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Assessment of CPR for Patients Upshot and their Predictors: A Code Blue Team Approach

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Abstract
Despite important advances, sudden cardiac arrest continues to be a leading cause of death worldwide. Research on resuscitation has considerably increased; guidelines for cardiac resuscitation have been implemented on an international level and have undergone substantial changes. The cardiac arrest team popularly known code blue team for in- hospital resuscitation has become a standard for many medical centres worldwide. Despite this, the reported survival rates vary significantly with the centre, patients, and event characteristics. It is essential that cardio pulmonary arrest to be recognized immediately and CPR started without delay to prevent adverse outcomes. Keeping all these facts in mind we planned a study on patients with cardiac arrest that would provide us predictors of favourable outcomes in patients in our institute and an insight into our healthcare system.

Keywords: Cardiac arrest, CPR, code blue team, Glasgow outcome scale

Introduction
Sudden cardiac arrest is a leading cause of death worldwide [1]. It has various etiologies (cardiac/ non cardiac), circumstances (witnessed/ unwitnessed) and settings (out of hospital or in hospital). This heterogeneity necessitates a core set of coordinated actions to provide a universal strategy for successful resuscitation [2]. Cardiac arrest occurs both in and out of the hospital. In the US and Canada approximately 350,000 people per year (approximately half of them in hospital) with a cardiac arrest and receive attempted resuscitation [3-7]. One in five of every 1000 in hospital patients are estimated with cardiac arrest and less than 20% of such patients survive to discharge in developed countries [8]. Survival rates from cardiac arrest remain poor (ranging from 6% to 19%) despite the development of both cardiopulmonary resuscitation (CPR) and electrical defibrillation as treatment modalities over the past 50 years [9, 10].

Hospitals all over the world have thus setup CPR teams, popularly termed code blue teams. The goal of this team is to support and to restore effective oxygenation, ventilation and circulation (return of spontaneous circulation- ROSC) with return of intact neurological function [11]. The outcome of cardiac arrest and CPR is dependent on critical interventions, particularly early defibrillation, effective chest compression and assisted ventilation. If patients outcome are to improve, an evaluation of the contribution of all potential risk factors and interventions is essential. Such interventions have been hindered by the lack of accurate data on structure, process and outcome of care, in part due to lack of uniformity in defining and reporting results [12]. The data available from developed countries cannot be directly applied to the Indian scenario due to varying patient profiles and differences in training of healthcare providers. The lack of data collection and its accuracy is also likely to have an impact on the eventual outcome of CPR. Therefore, a need was felt to conduct a study on patients with cardiac arrest attended by code blue team to evaluate the predictors of favourable outcomes.

Material and methods
A prospective observational study was carried out on 120 patients with cardiac arrest. These patients were attended by code blue team after a code blue alarm was triggered by the first

responder who detected cardiac arrest in any area of hospital coverage. A proforma was Prepared with following variables: socio-demographic characteristics (age, sex, occupation, and socio-economic status), presenting symptoms at the time of admission, co-existing diseases, general physical and systemic examination, investigations performed and treatment given prior to cardiopulmonary arrest. The CPR was assessed in terms of response time, presenting initial rhythm, time to first defibrillation with adherence to 2010 AHA guidelines, CPR time to ROSC, outcome. The patients who achieved ROSC were followed till hospital discharge/ LAMA/death.

Observations and results

Patients were categorized as per their final outcome, neurological outcome, return of spontaneous circulation (ROSC), pre arrest and peri arrest variables.

A. **Distribution of patients according to final outcome**
Out of 120 patients, 6 patients were survived to discharge, 8 took LAMA discharge in view of critical condition and rest were expired.

B. **Neurological outcome-Distribution of patients according to Glasgow outcome scale (GOS)**
We distributed the patients in to three groups.
Set A: GOS 1 (poor neurological outcome)
Set B: GOS 2, 3 (poor to moderate neurological outcome)
Set C: GOS 4, 5 (good neurological outcome)
Only 6 patients were in Set C, 14 patients were in Set B and 100 were in Set A.

C. Distribution of patients according to ROSC

Out of 120 patients only 54 patients achieved ROSC. Among 54 patients, 16 survived for >24 hrs whereas 38 for <24 hrs. (Table: 1)

Table 1: appreciating GOS of patients achieving ROSC

ROSC			
Survival >24 hrs (N=16)		Survival < 24 hrs. (N=38)	
GOS	No. of patients	GOS	No. of patients
5	5	3	1
4	2	2	5
3	9	1	32

D. Pre Arrest Variable

I. Age wise distribution

The mean age of patients having cardiac arrest among men was 46.7 years and 43.5 years among women. The mean age among the entire patients undergoing CPR was 45.1 years.

II. Distribution according to primary diagnosis and GOS

The table 2 showed the comparison between primary diagnosis of the patients and the neurological status at discharge. Good neurological outcome was observed in patients having LRTI, poisoning and pregnancy related disorder as their primary diagnosis.

Table 2

Diagnosis	GOS			Total	%
	Set A	Set B	Set C		
AF with FVR	1	0	0	1	0.8
AFI	1	0	1	2	1.6
Burns>50%	40	1	0	40	33.3
CAD	1	0	0	1	0.8
Carcinomas	9	3	1	13	11
CKD	4	1	1	6	5
CLD	1	1	0	2	1.6
CLD with portal HTN	2	0	0	2	1.6
COPD	5	1	0	6	5
CVA	1	0	0	1	0.8
DM	9	0	0	9	7.5
Fracture	3	0	0	3	2.5
IC Bleed	1	5	1	7	5.8
LRTI	1	0	0	1	0.8
Poisoning	2	0	0	2	1.6
Pregnancy related disorder	1	1	1	3	2.4
TB	2	0	0	2	1.6
UGI bleed	1	0	0	1	0.8
Others	14	2	1	17	14.1

III. Distribution according to co-morbidities

Among 120 patients who had cardiac arrest, 56 patients (46.6%) had no concurrent co-morbidity. (Table: 3)

Table: 3

Co-morbidities	Gender		%
	Male	Female	
ARF	1	1	1.6
CAD	3	2	4.1
CKD	3	2	4.1
DCM	2	0	1.6
DM	15	9	20
Down syndrome	0	1	0.8

HTN	13	10	19.1
NA	22	34	46.6
TB	0	1	0.8
Thyroid disorder	0	1	0.8
Sum	59	61	100

IV. Peri Arrest Variables

I. Response time with respect to neurological outcome (GOS)

Mean response time i.e. time from arrest to the arrival of the code blue team was analyzed using ANOVA. No statistically significant correlation could be established among GOS and response time.

II. Correlation between presenting initial rhythm and GOS

Among 6 patients, 2 presented with VF/VT and four presented with Asystole/ PEA with good neurological outcome while 100 patients with Asystole/ PEA and 14 patients with VF/VT had poor neurological outcome. No statistically significant correlation could be elicited between presenting initial rhythm and neurological status at discharge. (Table: 4)

Table: 4

GOS	Rhythm		Total	p-value
	Asystole/ PEA	VF/VT		
Set A	90	10	100	0.254
	90%	10%	100%	
Set B	13	1	14	
	92.9%	7.1%	100%	
Set C	4	2	6	
	66.7%	33.3%	100%	
Total	107	13	120	
	89.1%	11%	100%	

III. Relation between time to 1st defibrillation to GOS

In the present study, 16 patients were given defibrillation while performing CPR. The time to 1st defibrillation was compared with the neurological status of the patient at discharge. Chi square test showed no statistical significance between patients who had early defibrillation compared to those who had late defibrillation with regard to neurological outcome.

IV. Relation between time to 1st defibrillation to ROSC

It elicited no statistically significance between patients who received defibrillation <5min and those who received defibrillation <5min.

Regression analysis

The binary logistic regression analysis revealed absence of ROSC during CPR and presence of co-morbidities was predictors of poor outcome among the patients who had cardiac arrest. Therefore, ROSC achieved during CPR and absence of co-morbidities was found to be predictors of favourable outcome in present study.

Survival analysis

Survival analysis interpreted a positive correlation between response time and the chances of survival. It suggested that shorter the response time (from time of arrest to start of CPR) better the chance of survival.

Discussion

The present study was conducted on 120 patients with cardiac arrest who were attended by code blue team. Primary outcome was survival to discharge and secondary outcomes were to evaluate predictors of poor outcome in in-hospital cardiopulmonary resuscitation.

Outcomes

(a) Survival to hospital discharge

Among 120 patients, only 6 (5%) patients survived to hospital discharge, 8 (6.7%) patients took LAMA discharge, and 106 patients (88.3%) patients expired. These results are in consonance with the survival rates (7.2% and 7.38%) reported by Mohamed et al [13].

(b) Neurological outcome at discharge

We observed good neurological outcome (GOS score of 4 or 5) in 6 (3.9%) patients. Low rate of good neurological outcome observed in our study is in contrast to the results of Wall Muller *et al* and Ramchandran *et al.* Who reported good neurological outcome in 36% and 64% of patients respectively [14, 15]. They observed that patients with underlying cardiac causes had a significantly better outcome than those with non cardiac causes (44% vs. 23%). Girotra *et al* found a decrease in rate of neurological disability (33%to 28%) among patients over a period of time which they linked with quality improvement over time in the hospital [16].

The reason for poor neurological outcome in our study could be attributed to the presence of predominant number of patients with non cardiac causes and hence also Asystole/ PEA as an initial presenting rhythm.

Predictors influencing outcome

We evaluated the following factors which might contribute to poor outcomes observed in our study.

a) Age

The mean age of patients in present study was 45.1 years. No correlation with outcome measures could be elucidated in this study. The mean age of patients with cardiac arrest was lower in women i.e. 43.5 years compared to that in men i.e. 46.7 years in present study group, though this difference did not achieve any statistical significance. Previous studies have reported good outcome (survival to discharge) in patients of 40-60 years age Set and poor outcome in elderly set>60 years [17, 18].

b) Primary diagnosis

Previous literatures have reported cardiac causes as the common underlying primary diagnosis associated with good outcome following CPR. Wall Muller *et al* found cardiac patients as the largest subset of patients in their study followed by patients with pulmonary diseases. Outcome among cardiac patients was better (44%) as compared to other patients in their study [14].

Since patients with primary cardiac disease were primarily referred to this centre due to presence of a specialized cardiac subcentre of our hospital. Hence, a predominance of

non cardiac causes can be one of the contributing factors for poor neurological outcome in present study.

c) Co-Morbidities

Diabetes mellitus (20%, n=24) and hypertension (19.1%, n=23) were the most common co-morbidities seen among the patients in our study. A similar pattern was observed by Khan et al (hypertension 43%, diabetes 36%) and Huang et al (hypertension 33%, diabetes mellitus (36%) [18, 19]. Further analysis using binary logistic regression showed presence of multiple co-morbidities as predictors of poor outcomes in present study.

d) Response time

No statistically significant correlation among response time and neurological outcome was found in present study. However, a positive correlation between response time and probability of survival was elucidated using survival analysis. As the response time increased, the probability of survival in the patients declined in present study group.

Tok et al correlated immediate survival (ROSC) and survival to hospital discharge with the time of arrest to CPR initiation and could not elucidate any significant association among them [20]. Huang et al noted in their study that the prognostic factors of survival to discharge were a shorter interval between collapse and arrival of the resuscitation team and the time of collapse to confirmation of arrest [18]. AHA-ACLS guideline states that shorter response time leads to better outcome [1] which has been corroborated by the findings of survival analysis of our study.

e) ROSC

Out of 120 patients in present study, 45% of patients (54/120) achieved immediate return of spontaneous circulation whereas 55% (66/120) did not. Rajaram et al reported 45% ROSC, Khan et al observed 75% of patients with ROSC with only 13% of these sustaining ROSC for more than 20 min (17, 19). Huang et al observed successful ROSC in 67% of their patients and Saghafinia *et al* reported ROSC in 30.4% [18, 21].

In present study, time to achieve ROSC was found to be statistically insignificant as a predictor of outcome with survival to discharge or good neurological status. It can be due to small sample size. This is in contrast with the observations of Tok *et al* who found the mean CPR duration for patients who survived to hospital discharge (10.6±7.2 min) was significantly shorter than for patients who did not survive to discharge (33±18.5min) [20]. Saghafinia *et al* reported that duration of CPR> 10 min was highly predictive of significantly decreased survival to discharge [21].

f) Presenting initial rhythm

In our study, the most common initial rhythm among enrolled patients was Asystole/ PEA (83.3%). Only 16 patients had ventricular tachycardia or ventricular fibrillation as the initial presenting rhythm and only 2 out of 16 survived to discharge (GOS 4, 5), 1 patient had a GOS of 3 while the rest had poor neurological outcome of GOS 1, 2. This reflects a poor outcome in patients who had VF/VT in our study.

Previous studies have also reported Asystole or PEA nearly 60-84% of patients as the commonest presenting rhythm. 68% Asystole/PEA, 79%Asystole/PEA, 84% Asystole/PEA and 60-75% Asystole/PEA in meta-analysis was recorded [15, 16, 22, 23]. Immediate survival and survival to hospital discharge was significantly associated with the presenting rhythm especially when the initial cardiac rhythm was non VF/VT [20]. Khan et al observed initial cardiac rhythm to be PEA in almost 50% of their patients' set followed by Asystole (30%) and VF/VT (19%).

In present study the large number of patients with Asystole/PEA as the presenting rhythm could be attributed to delay in recognition of cardiac arrest in primary response or lack of monitors in many areas. Hence, this delay could have led to deterioration of a shockable rhythm to a non-shockable rhythm by the time code blue team arrived.

Conclusion

We observed poor outcomes in significant number of patients with cardiac arrest in hospital. These can be attributed to a statistically significant correlation with pre arrest variables like co-morbidities, peri arrest variables like absence of ROSC during CPR and longer response time. Prolonged time to achieve ROSC, longer time to 1st defibrillation along with presence of Asystole as the initial presenting rhythm were additional factors contributing to poor neurological outcomes.

This study has instigated introspective appraisal of our healthcare delivery system. We presume that lack of standardized training of providers in both filling CPR reporting forms and providing CPR or delay in recognition of cardiac arrest in a few in hospital locations could also account for lack of correlation of many important factors with outcomes. We recommend real time audit of code blue services and structured debriefing with retraining for qualitative improvement in outcome measures.

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