

Initial rhythm and outcome of in-hospital adult cardiac arrest in a tertiary care hospital

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Abstract

Introduction: Successful cardiopulmonary resuscitation after in-hospital cardiac arrest depends on basic and advanced life support systems, the ability to immediately defibrillate the arrested heart, and the quality of the CPR intervention. **Aim:** To determine the frequency of different cardiac arrest rhythms during the cardiac arrest event and also their effect on outcome. **Methodology:** This was a prospective study conducted in patients who sustained cardiac arrest in a tertiary hospital over 20 months. Tools used to collect data were Modified Utstein style Format for standard reporting of In-hospital cardiopulmonary resuscitation and Modified Early Warning Score chart. **Results:** There were a total of 1135 patients in the Pre MEWS group and there were 820 patients in the Post MEWS group. A total of 279 (14.27%) patients sustained VF/VT, 570 (29.15%) had pulseless electrical activity and 1106 (56.57%) had asystole. Survival to hospital discharge was significantly higher with VF/VT (18.27%) as compared to asystole (7.14%) and PEA (11.75%). There was no difference in the frequency of any cardiac arrest rhythm in various age groups, gender or degree of illness (APACHE II score). Furthermore, the cerebral performance category was significantly better if the initial rhythm was VF/VT. Survival to hospital discharge was higher if the initial rhythm was VF/VT (18.2%) as compared to asystole (7.14%) and pulseless electrical activity (11.75%). In the Pre MEWS period, 8.5% of the patients sustained VF/VT as compared to 23.7% sustaining VF/VT in the Post MEWS period. **Conclusion:** First monitored rhythm as VF/VT has significant association with the survival. Modified early warning score helps the nurses and the physicians to identify patients at risk of In-hospital adult cardiac arrest and this improves the survival of the patients.

Keywords: Asystole, cardiac arrest, ventricular fibrillation, ventricular tachycardia

Introduction

Cardiopulmonary resuscitation (CPR) was first described in 1960.¹ The most common form of nontraumatic cardiac arrests in adults is said to be due to ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT), both of which are associated with better outcomes than asystole or pulseless electrical activity (PEA). Cardiopulmonary resuscitation is a frequently performed medical

intervention in healthcare facilities. Successful cardiopulmonary resuscitation after in-hospital cardiac arrest depends on basic and advanced life support systems, the ability to immediately defibrillate the arrested heart, and the quality of the CPR intervention.¹

Aim of this study was to determine the frequency of different rhythms seen initially during the cardiac arrest event and also their influence on the survival of patients.

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Methodology

This was a prospective study conducted in patients who sustained cardiac arrest in a tertiary hospital over a period of 20 months. Institutional review

How to cite this article: Johnson S, Nileshwar A. Initial rhythm and outcome of in-hospital adult cardiac arrest in a tertiary care hospital. *Ind J Res Care* 2014; 3(1):421-5.

board approval and ethical clearance was obtained before the start of the study.

All adult patients (age >18 years) who sustained In-hospital cardiac arrest were included. Cardiac arrests occurring in operation theatre and patients brought dead to the hospital were excluded. The code blue team from ICU 1 responds to all cardiac arrests excluding those that occur in the operation theatres. Code blue calls are activated using a telephone number 24444 in the hospital. This team consisted of an anaesthesiologist, a Respiratory therapist and a critical care nurse, each of whom is trained in advanced cardiac life support (ACLS).

The following parameters were recorded: Demographic data, prearrest morbidity (using Acute Physiology and Chronic Health Evaluation - APACHE II score), date and time of cardiac arrest, initial rhythm, treatment given, whether resuscitation was successful or not, time to return of spontaneous circulation, duration of hospital stay, survival to hospital discharge, condition at discharge and cerebral performance category (CPC) 1-4. The CPC was recorded as follows:²

CPC 1: Good cerebral performance: conscious, alert, able to work, might have mild neurologic or psychologic deficit.

CPC 2: Moderate cerebral disability: conscious, sufficient cerebral function for independent activities of daily life. Able to work in sheltered environment.

CPC 3: Severe cerebral disability: conscious, dependent on others for daily support because of impaired brain function. It ranges from ambulatory state to severe dementia or paralysis.

CPC 4: Coma or vegetative state: any degree of coma without the presence of all brain death criteria. Unawareness, even if appears awake (vegetative state) without interaction with environment; may have spontaneous eye opening and sleep/awake cycles. Cerebral unresponsiveness.

In the last eight months of the study, the hospital had introduced the use of Modified Early Warning

Score (MEWS). MEWS score required that in the sicker patients, the vital parameters such as blood pressure, heart rate, respiratory rate, level of consciousness and pulse oximetry were recorded regularly and scored based on a scale provided. When the total score exceeded 4, the nurse was required to call in the duty doctor to attend to the patient and make any corrective changes. This was done to enable early identification of pre-arrest and peri-arrest scenarios so that cardiac arrest could be averted or managed immediately. The period before introduction of MEWS score was designated Pre-MEWS and the period after its introduction Post-MEWS. We attempted to evaluate the influence of introduction of MEWS score to the initial rhythm in cardiac arrest as well as outcome of CPR.

Statistical analysis was performed using statistical software SPSS Version 16.0. Values were expressed in Mean \pm SD or n (%). Most variables were categorical and were tested using chi square test. Continuous variable (APACHE II) was tested using Paired student *t* test. P value of 0.05 was considered significant.

Results

This was a prospective observational study conducted over a period of 20 months. A total of 1,18,968 in-patients were admitted to this tertiary care hospital in South India out of whom 1955 patients sustained cardiac arrest, giving an incidence of 16.4 per every 1000 admissions.

The mean (\pm SD) age of the patients was 53.1 (\pm 17.05) years with a range was 18-97 years. Of these, 1327 (67.88%) were males and 628 (32.12%) were females. The mean (\pm SD) APACHE II score was 21.51 ± 6.94 with a range 4- 51. The overall rate of resuscitation with ROSC was 21.9%.

The patients were divided into three different age groups (18-39 years, 40-59 years and \geq 60 years) to look for any influence of age on survival. Similarly, the data was analysed to look for differences in outcome of cardiac arrest with gender, degree of sickness using APACHE II score and the use of MEWS score. While the age, gender and APACHE II score were found to have no effect, patients

sustaining cardiac arrest in the postMEWS period had a significantly higher survival rate (*Table 1*).

Table 1: Demographic data

Parameter	All cases (n = 1955)	Survived (n = 197)	Died (n = 1758)	P value
Age (y) n (%)				
18 – 39	423 (21.6)	46 (10.9)	377 (89.1)	0.824
40 – 59	797 (40.8)	78 (9.7)	719 (90.2)	
≥ 60	735 (37.6)	73 (10)	662 (90.0)	
Gender n (%)				
Male	1327 (67.88)	127 (9.5)	1200 (90.4)	0.28
Female	628 (32.12)	70 (11.1)	558 (88.8)	
APACHE II n (%)				
< 20	775 (39.64)	83 (10.7)	692 (89.3)	0.451
≥ 20	1180 (60.35)	114 (9.7)	1066 (90.3)	
Pre MEWS n (%)	1135 (58.05)	59 (5.2)	1076 (94.8)	0.000
Post MEWS n (%)	820 (41.95)	138 (16.8)	682 (83.2)	

A total of 279 (14.27%) patients sustained VF/VT, 570 (29.15%) had pulseless electrical activity and 1106 (56.57%) had asystole (*Figure 1*).

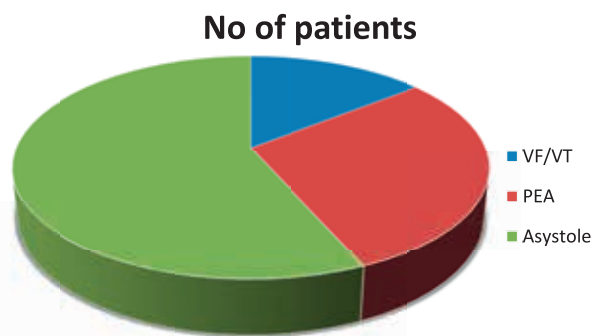


Figure 1: Frequency of initial rhythms of cardiac arrest

The data was analysed to look for relationship between the demographic data and any particular type of cardiac arrest rhythm (*Table 2*). There was no difference in the frequency of any cardiac arrest rhythm in various age groups, gender or degree of illness (APACHE II score). However, there was a highly significant increase in the number of patients presenting with VF/VT in the post-MEWS period as compared to PreMEWS period.

Table 2: Demographic data and the initial rhythm

Parameter	VF/VT (n = 279)	Asystole (n = 1106)	PEA (n = 570)	P value
Age (y) n (%)				
18 – 39	60 (14.2)	220 (52.0)	143 (33.8)	0.112
40 – 59	111(13.9)	453(56.8)	233 (29.2)	
≥ 60	108 (14.7)	433 (58.9)	194 (26.4)	
Gender n (%)				
Male	189 (14.2)	705(53.2)	433 (32.6)	0.000
Female	90 (14.4)	401 (63.8)	137 (21.8)	
APACHE II (mean±SD)	21.23 ± 7.82	21.43 ± 6.74	21.73 ± 6.85	0.350
PreMEWS n (%)	97 (8.5)	754 (66.4)	284 (25.0)	0.000
PostMEWS n (%)	194 (23.7)	306 (37.3)	320 (39.0)	

When outcome data was correlated with the initial rhythm, the proportion of cardiac arrest victims having any return of spontaneous circulation, sustaining it for > 24 h and surviving to hospital discharge was significantly higher if the initial rhythm was VF/VT. Furthermore, the cerebral performance category was significantly better if the initial rhythm was VF/VT (*Table 3*).

Table 3: Initial rhythm and outcome

Parameter	All cases (n = 1955)	VF/VT (n = 279)	Asystole (n = 1106)	PEA (n = 570)	P value
ROSC n (%)	430 (22%)	99 (35.48%)	162 (14.64%)	169 (29.64%)	0.0001
Duration of ROSC					
< 20 min	104	10 (3.58)	32 (2.8)	62 (10.8)	0.0001
20 min – 24 h	116	30 (10.7)	48 (4.3)	38 (6.67)	
>24 h	210	59 (21.1)	82 (7.4)	69 (12.1)	
Survival to discharge n (%)	197 (10.1%)	51 (18.27%)	79 (7.14%)	67 (11.75%)	0.0001
CPC at discharge (categories)					
1	101	43 (15.4)	29 (2.6)	29 (5)	0.0000
2	60	4 (1.4)	25 (2.2)	31 (5.4)	
3	14	2 (0.7)	9 (0.8)	3 (0.5)	
4	22	2 (0.7)	16 (1.4)	4 (0.7)	

Discussion

In the present study, 14.27% of the patients sustained VF/VT and 85.72% had either asystole or PEA (29.15% - PEA and 56.57% - asystole). Our

result is comparable to the results of Saket Girotra *et al*³ In their study comprising 84,625 hospitalised patients with cardiac arrest, 20.7% had ventricular fibrillation or pulseless ventricular tachycardia and 79.3% had asystole or pulseless electrical activity as the initial rhythm. Meaney PA and colleagues reported similar numbers in their study of 51,919 indexed cardiac arrests, first documented pulseless rhythm was VF/VT in 24% [VT in 3810 (7%), and VF in 8718 (17%)], pulseless electrical activity (PEA) in 19,262 (37%) and asystole 20,129 (39%).⁴ Our study did not show any association between age and gender with rhythm and outcome. Brindley *et al* had similar results.⁵

Survival to discharge was 10 % in the present study (197 of 1955 patients). Reported survival to hospital discharge varies from 0% to 42%, the most common range being between 15% and 20%.⁶ Saket Girotra *et al* reported the overall rate of survival to discharge of 17.0%. We compared the survival rate in patients presenting with VF/VT, asystole or PEA as the initial rhythm and found that rate of 'survival to hospital discharge' was better when the first documented rhythm was VF/VT (P <0.0001). Survival to hospital discharge was better in PEA (11.75%) than asystole (7.14%).

Nadkarni VM and colleagues reported that the rate of survival to hospital discharge following pulseless cardiac arrest was higher in children than adults (27% [236/880] vs 18% [6485/36,902]).⁷ Survival to hospital discharge was substantially more likely when the first documented rhythm was shockable rather than nonshockable, and slightly more likely after PEA than asystole. Survival to hospital discharge was less likely following PEA/asystole with subsequent VT/VF compared to PEA/asystole without subsequent VT/VF.

There was no statistically significant association found between APACHE II score and rhythm. Muhammad Junaid Patel *et al* identified the following five factors as independent predictors of survival in their patients. APACHE II score less than 20 (adjusted odd ratio: 4.64, 95% CI: 2.38-9.04), and APACHE score between 20 to 24 (adjusted odd ratio: 2.50, 95% CI: 1.26-4.95) as compared to greater than

24 APACHE scores.⁸ Controversies exist with the utility of APACHE II scores in predicting survival/mortality.⁹

In the present study, the overall rate of ROSC was 22% and 10% survived to hospital discharge. The rate of ROSC, its duration (< 20 min, 20 min to 24 hours and > 24 hours) and survival to discharge were correlated with the initial rhythm. There was a statistically significant association between rhythm and ROSC (P= 0.0001). with VF/VT associated with better outcomes than the rest. ROSC was seen after VF/VT in 35.48 % of the patients and 21.1% of these patients had ROSC for > 24 hours. The survival to hospital discharge was higher in the patients who had initial rhythm as VF/VT (18.27 %) whereas asystole had 7.14 % and PEA had only 11.75 % and this was statistically significant. Zubek *et al* reported that despite the fact that a primary arrhythmia was one of the precipitating events in nearly one half of adult cardiac arrests, ventricular fibrillation (VF) was the initial pulseless rhythm in only 16% of in-hospital cardiac arrest victims. ROSC occurred in 58% of VF cases, yielding a survival-to-hospital discharge rate of 34% in this subset of patients.⁹ Peberdy MA *et al* reported overall, 44% of adult in-hospital cardiac arrest victims had ROSC and 17% survived to hospital discharge.¹⁰

There was an increase in the number of patients who had VF/VT after the introduction of MEWS in the present study (8.5% vs 23.7%). Survival to hospital discharge was better and statistically significant after the introduction of MEWS (5.2% vs 16.8%). In the present study there was a reduction of 16 % in the in-hospital cardiac arrest (IHCA) and significant reduction of 11.6 % in the death following cardiac arrest after the introduction of MEWS. Early involvement of the MEWS may reduce cardiac arrests, deaths and subsequently will improve the survival for patients admitted in the High Dependency Units and wards as well as Intensive Care Units. This may be because there is early detection of the worsening of vital signs and an impending cardiac arrest and the help arrives early which may prevent cardiac arrest in these patients.

In a trial conducted before and after the introduction of an intensive-care based medical emergency team (MET), Bellomo *et al* observed a significant reduction in the incidence of IHCA (relative risk reduction 65%), death following cardiac arrest (56%) and overall in-hospital mortality (88%).¹¹ Buist *et al* demonstrated a significant reduction in the incidence of unexpected cardiac arrest (from 3.77 to 2.05 per 1,000 hospital admissions) and mortality (from 77% to 55%).¹²

Cerebral Performance Category is divided into 4 categories, 1-4.² In the present study the CPC at discharge was analysed to see the association with rhythm. 15.4% of patients who had VF/VT as the first documented rhythm were in the CPC category 1, which shows that the patients are conscious and alert with good cerebral performance; able to work and lead a normal life, may have minor neurological deficits. This is statistically significant and clinically relevant. The patients in cardiac arrest who had the first documented rhythm as VF/VT and attended by the medical personnel early will have a better outcome when compared to asystole or PEA. Saket Girotra *et al* reported 50.8 % patients in CPC 1 in the year 2000–2003, 49.5 % in the year 2004–2006 and 54.2 in the year 2007–2009.³

Conclusion

Ventricular fibrillation or ventricular tachycardia (shockable rhythms) as the first documented rhythm has a significantly better outcome with higher rates of ROSC, longer duration of ROSC, better survival to hospital discharge and better cerebral performance category after discharge after sustaining in-hospital cardiac arrest. The use of MEWS permits earlier detection of impending cardiac arrests, is associated with higher rates of VF/VT as the initial rhythm and better survival rates. MEWS should be widely used among patients admitted in the High Dependency Units and wards of the hospital so that patients at risk of cardiac arrest are identified and treated early.

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