with VF/VT in 70% of cases. About 36% of the patients less than 60 years old and 12% of the patients older than 60 were discharged. The CAT arrived within 1.6 minutes, first shock in VF/VT was delivered within 1.5 minutes and the first adrenaline dose in asystole/PEA was given within 2.7 minutes.
Conclusions: It is more likely for our patients to survive to discharge if they are less than 60 years old, they are hospitalized in the cardiology department and the initial rhythm is VF/VT. Our outcomes are similar to survival rates in larger studies. However, points of improvement have been identified and interventions need to be made in order to improve documentation and outcomes of in-hospital arrests.

It is well known that most patients undergoing in-hospital cardiac resuscitation do not survive to hospital discharge.[1] However, successful cardiopulmonary resuscitation (CPR) depends on the availability of basic and advanced life support systems, the capability for immediate defibrillation, and the quality of the CPR intervention.[2] The traditional way of calling the physician on duty when a cardiac arrest is suspected causes an unacceptable delay that may diminish the chance of survival.[3] The European Resuscitation Council Guidelines for Resuscitation published in 2005 stress the significance of early CPR and early defibrillation.[4,5] We also know that the presence of at least one advanced life support (ALS) trained team

member at in-hospital resuscitation efforts increases both short- and long-term survival following cardiac arrest.[6]

The Nicosia General Hospital is a tertiary hospital, the largest in Cyprus, with an Emergency Department that is on duty 24 hours per day. It does not include a pediatric or an obstetrics department. In October 2006, immediately after its transfer to new premises, Nicosia General Hospital attempted to implement its resuscitation policy and establish cardiac arrest teams (CAT) in order to optimize the response to and outcome of in-hospital cardiac arrests. Until then there was no official alert system for response to cardiac arrest, clinical wards were not appropriately equipped to treat cardiac arrests effectively and promptly, and there was no training system within the hospital for in-hospital resuscitation. During the preparatory period, which lasted from 2004 until 2006, 120 doctors and 378 nurses were successfully trained in ALS so they could participate as members of the CAT. A Resuscitation Officer was appointed in January 2007. His major task was to fully implement the hospital's resuscitation policy. Among other duties, he is responsible for the continuing education and maintenance of skills of the trained staff. He is also responsible for the necessary equipment (crash trolleys) in every hospital ward and department. We need to mention that, although there is a do not attempt resuscitation (DNAR) clause in the resuscitation policy, it is not implemented due to cultural and legal limitations.

The aim of this study was to assess the frequency of cardiac arrest and resuscitation outcomes in Nicosia General Hospital, and to determine the probability of an adult inpatient suffering cardiac arrest and being discharged alive. In addition, we aimed to assess the association between the survival rate and the patient's age and sex, the initial arrest rhythm, the site and time of cardiac arrest and witnessing of cardiac arrest. We also aimed to evaluate the effectiveness of in-hospital resuscitation in order to detect ways of improvement.

Methods

We prospectively analyzed the data on all cardiac arrest calls in Nicosia General Hospital between January and December 2007. The hospital had a capacity of 400 beds and 16,828 hospitalized patients during the year of observation. Data were collected using the Utstein style, focusing on demographic characteristics, etiology and presentation of cardiac arrest, time and date, site, the presence of a witness, any special-

ized interventions before and after the arrest, timing of interventions, return of spontaneous circulation (ROSC) and outcomes of cardiopulmonary resuscitation. There were only two possible outcomes: died in hospital or discharged alive. The data were documented by the cardiac arrest team leaders and collected by the Resuscitation Officer.

When a patient collapses and an arrest is confirmed, the ward staff dial the number 3333. This is an internal line that is answered by the operator and used only for cardiac arrests. According to the policy, the ward staff must clearly state the ward, the level and room number where the arrest is taking place. The operator responds to the call immediately by calling the internal wireless telephone devices which all members of the CAT carry. Members of the ward personnel are encouraged to start CPR immediately and before the arrival of the crash team.

The team consists of a trainee in cardiology (team leader), a trainee in anesthesiology, a trainee in internal medicine and a nurse, all ALS providers. The team leader gives the instructions and decides on the CPR process. The anesthesiologist is responsible for the airway management. The trainees are never supervised in any arrest or at any time of the day. Patients from all the wards and departments of the hospital were included.

Cardiac arrest was defined as the cessation of cardiac mechanical activity, as confirmed by the absence of signs of circulation. A witnessed cardiac arrest is one that is seen or heard by another person or an arrest that is monitored. ROSC was defined as the restoration of a spontaneous perfusing rhythm that results in more than an occasional gasp, fleeting palpated pulse, or arterial waveform.[7]

Statistical analysis

Statistical analysis was performed with the use of descriptive statistics. Means, standard deviations and 95% confidence intervals (CI) were used for continuous variables, and frequency tables as well as cross-tabulations were used to study categorical variables. Additionally, Student's t-test was used to examine the existence of statistically significant differences in continuous variables (age, arrival of the CPR team in minutes, etc.) between the two outcome groups of patients (discharged and deceased). Fisher's exact test was performed to identify possible associations between categorical variables, such as outcome, age, sex, existence of ventricular fibrillation or tachycardia, etc.

Results

From January to December 2007, 83 arrest calls were registered. Ten calls were considered as false since no arrest was documented. Four calls were primary respiratory arrests, the airway was secured with intubation and the patients were transferred to the intensive care unit (ICU). Sixty-nine patients had no signs of breathing or circulation and were confirmed as cardiac arrests (Table 1). The frequency of arrest in Nicosia General Hospital was 4.34/1000 patients per year.

The patients' mean age was 70.8 years (95% CI: 66.6-75.1). Regarding age distribution, 21.2% of the cases were less than 60 years old, 48.5% were between 61 and 80 and 30.3% were older than 80 years. Most of the patients with cardiac arrest were male 52 (75%) and only 17 (25%) were female.

Most of the cardiac arrests were inpatients in the cardiology department: 14 (20.3%) in the coronary care unit (CCU) and 5 (7.2%) in the cardiology ward. Fourteen (20.3%) patients had an arrest in the internal medicine wards, 9 (13%) in the ICU, 9 (13%) in the emergency department, 7 (10.1%) in the angiothoracic ward, 4 (5.8%) in the surgical ward, 3 (4.3%) in the nephrology department, 2 (2.9%) in the orthopedic ward, 1 (1.4%) in the urology ward and 1 (1.4%) in the neurosurgery ward.

Most of the arrests (39.7%) occurred between the hours 0:00-7:59, 28.6% occurred between 8:00-15:59 and 31.7% between 16:00-23:59. The arrest was witnessed in 56 (81.2%) cases and not witnessed in 13 (18.8%).

The initial rhythm in cardiac arrests was ventricular fibrillation or pulseless ventricular tachycardia (VF/VT) in 10 (14%) cases and asystole or pulseless electrical activity (asystole/PEA) in 59 (86%).

ROSC was achieved in 36 (52%) cardiac arrests. ROSC was achieved in 90% of cases of VF/VT and 46% of asystole/PEA. Overall 13 (17.8%) patients were discharged alive, whereas 60 (82.2%) died in hospital. Among the 69 cardiac arrests 10 (14.5%) patients survived to discharge: 70% of patients with initial rhythm VF/VT were discharged and 5% with initial rhythm asystole/PEA (Table 2).

The crash team arrived within 1.6 minutes (95% CI: 1.31-1.79), first shock in VF/VT was delivered within 1.5 minutes (95% CI: 0.87-2.1) and the first adrenaline dose in cases of asystole/PEA was given within 2.7 minutes (95% CI: 2.2-3.2). The airway was secured within 6.4 minutes (95% CI: 4.4-8.4) (Table 3). The time intervals refer to the time from the emergency call.

Table 1. Characteristics of patients with cardiac arrest in Nicosia General Hospital.

Characteristics	No. (%) of patients
Sex:	
Men	52 (75%)
Women	17 (25%)
Witness:	
Yes	56 (81.2%)
No	13 (18.8%)
Initial Rhythm:	
VF/VT	10 (14%)
Asystole/PEA	59 (86%)
Mean Age (years)	70.8 (95% CI: 66.6-75.1)

PEA – pulseless electrical activity; VF/VT – ventricular fibrillation or pulseless ventricular tachycardia.

Table 2. Outcomes of in-hospital resuscitation of Nicosia General Hospital in 2007.

	No.	ROSC	Discharged
Respiratory arrests	4	4 (100%)	3 (75%)
Cardiac arrests	69	36 (52%)	10 (14.5%)
VF/VT	10	9 (90%)	7 (70%)
Asystole/PEA	59	27 (46%)	3 (5%)
Overall	73	40 (54.8%)	13 (17.8%)

ROSC – return of spontaneous circulation; other abbreviations as in Table 1.

Table 3. Cardiac arrest team performance in minutes and 95% confidence intervals (CI).

	Mean time (min)	95% CI
Arrival of team	1.6	1.31-1.79
First shock in VF/VT	1.5	0.87-2.1
First adrenaline in asystole/PEA	2.7	2.2 -3.2
Securing the airway	6.4	4.4 -8.4

Abbreviations as in Table 1.

Associations

Fisher's exact test indicated a highly significant association between the initial rhythm and the outcome of cardiac arrest (Table 4). While the majority of patients (70%) who suffered VF/VT survived, a significantly lower proportion of patients with asystole/PEA (5%) survived the arrest (Fisher's exact test: $p < 0.001$). There was also a statistically significant association regarding the outcome of cardiac arrest and the patients' age. In the patients aged ≤60 years 36% survived the cardiac arrest, whereas only 12% of the pa-

Table 4. Significant associations of patients' characteristics with outcome.

Characteristics of patients	Discharged	Died	p
Age:			
≤ 60	36%	64%	0.046
> 60	12%	88%	
Initial Rhythm:			
VF/VT	70%	30%	<0.001
Asystole/PEA	5%	95%	
Site:			
Cardiology department	32%	68%	0.022
All other departments	8%	92%	

Abbreviations as in Table 1.

tients aged >60 years survived (Fisher's exact test: p=0.046). A significant association was also observed between the outcome of arrest and the department in which the arrest took place, as 32% of the patients who had the arrest in the cardiology departments survived, compared to 8% of the patients who had the arrest in any other department of the hospital (Fisher's exact test: p=0.022).

The sex of the patients was not associated with the outcome (Fisher's exact test: p=0.719). There was no statistically significant association between the outcome and the time of the arrest. Nor was any statistically significant association observed between the outcome of cardiac arrest and the presence of a witness at the time of the arrest (Fisher's exact test: p=0.189).

Discussion

A total of 73 arrests occurred in Nicosia General Hospital during the year of the study period. Most of the in-hospital arrests occurred in male patients and in the cardiology department. It is more likely for our patients to survive to discharge if they are less than 60 years old, they are hospitalized in the cardiology department, and the initial rhythm is VF/VT. Our survival to discharge rate for patients with asystole/ PEA is very low, while the overall survival rate of 17.8% is similar to that in larger studies.[8,9] The performance of the cardiac arrest team is considered satisfactory, since the team arrives at the site of the arrest in less than two minutes and delivers the first shock in VF/VT also in less than two minutes. Delivery of the first adrenaline dose is a time variable that should be improved, while timing of securing the airway is affected by many factors and no conclusions should be drawn.

A limitation of our study is the small number of the patients, since this is the first year that cardiac arrests have been registered. Another limitation is that the data are collected by the cardiac arrest team members and so they may be biased. We also know from other studies that documenting time intervals is difficult. Even when a person was added to the resuscitation team as a data recorder, the time intervals during resuscitation were collected inaccurately or not at all.[10-12] However the cardiac arrest chart was revised in order to make documentation easier and more accurate.

It was also noted that none of the 14 cases (20.3%) of cardiac arrests that occurred in the internal medicine ward survived to discharge. All of these cases had asystole or PEA as initial rhythm. In the internal medicine ward patients are not usually monitored constantly: therefore, these could be cases of VF/VT that deteriorated into asystole. However, there was no statistically significant difference in the rate of reported witnessing of the arrests in internal medicine wards, even though there was a trend for higher rates of witnessing the arrest in the cardiology departments (Fisher's exact test: p=0.094). The low survival rate in medical wards might also be attributed to late recognition of clinical deterioration. There is some evidence showing that delays in recognizing deterioration or inappropriate management can result in late treatment, avoidable admissions to intensive care, and in some cases cardiac arrest and unnecessary deaths.[13] In addition, these patients had a greater mean age and a worse medical condition with multiple problems and would probably represent DNAR cases. Although there is a clause in the resuscitation policy regarding DNAR, it is not currently implemented. This issue is at the moment under consideration by the hospital resuscitation committee in order to overcome cultural and legal limitations that impede its full implementation. In fact, the implementation of DNAR policy will most probably affect the outcomes of in-hospital resuscitation and the survival rate among the cases of attempted resuscitation is likely to be higher.[14] As has been said before, resuscitation was never originally recommended for all patients, and its goal should be to "reverse premature death not prolong inevitable death."[15] Therefore, we believe that a DNAR policy is also necessary in Nicosia General Hospital.

The use of a board was considered during CPR to improve the quality of chest compressions; however we strongly believe that this would cause interruptions or even delays in delivering early compressions. Pre-filled

syringes with adrenaline, atropine and amiodarone provide a way to improve the delivery time of the drugs. As stressed above, we need to shorten the time interval to the first adrenaline in asystole/PEA. Finally, we are at the moment facing the challenge of transforming the established CAT into a medical emergency team in order to prevent in-hospital cardiac arrests.

Conclusions

For the first time in Cyprus we have established a resuscitation policy in our largest hospital and this study represents the registry and outcomes from the first year of practice. Our patients are more likely to survive to discharge if they are less than 60 years old, they are hospitalized in the cardiology department and the initial rhythm is VF/VT. Our outcomes are similar to survival rates in larger studies but are limited by the small number of cases in this first year's registry. Points of improvement have been identified and interventions need to be made in order to improve the documentation and outcomes of in-hospital arrests. Furthermore, we would also recommend to the hospital management the implementation of a DNAR policy and the transformation of the CAT into a medical emergency team. We believe that this analysis will be a useful tool for improving the quality and effectiveness of the resuscitation service delivered, not only in Nicosia General Hospital but in all hospitals around Cyprus.

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