Survival after in-hospital Cardiopulmonary Resuscitation

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ABSTRACT

Background: During recent years, cardiopulmonary resuscitation (CPR) in hospital has received much attention. However, the survival rate of CPR in Iran's hospitals is unknown. This study was designed to evaluate outcome of in-hospital CPR in Kashan.

Methods: A longitudinal case registry study was conducted on all cases of in-hospital CPR during 6 months at 2002. Necessary data including; age, sex, underlying disease, working shift, time from cardiac arrest until initiating of CPR and until defibrillation, duration and result of CPR, frequency of tracheal intubations and time served for it were collected in a checklist.

Results: In six months study, 206 cases of cardiopulmonary resuscitation attempted. The survival rate was similar for both sexes. Short-term survival observed in19.9% of cases and only 5.3% survived to discharge.

Conclusions: Duration of CPR, time of the first defibrillation, response time and the location of cardiac arrest are the key predictors of survival to hospital discharge and in-hospital CPR strategies require improvement. This study promotes a national study on post CPR survival for accurate data on our performance in attention to chain of survival.

KeyWords: Cardiopulmonary Resuscitation (CPR), Survival rate, Iran

Cardiopulmonary arrest is one of the most unfortunate incidents that can occur unexpectedly at any time or anywhere. It is responsible for the half of total mortalities [1, 2]. However, many cases could be saved by immediate cardiopulmonary resuscitation (CPR) [3-5]. Survival from cardiac arrest and the quality of post− resuscitation life depends on rapidly initiated CPR and advanced cardiac life support (ACLS). This has resulted in the chain of survival concept in out-of-hospital and in-hospital cardiac arrest [6-8].

The rate of successful CPR will increase dramatically when it is delivered within the first 4 minutes of arrest and ACLS within 8 minutes. The rate of survival would decline if either times is exceeded [6]. The survival rate following out-of-hospital resuscitation has improved upon 30 to 40 percents through decrease in response time, quick initiating of CPR, widespread CPR training, short distance to the site of arrest, and the skill of ACLS teams [6, 9]. However, the reported rate of survival after in-hospital CPR is lower than of out-of-hospital CPR [10-12].

For explaining this lower successful resuscitation in hospital, the relation between pre-arrest variables and survival after in-hospital CPR were studied [13-15]. These studies have reported poor prognosis of hospitalized patients because of critical circulatory, respiratory, neurological, and malignant disorders. Age, hypotension, azotemia, pneumonia and homebound life style were also demonstrated as independent predictors of mortality after in-hospital CPR [9, 16]. Others also attributed the low successful rate of in-hospital CPR to the factors such as poor knowledge and skill of health care providers, and lack of the formal life support training of them [2, 4, 9, 17, 18]. However there is no published work from Iran to confirm or refuse these reports. The majority of studies are from United State and the Europe where outcome of CPR may be affected by different medical practices. For example, the provision of intensive care services for management of patients after cardiac

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arrest is better in USA, and the health care providers may have a grater knowledge and skill of basic and advanced life support. Considering difference between reported studies, variety of influencing factors and lake of information about success rate of in-hospital CPR in Iran, this study was conducted to determine some peri-arrest variables and survival following in-hospital CPR in kashan hospitals during six months at 2002.

Subjects and Methods

A longitudinal case registry study was conducted on all patients have received CPR for the first six months of year 2002 in 4 educational hospitals in Kashan, Iran. The researcher, head nurse or nurse presented during each CPR completed primary checklist for type of ward, age, sex, working shift, underlying cause of cardiac arrest, time served from cardiac arrest to CPR initiation (response time) and to the first defibrillation, the outcome and duration of CPR, the presence or absence of defibrillator at the time of arrest, the lost time for preparing defibrillator or tracheal intubation, the number of tubing trial and the time served for it.

Cardiopulmonary arrest was defined as the absence of detectable pulse, arrest rhythms noticed on monitors, or by the absence of spontaneous respiration and the patient's unresponsiveness (unconciousness).

The patients were already undergoing CPR on arrival at hospital or with only respiratory arrest were excluded.

The outcome of resuscitation was recorded as unsuccessful (death of patient), short-term survival (return of heart rhythm with or without respiration for 2-24 hours) and survival to hospital discharge.

Each patient was considered only one time. For patient suffered multiple cardiac arrests, only the initial in-hospital CPR was recorded for avoiding falsely elevating rate of successful CPR, or falsely diminishing rate of survival to hospital discharge.

Statistical analysis was performed using SPSS Version 9. Chi-square test was used to evaluate the effects of time to initiation of CPR, working shift, etiology (cardiac or non cardiac) and gender on survival. The effects of age, the duration of CPR, the type of ward on survival were analyzed by Kruskal-Wallis test. ANOVA test was used to evaluate the effects of time served for the initiation of CPR, the time between cardiac arrest and the first defibrillation on survival. This test was also evaluated the effect of working shift on the time served for initiation of CPR. Logistic regression was also used to identify significant predictors of survival. A value of P≤0.05 was considered statistically significant. The ethics committee of Kashan University of Medical Sciences gave permission for the study.

Results

A total of 206 cases of CPR were attempted during 6 months. No DNR (Do Not Resuscitate) ordered during the study. The study population consisted of 122 males (59.2%) and 84 females (40.8%) ranging in age from 2 to 90 years with a mean age of 53.87±22.3 years.

The survival rates were similar for both sexes. From the total of CPR cases, 154 cases (74.8%) were unsuccessful, 41 cases (19.9%) resulted in short-term survival, and only 11 cases (5.3 %) survived to hospital discharge.

Few patients were under the age 20 (11.7%) and 46.6 % were 61 years and over. The survival rate to hospital discharge was 16.7 % for the age under 20 while this rate was only 1.1% for the age 61 and over (Table 1).

Table 1. The distribution of CPR cases according to the result and the age of patients

Age \ Result	Total	Unsuccessfuln (%)	Survival to dischargen (%)	Short-term survivaln (%)
20 and lower	24 (100)	15 (62.5)	4 (16.7)	5 (20.8)
21- 40	26 (100)	20 (76.9)	3 (11.5)	3 (11.5)
41- 60	60 (100)	46 (76.7)	3 (5)	11 (18.3)
61 and over	96 (100)	73 (76)	1 (1.1)	22 (22.9)
Total	206 (100)	154 (74.8)	11 (5.3)	41 (19.9)
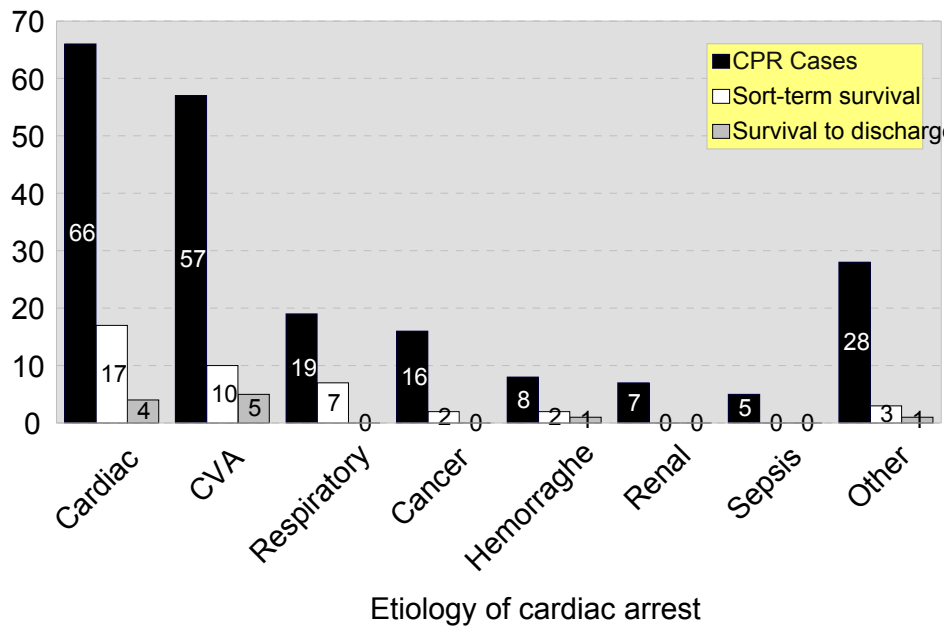
Graph 1. The distribution of CPR cases according to the outcome and etiology of cardiac arrest.
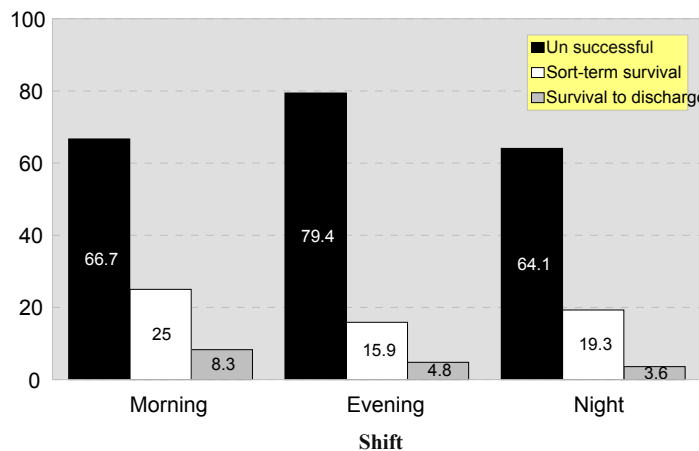
Graph 2. The distribution of CPR cases according to the outcome and the shift

Summarizes underlying causes of cardiac arrest. Most of patients whom undergone CPR, had a cardiac etiology.

From the total cases of CPR, 29.1% were performed during morning shift, 30.6 % during evening shift and 40.3% during night shifts. However, the survival rate to discharge was nearly 2 times at the morning (Graph 2).

The mean response time was 2.98±3.78 minutes (range 1-35 min). In all cases of CPR, in the morning shift CPR initiated at 1-6 minutes after cardiac arrest. This proportion was 92% for evening and 89% for night shifts. In the other word, the response time for 8-11% of all CPR cases was 7-35 minutes. All patients surviving to discharge and 97.5% of cases with short-term survival showed a response time of 1-6 minutes. In 81.8% of the patients who survived to hospital discharge, resuscitation was performed within the first 3 minutes of arrest.

From all CPR cases, 47.6% were attempted in coronary or intensive care units, 25.2% in emergency units, 21.4% in medical, infectious or pediatrics units and 5.8% in operating rooms or surgical wards. The rates of survival to hospital discharge were 6.1%, 7.7%, 0%, and 8.3% in these units, respectively (Table 2).

Defibrillator was used in 63.5% of all CPR cases. It was available at the initiation of CPR in 122 cases (59.2%). It also requested by call in 32 cases. However, it last 11.09±6.76 minutes for transferring and preparing the apparatus, when it was not already presented.

The mean interval from initiation of CPR to using the first DC shock was 10,41±7.85 minutes. However, a delay was noted in its usage so that only in 28.2% of cases whom DC shock were used, the first shock was performed in the first 2-6 minutes. In 10,7% of all cases of defibrillation, DC shock was used with a delay ranging 16-60 minutes. However, 8 of 11 patients (72.7%) who survived to hospital discharge, belonged to those

whom were defibrillated in less than 9 minutes and no one survived to discharge if the delay exceeded 16 minutes.

DC shocks were used mostly in the intensive care and emergency units so that 82.4% of patients whom DC shock was used, belonged to these units.

The mean CPR duration was 40.16±32.98 minutes. Sixteen percent of the resuscitation attempts lasted for less than 30 minutes and 39.3% lasted for 31-60 minutes. However, 81.8% of patients who survived to hospital discharge belonged to the cases lasted for 30 minutes or less. No patients survived to discharge for CPR lasting more than 60 minutes (Table 3).

Tracheal intubation was done for 138 patients (67%) and in 64.5% of them, intubation were done within 1-2 trials, 29% within 3-4 trials and 6.5% within 5-6 trials. The mean time for tracheal intubation was 2.47± 3.07 minutes (range from 0.5 to 15 min).

Table 2: The distribution of resuscitation cases according to the type of ward and results of CPR

Result / Ward	Survival to discharge n (%)	Short-term survival n (%)	Unsuccessful n (%)	Total n (%)
Emergency	4 (7.7)	5 (9.6)	43 (82.7)	52 (100)
Medical	0	8 (18.2)	36 (81.8)	44 (100)
ICU, CCU	6 (6.1)	26 (26.5)	66 (67.3)	98 (100)
Surgery & OR	1 (8.3)	2 (16.2)	9 (75.0)	12 (100)
Total	11 (5.3)	41 (19.9)	154 (74.8)	206 (100)

Table 3: The distribution of cases according to the result and duration of CPR

Result / Duration (min.)	Unsuccessful n (%)	Shorterm success N (%)	Survival to discharge n (%)	Total n (%)
3-15	10 (25)	24 (60)	6 (15)	40 (100)
16-30	51 (78.5)	11 (16.9)	3 (4.3)	65 (100)
31-60	73 (90.1)	6 (7.4)	2 (2.5)	81 (100)
61 & over	20 (100)	0	0	20 (100)
Total	154 (74.8)	41 (19.9)	11 (5.3)	206 (100)

Discussion

Our findings are warning. A small number of patients survived after cardiac arrest. The overall rate of survival to hospital discharge was 5.3% for in-hospital CPR. Though the overall survival rates have been low in many studies, but our finding contrasts with other studies who reported long-term survival rates of 13.4% to 32.2% [16, 19-20].

This wide difference could be related to the different definition of long and short-term survival and also to the types of patients being involved.

In the present study, cardiac diseases were the most frequent underlying causes of cardiac arrest. The survival to hospital discharge was higher in the patients with hemorrhage. However, no patients survived to hospital discharge in the group of cancer, renal or respiratory diseases and sepsis.

These findings are in accordance with other observations[13, 25-27].

The most patients who survived to hospital discharge were younger than 20 years and this may suggest better survival in lower age. The survival rate doesn't differ between age groups by using

Kruskal-Wallis test (P = 0.124), but Chi-squared test shows difference in outcome between age lower and over 60 years, significantly (P = 0.029). The association between age and adverse outcomes following in-hospital CPR is controversial. Some authors have found that the age over 70 is associated with failure to survive to discharge[16, 28] Others have reported no difference between the ages above and lower 70 and the outcome of CPR[29]. Because age is not a good indicator for physiologic and functional status among the elderly, it may be a weak predictor of the outcome of in-hospital CPR.

The present study showed a higher survival to hospital discharge for the patients who resuscitated in the morning shifts than evening or night shifts. Although there was no significant relationship between the outcome of CPR and shift, however the response times were significantly related to different shifts (P = 0.016). There was also a significant relationship between the result of CPR and response time (P = 0.009). Also short-term survival and survival to hospital discharge were not associated with the location of cardiac arrest

significantly, but the location was significantly associated with response time (P=0.001).

So the better outcome in morning shift may be a reflection of shorter response time in this shift. This may be a good reason for the better outcome in some wards like CCU, ICU and operating room. Several retrospective studies have also shown that CPR performed during the day results in more survivors than other times [4, 30, 31]. It seems that factors such as early detection of cardiac arrest due to the presence of medical and nursing staff at the patients' side, quick access to physicians and skilled staff in morning and also in some special units have caused this difference.

According to our data, early defibrillation plays an important role in reducing cardiac arrest deaths (P = 0.000). The time to defibrillation is one of the most important factors affecting survival after cardiac arrest [7, 32-34] Rarely, a patient survived if defibrillation was not used within the first 8 minutes of cardiac arrest [35], however, it was used with a delay of more than 10 minutes for half of patients in the study. It seems that the first valuable minutes usually wasted for transferring and preparing defibrillator for the general wards. Moreover, it appears that the first minutes usually are lost for tracheal tube insertion and intubation's difficulties due to insufficient skill[2].

So, Late initiation of CPR and lost time for intubation usually cause a delay of more than 6 minutes for assisted respiration and cardiac compression and the golden time for CPR is expired. This problem may be related to the ABC method of education for CPR. While new researches show that the oxygen available in blood stream is sufficient for the brain even in 10-15 minutes after the cardiopulmonary arrest so the American Heart Association recommends education for CPR to be in the form of CAB instead of ABC [34].

The outcome of CPR was related to CPR duration, significantly (P = 0.000). No patients survived to discharge for CPR lasting more than 60 minutes. This finding have supported by So HY, who reported that the patients resuscitated within 15 minutes have a better outcome, whereas those resuscitated for longer than 30 minutes usually die in ICU[4].

Regression analysis indicated that CPR duration (P= 0.000), time served to the first

defibrillation (P= 0.000), response time (P= 0.000) and the location of cardiac arrest (ward)

(P= 0.001) could predict survival to hospital discharge (Table 4).

Table 4: Predictors of survival to hospital discharge

Parameter	B	SE	95% confidence interval		Exp (B)	p-value
			Lower	Upper		
CPR Duration	-0.103	0.016	0.874	0.932	0.902	0.000
Time of the first DC shock	-.232	0.057	0.709	0.886	0.793	0.000
Response time	-0.613	0.17	0.388	0.756	0.542	0.000
Ward	0.269	0.080	1.120	1.530	1.308	0.001
Constant	5.995					0.001

In conclusion, our study was the first analysis of in-hospital CPR in our region that points out the need for improvements in CPR management strategies and basic and advanced life support training programs. However, our results could not be generalized to all hospitals in Iran, because of short duration and limited cases of study. Additional researches will provide a pool of accumulated data related to factors affecting survival after in-hospital CPR and would help us for better management of after in-hospital CPR.

Refrences

1. Guidelines for Cardiopulmonary resuscitation and emergency cardiac care. JAMA 1992; 268(16): 2171-83.
2. Adib Hajbagheri M, Afazel MR, Mousavi SGA. Evaluation of knowledge and skills of medical personnel of Kashan's hospitals regarding cardiopulmonary resuscitation. FEYZ (journal of Kashan University of Medical Sciences) 2001; 19(5): 103-96.
3. Moule P; Knight C. Emergency, cardiac arrest! Can we teach the skills? Nurse Education Today 1997; 17(2): 99-105.
4. So HY, Buckley TA, Oh TE. Factors Affecting Outcome Following Cardiopulmonary Resuscitation. Retrieved 2004 http://www.fsm.ac.fj/sms/anaesthesia/WFSAnew/html/reviews/ Review11-Factors Affecting Outcome Following Cardiopulmonary Resuscitation.htm
5. Timerman A, Sauaia N, Piegas LS, et al. Prognostic Factors of the Results of Cardiopulmonary Resuscitation in a Cardiology Hospital. Arq Bras Cardiol 2001; 77(2): 142-60 http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0066-782X2001000800006&lng= pt&nrm=iso
6. Bachman JW, McDonald GS, O'Brien PC. A study of out-of-hospital cardiac arrest in Northeastern Minnesota. JAMA 1986; 256(4): 477-83.
7. Jennings P, Pasco J. Survival from out-of-hospital cardiac arrest in the Geelong region of Victoria, Australia. Emergency Medicine 2001; 13(3): 319-25.
8. Skrifvars MB, Castrén M, Kurola J, Rosenberg PH. In-hospital cardiopulmonary resuscitation: organization, management and training in hospitals of different levels of care. Acta Anaesthesiologica Scandinavica 2002, 46 (4):458 -65.
9. Lowenstein SR, Sabyan EM, Lassen CF, Kern DC. Benefits of training physicians in advanced cardiac life support. Chest 1986; 89(4): 512-6.
10. Weston C, Jones S, Wilson R. Outcome of out-of-hospital cardio-respiratory arrest in South Glamorgan. Resuscitation 1997; 34(3): 227-33.
11.Fischer M, Fischer N, Schuttler J. One-year survival after out-of-hospital cardiac arrest in Bonn city: Outcome report according to the 'Utstein style'. Resuscitation 1997; 33(3): 233-43.
12. Graves JR, Herlitz J, Bang A, et al. Survivors of out of hospital cardiac arrest: Their prognosis, longevity and functional status. Resuscitation 1997; 35(2): 117-21.
13. Bedell SE, Delbanco TL, Cook EF, Epstein FH.Survival after cardiopulmonary resuscitation in the hospital. N Engl J Med 1983; 309(10): 569-75.
14. Arena FP, Perlin M, Turner AD.Initial experience with a "code-no code" resuscitation system in cancer patients. Crit Care Med. 1980; 8(12): 733-5.

15. *Ebell MH, Neale AV, Hodgkins BA.An expert system for the calculation of sample size. Fam Pract Res J.1994 14:183-95.*

16. *Ebell MH, Becker LA, Barry HC, Hagen M. Survival After In-Hospital Cardiopulmonary Resuscitation A Meta-Analysis.* Journal of General Internal Medicine 1998; *13(12): 805-16.*

17. *Lowenstein SR, Libby L, Mountain RD, Hansbrough JF, Hill DM, Scoggin CH. Cardiopulmonary resuscitation by medical and surgical house officers. Lancet 1981; 262(8248): 679-81.*

18. *Skinner DV, Camm AJ, Miles S. Cardiopulmonary resuscitation skills of pre-registration house officers. Br Med J 1985; 25; 290(6481): 1549-50.*

19. *Takeda Y, Mifune J, Taga K, et al. Survival after sudden cardiac arrest in hospital. JPN Heart j 1989; 30(5): 645-53.*

20. *Marwick TH, Case CC, Siskind V, Woodhouse SP. Prediction of survival from resuscitation: A prognostic index derived from multivariate logistic model analysis. Resuscitation 1991; 22 (2): 129-37.*

21. *Tortolani AJ, Risucci DA, Rosati RJ, Dixon R. In-hospital cardiopulmonary resuscitation: patient and resuscitation factors associated with survival. Resuscitation 1990; 20(2): 115-28.*

22. *Kuhnigk H, Sefrin P, Paulus T. Skills and self-assessment in cardio-pulmonary resuscitation of the hospital nursing staff.Eur J Emerg Med. 1994; 1(4): 193-8.*

23. *Hayward M. Cardiopulmonary resuscitation: are practitioners being realistic? Br. J. Nurs. 1999; 8(12): 810-4.*

24. *Zoch TW, Desbiens NA, DeStefano F, Stueland DT, Layde PM. Short and long-term survival after cardiopulmonary resuscitation. Arch Intern Med 2000; 160(13): 1969-73.*

25. *Peatfield RC, Sillett RW, Taylor D, McNichol MW. Survival after cardiac arrest in hospital. Lancet 1977; 11; 1(8024): 1223-5.*

26. *Woog RH, Torzillo PJ. In-hospital cardiopulmonary resuscitation: prospective survey of management and outcome. Anaesth Intens Care 1987; 15(2): 193-8.*

27. *Rosenbaum EA, Shenkman L. Predicting outcome of in-hospital cardiopulmonary resuscitation. Crit Care Med 1988; 16(6): 583-6.*

28. *Ebell MH. Pre-arrest predictors of survival following in-hospital cardiopulmonary resuscitation: a meta-analysis. J Fam Pract 1992; 34 (5): 551-8.*

29. *Sivertssen E, Rokvam AS, Oimoen SB, Stokland O, Skulberg A. Cardiopulmonary resuscitation attempts at Ulleval hospital during January 1989-July 1990. Tidsskr Nor Laegeforen. 1991; 10; 111(24): 2940-2.*

30. *Hershey CO, Fisher L. Why outcome of cardiopulmonary resuscitation in general wards is poor. Lancet 1982; 2; 1(8262): 31-4*

31. *Scott RP. Cardiopulmonary resuscitation in a teaching hospital, A survey of cardiac arrests occurring outside intensive care units and emergency rooms. Anaesthesia 1981; 36(5): 526-30.*

32. *Holmberg M, Holmberg S, Herlitz J, Gardelov B. Survival after cardiac arrest outside hospital in Sweden. Swedish Cardiac Arrest Registry. Resuscitation 1998; 36(1): 29-36.*

33. *Bernard S. Outcome from pre-hospital cardiac arrest in Melbourne, Australia. Emerg Med 1998; 10: 25-9.*

34. *Weinberg A, Paturas J. EASY ACLS. Boston johns & bartlet, 1995.*

35. *Braunwald U. Cardiovascular diseases. In: Harrison's principles of internal medicine. McGraw-Hill 2001.*