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Original Research Article

Initial Cardiac Rhythm and Its Correlation to Survival in Emergency Department

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Abstract:

Background: This study was done to correlate the initial cardiac rhythm and survival of prehospital cardiac arrest.

Methods: A prospective observational study was carried out in Department of Emergency Medicine, SMS Hospital, Jaipur, Rajasthan

Results: This group manifested an overall survival rate of 10% (30 of 300) of prehospital cardiac arrest patients. The most common presenting arrhythmia was ventricular fibrillation (VF) (45.0%), asystole (ASY) (35%), and pulseless electrical activity (PEA) (15%). Less commonly found were normal sinus rhythm (NSR) (1.8%), other (1.8%), ventricular tachycardia (VT) (0.6%), and atrioventricular block (AVB) (0.5%) as pre-arrest rhythms. The best survival was noted in those with a presenting rhythm of AVB (58.1%), VT (33.5%), VF (15%), NSR (14%), PEA (11%), and ASY (11.1%) ($p = 0.02$). However, there was no correlation between the final cardiac rhythm and outcome, other than an obvious end-of-life rhythm.

Conclusion: The most common presenting arrhythmia was VF (45%), while survival is greatest in those presenting with AVB (58.1%).

Keywords: Cardiac Rhythm, Cardiac Arrest, Prehospital, Emergency, Arrhythmia.

Introduction

The US emergency medicine services (EMS) experience was reported by Crampton in 1975 noting a 26% decline in prehospital and 62% in-hospital mortality involving those who underwent ambulance transport, who were <70 years of age, noting a 66% success rate in prehospital cardiopulmonary resuscitation (CPR) measured as long-term survival under optimal circumstances. [1]

Iseri reported experience with 26 primary cardiac arrest patients and rapid response paramedic units demonstrating optimal resuscitation in the ventricular fibrillation (VF) group (14) which was amenable to successful counter shock therapy in 86% (12) resulting in survival in 43% (6). [2] They also defined a poor outcome cohort, the brady-systolic cardiac arrest group, which was associated with autopsy-proven coronary artery disease in 50% (7) of patients and was found to be universally fatal. Interestingly, they concluded that a more aggressive approach to prehospital management of brady-systolic arrests was warranted. Eisenburg reported the results of an evaluation of prehospital care by Emergency Medical Technicians (EMTs) compared to that delivered after the addition of paramedic skills, such as defibrillation, endotracheal intubation, and drug administration to the resuscitation armaterium. [3] They reported an improved rate of survival to the coronary care unit (19% to 34%) and rate of hospital discharge (7% to 17%), which they related to a decrease in time delay to advanced care delivery, which was decreased to one-third from 27.5 to 7.7 minutes. The use of prehospital health care providers to intervene in acute cardiac emergencies has historically been a focus of emergency care.

However, Dean reported on the outcome of 134 patients who received mobile paramedic unit care compared to control patients without paramedic intervention demonstrating no change in outcome by multiple logistic regression analysis. [4] Defibrillation was the only beneficial intervention identified but it also added a 29-minute delay to hospital arrival suggesting the need for more streamlined care. Later, Shuster went on to evaluate 15 prehospital studies during the early years of emergency medical care suggesting no benefit of prehospi-

tal administration of any of several commonly administered prehospital medications. [5] Four factors are related to the ability to resuscitate patients in prehospital arrest: time of starting rescue procedures, use of electrical defibrillation, accuracy of technique of basic life support (BLS), and ventilation efficacy decreasing in utility. [6]

The "early defibrillation" controversy has once again raised interest in the utilization of first responders or EMTs in a two-tier response system. Wilson evaluated 126 patients whose care was limited to BLS: mask oxygen, intravenous (IV) fluids, closed chest massage, and artificial respiration. [7]

The survival rate was 22% (28) to hospital admission and 9% (11) to hospital discharge, with a favorable prognosis group identified to include those with initial rhythm of VF or tachycardia, 14% (7 of 50); and initial blood pressure > 90 mmHg and pulse rate >50 bpm, 50% (3 of 6).

However, if the patient was in cardiac arrest, then CPR did not change the outcome, other than an obvious end-of-life rhythm. Our study attempted to correlate the outcome in prehospital cardiac arrest to the initial cardiac rhythm documented pre-arrest, as a secondary endpoint.

Methods

Prospective observational study

The present study was carried out in the Department of Emergency Medicine, SMS Hospital, and Jaipur Rajasthan.

Study Area: The present study was conducted in patients with prehospital cardiac arrest attending the Emergency department at SMS Hospital, Jaipur Rajasthan.

Study Population: All patients with prehospital cardiac arrest presenting to the emergency department of SMS Hospital during the mentioned period and fulfilling the inclusion criteria.

Study Design: Prospective observational study.

Sample Size: 300

Study Schedule: The study was conducted over a period of 6 months from June 2022 to November 2022.s

The inclusion criteria were subjects suffering from cardiac arrest. Patients received standard advanced cardiac life support (ACLS) protocol including chest compressions, ventilation, defibrillation, epinephrine (0.01 mg/kg), and antiarrhythmics or pressor agents as warranted. Presentation and final cardiac rhythms such as VF, asystole (ASY), pulseless electrical activity (PEA), normal sinus rhythm (NSR), ventricular tachycardia (VT), and atrioventricular block (AVB) were noted. Patient outcome was recorded as the return of spontaneous circulation (ROSC) and initial emergency department survival as a primary endpoint. Patients were enrolled under the Doctrine of Implied Consent for the emergency use of an accepted resuscitation modality and notification was provided if requested by family or healthcare resources. Their hospital records were not reviewed.

Results

This group manifested an overall survival rate of 10% (30 of 300) of prehospital cardiac arrest patients as shown in Fig 1.

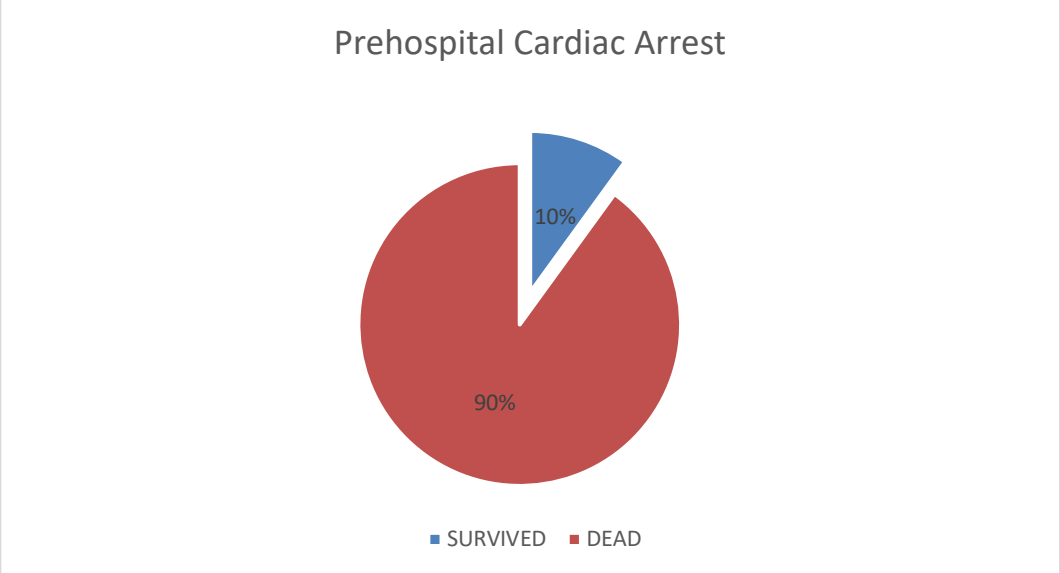

Figure 1: Prehospital Cardiac Arrest

The most common presenting arrhythmia was ventricular fibrillation (VF) (45.0%), asystole (ASY) (35%), and pulseless electrical activity (PEA) (15%).

Less commonly found were normal sinus rhythm (NSR) (1.8%), other (1.8%), ventricular tachycardia (VT) (0.6%), and atrioventricular block (AVB) (0.5%) as prearrest rhythms. The best survival was noted in those with a presenting rhythm of AVB (58.1%), VT (33.5%), VF (15%), NSR (14ssssss %), PEA (11%), and ASY (11.1%) ($p = 0.02$).

However, there was no correlation between the final cardiac rhythm and outcome, other than an obvious end-of-life rhythm. As shown in Fig 2

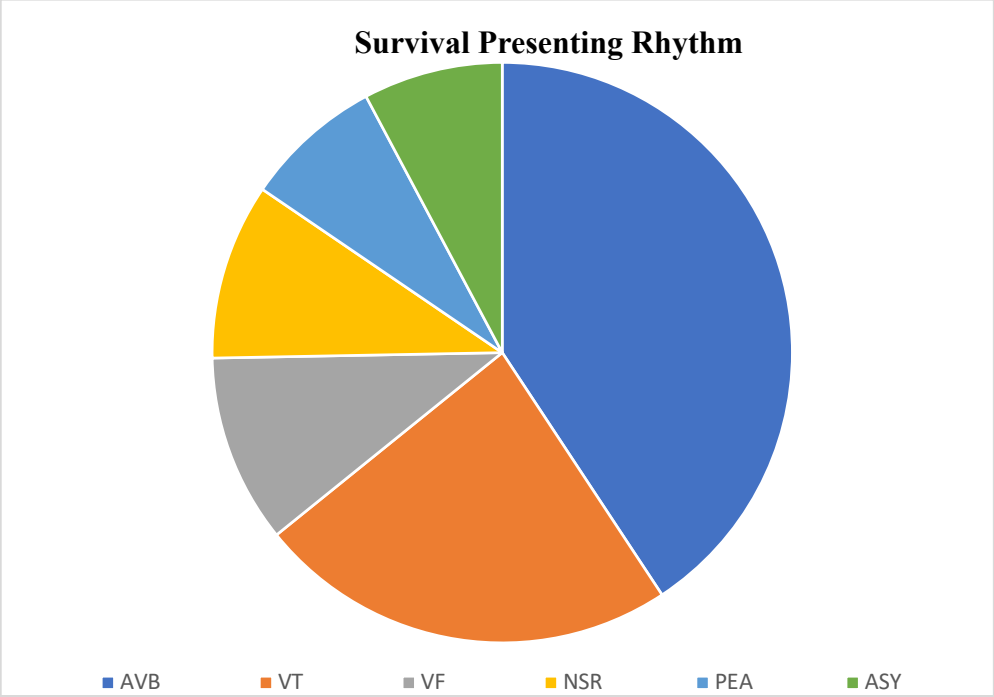

Figure 2: Survival Presenting Rhythm

Discussion

Prehospital predictors of outcome may potentially be inferred by the analysis of animal experimental data. Angelos evaluated a ten-minute VF and five-minute BLS resuscitation model to identify improved coronary perfusion in the normal neurologic outcome group as an independent predictor of a favorable outcome. [8] The author has performed a similar trial in brief (five-minute), moderate (ten-minute), and prolonged (15 minutes) canine VF models to also identify improved coronary perfusion pressure (CPP) and systemic mean arterial pressure as favorable outcome predictors associated with improved survival and neurologic outcome. [9]

Paradis in a study where the CPP quantified as the aortic to right atrial pressure gradual during the relaxation phase, correlated to the ROSC. [10] In those patients with ROSC, the initial CPP was increased (13.4 vs. 1.6 mmHg), as was the maximal CPP obtained (25.6 vs. 8.4 mmHg). They found that only those with a CPP > 15 mmHg had ROSC, although not all 75% (18 of 24) of those with adequate coronary perfusion were successfully resuscitated. Brison's demographic analysis of the cardiac resuscitation experience of 1510 cardiac arrest patients where 92.1% of patients were 50 years of age, 68.3% were male, and 79.6% of arrests occurred at home. [11] The average ambulance response time of witnessed events was 7.8 minutes with an overall survival rate of 2.5%. Factors predicting survival include: age, ambulance response time, and whether CPR was started before ambulance arrival, but interestingly was not related to early defibrillation.

Tresch evaluated a population of 381 cardiac arrest patients comparing older and younger (<20 years) cohorts, who have undergone paramedic-witnessed cardiac arrest. [12] The elderly patient cohort more commonly had a history of heart failure (25 vs. 10%) was more commonly taking digoxin (40 vs. 20%), diuretics (35 vs. 25%), and were more likely to complain of dyspnea (53 vs. 40%). Younger patients were more likely to complain of chest pain (27 vs. 13%) and presented in VF (42 vs. 22%). Interestingly, the patient's chief complaint correlated with initial rhythm where 68% of those with chest pain demonstrated a VF event compared to 21% of those with dyspnea. Although, there were equivalent initial resuscitation rates in the elderly their survival to discharge was decreased comparatively (24 to 10%).

Survey data offered by Ng concerning 105 younger arrests (1–39 years) patients found a male predominance (62%), was secondary to cardiac disease (38%) due to atherosclerotic heart disease in 50%, and secondary toxic exposure in 21%. [13] the most common presenting rhythm was VF (45%) associated with a 48% resuscitation rate with over 28% of post-resuscitation patients progressing to long-term survival. Favorable outcome was predicted by the arrest being witnessed or associated with primary cardiac dysrhythmia; while asystole was a negative prognostic indicator. Age, sex, race, bystander CPR, and paramedic response time were not significant prognostic factors affecting long-term survival.

The effect of an extended EMS training program on cardiac arrest survival was evaluated in 1196 patients by Wright, where the majority of patients 62% (740) presented in electromechanical dissociation (EMD) or ASY, while 38% (456) presented in VF. [14] The survival rate in those who presented with asystole was dismal 0.1% (1 of 740). Factors associated with the likelihood of presenting with ventricular fibrillation include age < 71 years, witnessed arrest, bystander resuscitation, public arrest, and ambulance response time <6 minutes. While improved outcome was associated with shorter response time, but not bystander CPR with the newly acquired skills used in 78% of patients.

There are widely discrepant rates of survival in hospitals compared to prehospital cardiac arrest events. Rosenberg evaluated 300 hospitalized patients demonstrating a 54% initial post-CPR survival followed by 23% survival to hospital discharge. [15] Predictors of good resuscitation outcome include an initial ventricular tachycardia or fibrillation rhythm, and brief duration of CPR < 30 minutes.

Prehospital survival was suboptimal compared to in-hospital events due to inherent logistic considerations. Roth reported on 187 cases of out-of-hospital arrest where an improved outcome was noted based on initial rhythm—VF/VT (15.3%) compared to other rhythms-including ASY, idioventricular (IVR), AVB, and EMD (3.4%), as well as with bystander CPR improving survival to 24% in VF/VT and 0% in other rhythms. [16]

Secondly, response times of less than four minutes resulted in improved survival to discharge in 23.1 compared to 7.0% of VF/VT events, and 30.8 compared to 7.7% of other arrhythmic events (13). Likewise, the use of bystander CPR improved outcome from 23.1 to 42.9% in VF/VT and 7.7 to 15.8% when ACLS providers arrived within four minutes. [14] The overall survival rate of 13.9% (110 of 793 of our study) patients compares favorably to a 3.8% (1.7%–13%) pooled analysis of 3220 prehospital arrest patients suggesting improved prehospital outcome in this study. [17] The predominant proportion (80%) of patients presenting in prehospital cardiac arrest are found to have VF (45%) or asystole (35%). Certainly, it is appropriate to direct the major emphasis of care toward the VF population, suggested to have the best chance at achieving ROSC based on the rapid defibrillation intervention.

However, the probability of successful resuscitation was more likely with AVB (57.1%) and VT (33.3%) than for VF (15.7%). It is better to define the AVB-bradycardia group as a lower risk with its attendant etiology usually associated with less significant cardiac pathophysiology. However, we are then left with the likelihood of Type II error, failing to conclude a difference between groups when in fact limited by a small sample size. Focusing on the ventricular tachycardia-fibrillation continuum associated with more significant cardiac pathophysiology we find an adequate sample size—80% of the total population to reach conclusions concerning the likelihood of survival in this group.

Therefore, it seems that initial cardiac rhythm serves as the only a possible predictor of outcome with organized rhythms AVB vs. PEA/ASY associated with a higher resuscitation rate than less organized rhythms VT vs. VF in this present content.

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