VIA MEDICA
ORIGINAL ARTICLE
Cardiology Journal
2008, Vol. 15, No. 6, pp. 543–547

ISSN 1897–5593

Ten-year follow-up after in-hospital adult cardiac arrest

Paweł Franczuk, Krzysztof Rewiuk, Jerzy Gasowski, Piotr Faryan, Haghighi Massod Vadiee, Tomasz Grodzicki

Department of Internal Medicine and Gerontology, Jagiellonian University, Medical College, Kraków, Poland

Abstract

Background: *The aim of the study was to determine the prevalence of in-hospital cardiac arrest and survival during 10 years of observation.*

Methods: *Study group: patients hospitalized in the Internal Medicine Unit (including Intensive Care) in the years 1995–1997 with cardiac arrest during hospitalization. The probable reasons for the cardiac arrest were defined (cardiac or non-cardiac) as well as the mechanism (VF/VT, other). The number of deaths during the first 24 hours from the episode, during the whole stay in the hospital and after one, five and ten-years was analyzed.*

Results: *During the period examined, 152 cardiac arrests took place. The resuscitation was successful in 83 cases. In that group, 66% patients had cardiac cause of cardiac arrest, 50.6% in the mechanism of VF. Ninety percent of the patients died during their stay in the hospital (38.5% during the first 24 hours after the episode), 10% of the patients left the hospital alive. Only 2 of them (2.4%) survived the next 5 years. Nobody survived 10 years.*

Conclusions: *Cardiac arrest within the internal ward was characterized by high in-hospital mortality risk and unsuccessful late prognosis. Non-cardiac cause of cardiac arrest, relatively common in cases of in-hospital cardiac arrest, is connected with better survival after the first 24 hours; however, it does not improve the general survival to hospital discharge.* (Cardiol J 2008; 15: 543–547)

Key words: cardiac arrest, resuscitation, cardiac death

Introduction

Many studies have been conducted to determine the effectiveness of cardio-pulmonary resuscitation (CPR). Out-of-hospital cardiac arrest (CA) epidemiology has been investigated in many population-based studies. Fewer data have been presented regarding in-hospital cardiac arrest [1, 2].

Survival following in-hospital CA is still poor. Some studies have shown that in-hospital survival has not changed markedly in the last 40 years [3]. An aging population and presumably a sicker inpatient population may mean that survival data are incomparable, despite therapeutic improvements [4].

Effective CPR is noted as a success for the resuscitative team, but in the majority of cases the return of spontaneous circulation is only transient and gives the patient no benefit [5].

The aim of the study was to determine the prevalence of in-hospital cardiac arrest and survival during 10 years of observation.

Address for correspondence: Paweł Franczuk, Department of Internal Medicine and Gerontology, Jagiellonian University, Medical College, Śniadeckich 10, 31–531 Kraków, Poland, tel: +48 12 424 88 00; fax: +48 12 424 88 54; e-mail: franczuk@mp.pl

Received: 17.06.2008 Accepted: 24.09.2008

Methods

Study population

Data were collected for adult patients sustaining in-hospital cardiac arrest between January 1995 and December 1997 in the Department of Internal Medicine. All patients after successful CPR were included into the database and were observed for 10 years. The study population included in patients admitted either to the intensive care unit or to general wards (monitored and unmonitored). Only patients requiring intubation and mechanical ventilation during CPR were included.

Study end-points and definitions

Successful resuscitation was defined as a return of spontaneous circulation at the completion of resuscitative efforts. The mechanism, and probably the reason, for CA were analyzed. The primary arrest rhythm was determined from defibrillator or electrocardiograph and was defined as ventricular fibrillation/ventricular tachycardia (VF/VT) or other (asystolic or pulseless electrical activity). The reasons were divided into cardiac or non-cardiac. Survival was categorized into the following observation periods: survived 24 hours after CPR, discharged alive, survived after 5 years and alive after 10 years. Survival to hospital discharge was analyzed according to stratification into groups based on age, gender, mechanism (VF/VT or not) and reason (cardiological or not). Five and ten years after resuscitation, patients (or family) were contacted by phone.

Statistical analysis

Continuous variables were expressed as mean ± standard deviation, and categorical data was expressed as percentages. Continuous variables were compared using Student's t-test and categorical χ^2 test. The probability of survival beyond 24 hours after the episode was assessed using logistic regression.

Results

During the study period, a total of 152 patients was identified as sustaining in-hospital cardiac arrest.

Successful resuscitation took place in 83 patients (54.2% male, mean age 64.4 ± 15.5 years). The initial type of cardiac arrest rhythm was VF in 42 cases (50.6%). Cardiac cause of CA was determined in 55 patients (66.2%).

Fifty-one patients survived the first 24 hours after CA. In the model of logistic regression, non-cardiac cause of CA was the only predictor of survival (Table 1).

Table 1. Odds ratios for survival after first 24 hours.

	Point estimate	95% confidence interval	p
Age (years)	1.00	0.97–1.03	NS
Sex	1.68	0.67–4.25	NS
Ventricular fibrillation	1.73	0.65–4.64	NS
Cardiac cause	0.32	0.10–0.98	< 0.05

Table 2. Characteristics of cardiac arrest survivors. Comparison between those who died in hospital and those discharged alive.

	Died in hospital (n = 75)	Discharged alive (n = 8)	p
Age (years)	64.4 ± 16.0	64.8 ± 10.9	NS
Males (%)	38 (50.7)	7 (87.5)	< 0.05
Arrest specifics (%)			
Ventricular fibrillation	35 (46.7)	7 (87.5)	0.03
Cardiac cause of cardiac arrest	50 (66.7)	5 (62.5)	NS

Seventy-five patients died in hospital. Only 8 patients were discharged alive. Male gender and ventricular fibrillation as mechanisms of CA were significantly more common among patients discharged alive. There were no differences between those who died in hospital and those discharged alive in mean age and cause of CA (Table 2).

Cardiac causes of CA (myocardial infarction, heart failure, valvular heart disease) were more common than non-cardiac (pneumonia, chronic obstructive pulmonary disease, asthma, diabetes, alcohol abuse, septicemia). Patients with cardiac cause of CA were older (67.7 ± 12 *vs*. 57.9 ± 18.8), and VF was the most common mechanism of CA in this group (Table 3).

The five-year observation period was survived by only 2 patients. Nobody survived 10 years (Fig. 1).

Discussion

To sum up: observation of 83 successfully resuscitated patients revealed that most of them died in hospital (90%). This means that despite the 55 successes in returning spontaneous circulation only

Table 3. Characteristics according to cause of cardiac arrest (cardiac or non-cardiac)

	Cardiac cause (n = 55)	Non-cardiac cause (n = 28)	p
Age (years)	67.7 ± 12.5	57.9 ± 18.8	0.01
Males (%)	31 (56.4)	14 (50)	NS
Ventricular fibrillation (%)	34 (61.8)	8 (28.6)	0.004
Died within 24 h after cardio-pulmonary resuscitations	25 (45.5)	7 (25)	0.07

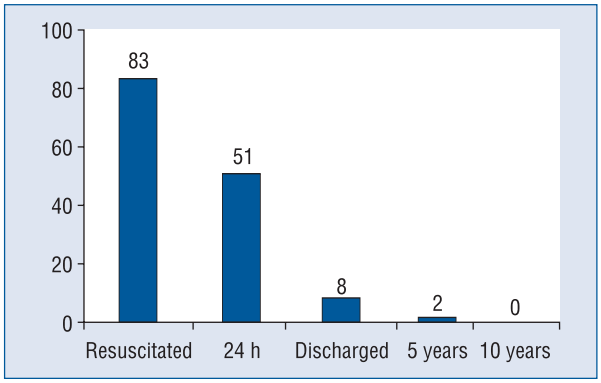

Figure 1. Number of patients alive in observation periods.

10% of successfully resuscitated patients were discharged from hospital. Two patients were alive after 5 years of observation and nobody survived 10 years.

Several publications have reported the outcome of in-hospital CA over the past 40 years. Generally, the rate of survival to hospital discharge varies from 14% to 17% [1–3]. In Suraseranivongse's et al. study [6] 61.7% of CA patients achieved restoration of spontaneous circulation and only 6.9% survived to discharge. The initial survival rate was not associated with sex, age or time to advanced life support, but was significantly related to the monitored area. Herlitz et al. [7] observed that if patients with in-hospital VF were defibrillated early, in both monitored and non-monitored wards, survival to hospital discharge was high. Fredriksson et al. [8], in a large single-centre study of in-hospital cardiac arrest, pointed out that short intervals before the start of CPR and defibrillation are the most important factors for a high survival rate.

In our study the lower outcome of overall survival contrasts with the relatively high effectiveness of first resuscitation (55% *vs*. 44% in the NRCRP study). The reason for this difference is unclear. One of the possible explanations is the specificity of internal medicine wards. Generally, the rate of survival after CA in general wards is not only lower than in cardiac care units, but is in fact lower compared to any other kind of ward. Some authors underline that the definite effectiveness of in-hospital CPR depends on not only quality and time of basic and advanced life support actions but on the identification of do-not-attempt resuscitation cases and on post-resuscitation care quality [9].

Interestingly, in contrast to out-of-hospital resuscitation, survival after in-hospital CA has not increased during the last 4 decades [3]. This could be explained by the increasing number of CPR in patients at the end stage of chronic diseases [9]. The increasing age of patients and progress in the management of chronic diseases mean that the number of resuscitation attempts is growing faster than the number of survivors. In fact, the sufferers of in-hospital CA differ from out-of-hospital sufferers. In our study one third of resuscitated patients had no cardiac cause of CA. Only half of the patients had ventricular fibrillation/ventricular tachycardia as a first documented pulseless rhythm. The low incidence of VF/VT among patients with in-hospital CA is a widely known phenomenon and probably the main reason for the lack of progress in patient management compared with out-of-hospital CA. In fact, automated external defibrillators located in public areas have significantly increased the rate of survival in the second instance [10]. The higher percentage of non-cardiac cause of CA and relatively rare tachyarrhythmic mechanism is especially typical for general wards [11]. The Skrifvars et al. study [12] showed that patients with documented clinically abnormal observations before CA have a worse outcome than those without, despite prompt resuscitation. It is important to identify these patients in time, thereby possibly avoiding the arrest.

There are some described determinants of survival of in-hospital CA. These include: age, rhythm, concurrent cardiopulmonary and non-cardiac diseases, hospital location, monitoring during the circulatory cessation, and time of CA [13–16]. In our study we showed the influence of male gender and tachyarrhythmic mechanism on overall survival. In the observations of Sandroni et al. [17], the survival of patients having cardiac arrest in non-monitored areas strongly depended on advanced life support. Prompt defibrillation by ward staff is the most important improvement necessary to increase cardiac arrest survival [17]. Sandroni et al. [18]

concluded that the prognostic value of age is controversial. Among comorbidities, sepsis, cancer, renal failure and homebound lifestyle are significantly associated with poor survival. Mild therapeutic hypothermia is effective as post-arrest treatment of out-of-hospital cardiac arrest due to VF/VT, but its benefit after in-hospital CA and after cardiac arrest with non-VF/VT rhythms has not been clearly demonstrated. Setting time guidelines for Advanced Cardiac Life Support (ACLS) has improved initiation of CPR, emergency team arrival, first defibrillation, and first medication administration. These time reductions have been accompanied by improved event survival and a statistically improved survival to discharge [13, 19].

The presented study is the only in-hospital resuscitation report we know with such a long follow-up. The presented percentage of 5-year and 10-year survival rates contrast with the statistically suspected length of survival in Polish 65-year-old men (14.5 years) and women (18.8 years) [20].

Previous observations proved that unwitnessed asystolic arrest has almost universal mortality in both in- and out-of-hospital CA; in such cases prolonged resuscitation should be avoided. Matot's et al. studies [13] showed that unwitnessed arrest is more prevalent during night shift, and resuscitation during this shift is associated with poorer outcome independently of witnessed status.

Compared with out-of-hospital cases, in-hospital cardiac arrests rarely have signs of sudden cardiac death and more often are the last step in chronic, irreversible, lethal disease. In cases of the end stage of chronic disease the problem of the possibility of resuscitation should be discussed with patients and their will concerning resuscitative attempts should be honoured. The patient's family and ward personnel should be informed in case of a "do not resuscitate" order [21].

In our study, non-cardiac cause of CA was a positive predictor of survival after the first 24 hours. In contrast, there was no statistically important difference between cardiac and non-cardiac patients according to survival to discharge. What is more, VF/VT mechanism connected with cardiac cause of CA was a predictor of survival to hospital discharge. The disproportion between the effectiveness of the first resuscitative attempt and poor longer prognosis should draw our attention to improving post-resuscitative care, not only in-hospital but also after discharge. The wider use of implantable cardioverter-defibrillators could improve the long-term prognosis in the group of survivors in danger of VF/VT [22].

Conclusions

In-hospital cardiac arrests are associated with high mortality during the resuscitative period, with a very high rate of mortality during hospitalization and unsuccessful late prognosis.

Non-cardiac cause of CA, relatively common in cases of in-hospital CA, is connected with better survival after the first 24 hours; however, it does not improve general survival to hospital discharge.

Acknowledgements

The authors do not report any conflict of interest regarding this work.

References

1. Peberdy MA, Kaye W, Ornato JP et al. Cardiopulmonary resuscitation of adults in the hospital: A report of 14720 cardiac arrests from the National Registry of Cardiopulmonary Resuscitation. Resuscitation, 2003; 58: 297–308.
2. Kalbag A, Kotyra Z, Richards M et al. Long-term survival and residual hazard after in-hospital cardiac arrest. Resuscitation, 2006; 68: 79–83.
3. Weil MH, Fries M. In-hospital cardiac arrest. Crit Care Med, 2005; 33: 2825–2830.
4. Gombotz H, Weh B, Mitterndorfer W, Rehak P. In-hospital cardiac resuscitation outside the ICU by nursing staff equipped with automated external defibrillators — the first 500 cases. Resuscitation, 2006; 70: 416–422.
5. Kinney KG, Boyd SY, Simpson DE. Guidelines for appropriate in-hospital emergency team time management: The Brooke Army Medical Center approach. Resuscitation, 2004; 60: 33–38.
6. Suraseranivongse S, Chawaruechai T, Saengsung P, Komoltri C. Outcome of cardiopulmonary resuscitation in a 2300-bed hospital in a developing country. Resuscitation, 2006; 71: 188–193.
7. Herlitz J, Aune S, Bång A et al. Very high survival among patients defibrillated at an early stage after in-hospital ventricular fibrillation on wards with and without monitoring facilities. Resuscitation, 2005; 66: 159–166.
8. Fredriksson M, Aune S, Thorén AB, Herlitz J. In-hospital cardiac arrest — an Utstein style report of seven years experience from the Sahlgrenska University Hospital. Resuscitation, 2006; 68: 351–358.
9. Perkins GD, Soar J. In hospital cardiac arrest: missing links in the chain of survival. Resuscitation, 2005; 66: 253–255.
10. Hallstrom A, Ornato JP, Weisfeldt M et al. Public-access defibrillation and survival after out-of-hospital cardiac arrest. N Engl J Med, 2004; 351: 637–646.
11. Herlitz J, Bang A, Aune S. Characteristics and outcome among patients suffering in-hospital cardiac arrest in monitored and non-monitories areas. Resuscitation, 2001; 48: 125–135.
12. 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: 215–222.

13. Matot I, Shleifer A, Hersch M. In-hospital cardiac arrest: Is outcome related to the time of arrest. Resuscitation, 2006; 71: 56–64.
14. Skrifvars MB, Castren M, Aune S et al. Variability in survival after in-hospital cardiac arrest depending on the hospital level of care. Resuscitation, 2007; 73: 73–81.
15. Treanor G, Spearpoint K, Brett S. Survival from in-hospital cardiac arrest: the potential impact of infection. Resuscitation, 2005; 64: 59–62.
16. Herlitz J, Bång A, Alsen B et al. Characteristics an outcome among patients suffering from in hospital cardiac arrest in relation to whether the arrest took place during office hours. Resuscitation, 2002; 53: 127–133.
17. Sandroni C, Ferro G, Santangelo S et al. In-hospital cardiac arrest: survival depends mainly on the effectiveness of the emergency response. Resuscitation, 2004; 62: 291–297.
18. Sandroni C, Nolan J, Cavallaro F, Antonelli M. In-hospital cardiac arrest: Incidence, prognosis and possible measures to improve survival. Intensive Care Med, 2007; 33: 237–245.
19. Herlitz J, Rundqvist S, Bang A et al. Is there a difference between women and men in characteristics and outcome after in hospital cardiac arrest? Resuscitation, 2001; 49: 15–23.
20. http://www.stat.gov.pl/cps/rde/xbcr/gus PUBL_trwanie_zycia_01_lifetables1995-2006.xls
21. Nadkarni VM, Larkin GL, Peberdy MA et al. National Registry of Cardiopulmonary Resuscitation Investigators: First documented rhythm and clinical outcome from in-hospital cardiac arrest among children and adults. JAMA, 2006; 295: 50–57.
22. Cohn AC, Wilson WM, Yan B, Joshi SB et al. Analysis of clinical outcomes following in-hospital adult cardiac arrest. Intern Med J, 2004; 34: 398–402.