A Profile of Out-of-Hospital Cardiac Arrest in Amang Rodriguez Memorial Medical Center: A Prospective Cohort Study

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Abstract

Introduction: Cardiac arrest occurs when abrupt cessation of cardiac function results in loss of effective circulation and complete cardiovascular collapse. For every minute of cardiac arrest without early intervention (cardiopulmonary resuscitation [CPR], defibrillation), chances of survival drop by 7 – 10%. It is crucial that CPR be initiated within 4 – 6 minutes to avoid brain death. Most out-of-hospital cardiac arrests (OHCA) occur in a residential setting where access to trained personnel and equipment is not readily available, resulting in poor victim outcomes.

Methods: This descriptive study was done from August to November 2021 using a prospective cohort design. Participants of the study include adult patients aged 18 years and above brought to the emergency room who suffered from out-of-hospital cardiac arrest. Out of the total 102 cases of OHCA, 63 participants were included in the study. Descriptive statistics was used to summarize the demographic and clinical characteristics of the patients.

Results: Forty-three subjects were male patients, comprising the majority at 73.02%. Hypertension was identified as the top comorbidity, followed by diabetes mellitus, heart failure, and chronic kidney disease (CKD). Medical causes of arrest were identified in 96.83% of the cases. 90.48% of cardiac arrests occurred at home. Only 26 patients (41.27%) received pre-hospital intervention before ER arrival, comprising only hands-on CPR. Twenty-three of these were performed by individuals with background knowledge of CPR. 60.32% were brought via self-conduction, the remainder by ambulances, which were noted to have no available equipment necessary to provide proper resuscitation. The average travel time from dispatch to ER arrival is 20 minutes.

Conclusion: Overall survival of OHCA in our local setting remains dismal, as the return of spontaneous circulation was not achieved in any of the patients. The small number of patients having pre-hospital CPR indicates the need for emphasis on training and community education.

Keywords: Out-of-hospital cardiac arrest, cardiopulmonary resuscitation, survival

Introduction

Cardiac arrest occurs when abrupt cessation of cardiac function results in loss of effective circulation and complete cardiovascular collapse, which may be due either to an acute onset of life-threatening arrhythmia or sudden loss of myocardial pump function.[1] For every minute of cardiac arrest without intervention such as early CPR or early defibrillation, a patient's chance of survival dramatically falls by 7 – 10%.[2] This implies the importance of early intervention in pre-hospital settings, as permanent brain damage ensues after only 4 minutes without oxygen.[3] Upon recognition of cardiac arrest, it is crucial that CPR must begin within 4 to 6 minutes, and advanced life support measures must begin within 8 minutes to avoid brain death.[4] This means that the community and bystander response is integral to survival from OHCA.

Most incidences of cardiac arrest occur outside the hospital, and the most common place for an OHCA to occur is in a residential setting[2]. Other common arrest locations identified in the CARES registry were nursing homes, public or commercial buildings, streets or highways, and healthcare facilities, where access to life-saving equipment such as automated external defibrillator (AED) and trained professionals are usually out of reach, resulting to an increasing public health problem due to poor victim outcomes. Despite

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expanding research on cardiopulmonary resuscitation (CPR) and training of medical professionals and bystanders on basic life support (BLS), out-of-hospital cardiac arrest (OHCA) continues to pose a major health burden due to its low survival rates.

Amang Rodriguez Memorial Medical Center (ARMMC), situated in Marikina City, is a tertiary licensed facility under the supervision of the Department of Health catering to outpatient and emergency cases referred from the eastern part of Rizal and other surrounding cities and provinces. It has been considered a "referral center" for medical and trauma cases and has received many OHCA cases. Previous research done in ARMMC presented the profile of 66 OHCA patients in the emergency room from February to November 2015. It showed that the total duration of arrest prior to hospital arrival averaged 13 minutes, mostly brought to the hospital through EMS services. However, still, a significant number were brought in by relatives. Of the 66 subjects analyzed in the study, only one received CPR before EMS arrived. Most EMS personnel performed chest compressions without airway management or defibrillation, owing to a lack of proper equipment in EMS ambulances such as AED or advanced airway.[5]

A pioneering study on the local incidence of OHCA was done in 2011 at Manila Doctors Hospital (the POHCA-MDH study), showing that the majority (79%) of subjects in the study group had a cardiac etiology of the OHCA. However, the study was limited due to the small number of patients investigated. Further recommendations include doing a large-scale study on out-of-hospital cardiac arrest CPR to further characterize the efficiency of emergency medical services in the country and to include bystander involvement in pre-hospital resuscitation in influencing survival rates of patients suffering from OHCA. [6] However, up to this day, local data are still limited.

The COVID-19 pandemic, which was first identified in December 2019 in the Hubei province of China and has been, up to this day, an ongoing pandemic affecting more than 273 million people worldwide[7], posed a big challenge in relation to cardiopulmonary resuscitation. The pandemic has been associated with an increase in OHCA, and it has been challenging to distinguish between patients who do or do not have COVID-19 in an undifferentiated OHCA.[8] Healthcare workers and emergency responders who perform cardiopulmonary resuscitation in an uncontrolled environment are at greatest vulnerability to COVID-19 and other infectious diseases spread by aerosols or respiratory droplets, especially in the performance of invasive airway interventions such as endotracheal intubation. Hence, emergency healthcare workers and physicians encountering patients who sustained OHCA in an acute setting worked on the assumption that these patients are at high risk for COVID-19 and ensured that these patients get the best possible chance of survival without compromising the safety of the rescuers and staff. This included the provision of compression-only CPR and passive oxygenation through a nonrebreather face mask

or as an alternative to bag-valve-mask ventilation during the initial phase of resuscitation to limit the exposure to aerosolized particles.[8] It is recommended that adequate personal protective equipment and staff safety is the number one priority before assessing any patient in cardiac arrest, especially in an uncontrolled and inadequate setting, thus changing the team dynamics and equipment allocation in providing cardiopulmonary resuscitation.[9]

In the United States, about 350,000 out-of-hospital cardiac arrests occur annually, with a survival-to-hospital discharge rate of only 10.4%, according to the Heart Disease and Stroke Statistics 2020 Update by the American Heart Association. The majority of OHCA occur at home (69.8%), followed by public settings (18.8%) and nursing homes (11.5%), wherein 49.6% were unwitnessed.[10] Philippine data shows that 12.7% of total deaths in 2016 were caused by cardiovascular disease, and roughly 50% of these deaths happened as sudden cardiac arrest.[11,12] Hence, advocacies on strengthening EMS policies, campaigns on raising CPR awareness among bystanders, and establishing local registries to improve data collection must be implemented to determine how it affects the population and assess the effectiveness of current protocols and practices. In addition, monitoring and reporting of the incidence and outcomes of OHCA will improve understanding of its epidemiology.

Survival of cardiac arrest victims largely depends on timely recognition and immediate CPR. Hence, determining variables such as patient risk factors, knowledge, and skills of the immediate responder, and implementing the chain of survival will provide an opportunity to improve emergency medical services further and mobilize bystander CPR.

This study aims to identify the variables surrounding out-of-hospital cardiac arrest in Amang Rodriguez Memorial Medical Center. Through this, preventive and informative measures such as CPR training in the community and enhancement of data collection methods may be initiated to improve patient outcomes and reduce the burden of cardiac deaths.

This research paper aims to inform the medical community about the incidence of OHCA, strengthen the knowledge, attitudes, and practices of emergency medical services teams since they are the first-line responders in OHCA, and encourage bystanders to learn CPR. Demographic data collected will be used to target EMS that may need reinforcement or proper training in CPR.

Methodology

Selection and Description of Participants. The descriptive study used a prospective cohort design from August 2021 to November 2021. The Ethics Review Board of Amang Rodriguez Memorial Medical Center approved the study. Participants of the study include patients brought to the emergency room who suffered from out-of-hospital cardiac arrest aged 18 years old and above,
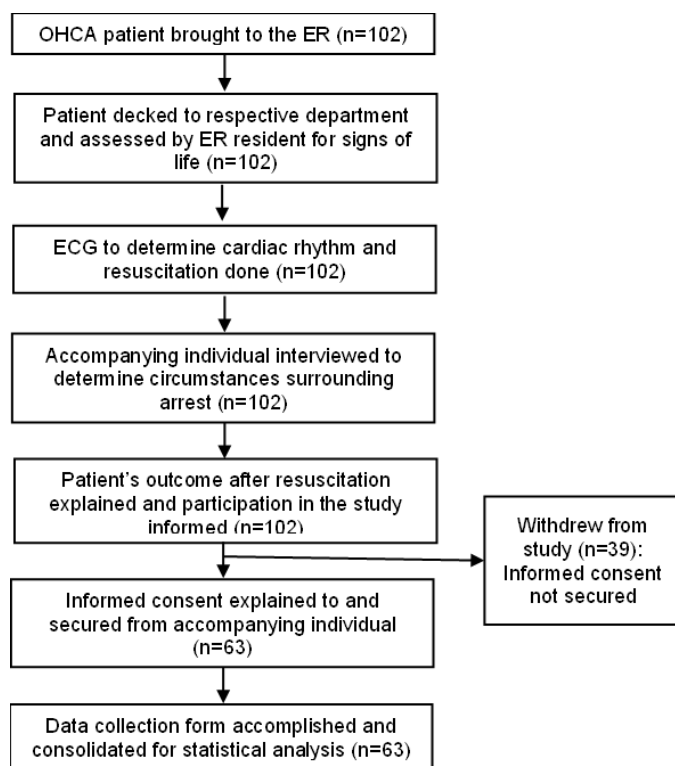
Figure 1 Flowchart of Data Collection

Table I. Patient Demographic Factors (n=63)

Parameter	Frequency (%); Mean ± SD;
Age	54.86 ± 16.37
Sex	
Male	46 (73.02)
Female	17 (26.98)
Place of Occurrence of Arrest	
Residence	57 (90.48)
Public place	3 (4.76)
Others (street/highway, workplace)	3 (4.76)
Comorbidities and Risk Factors	
With comorbidities and risk factors identified	44 (69.84)
Hypertension	26 (41.27)
Diabetes mellitus	12 (19.05)
Heart failure	4 (6.35)
Chronic kidney disease	3 (4.76)
Cancer	2 (3.17)
Pulmonary tuberculosis	2 (3.17)
Stroke	1 (1.59)
Liver cirrhosis	1 (1.59)
Alcohol drinking	8 (12.7)
Smoking	7 (11.11)
Illegal drug use	1 (1.59)
None identified	19 (30.16)
Identifiable etiology	
Medical	61 (96.83)
Traumatic	2 (3.17)
Drug overdose	0
Drowning	0
Electrocution	0
Asphyxia	0

seen and attended by the Internal Medicine Department, or seen by other departments but referred to Internal Medicine as well. Cardiac arrest caused by medical trauma, drug overdose, drowning, electrocution, and asphyxiation were included. Those patients below 18 years old who are seen by pediatrics are excluded from the study.

Sample Size Estimate and Procedure. Using G*Power 3.1.9.2, a minimum of 61 patients are required for this study based on 38.18% of alive patients with less than 10 minutes of initial-in-hospital CRP duration[13] versus expired patients at 0.65%, 5% level of significance, and 95% power.

Data Collection Process. The triage officer assessed the OHCA patients brought to the emergency room and decked to the respective department for further evaluation. The ER resident then assessed the patient, including determining the signs of life and vital signs if they were still present. ECG was done to determine cardiac rhythm. Appropriate resuscitations are delivered once arrest rhythms are noted (asystole, pulseless electrical activity [PEA], ventricular fibrillation, or ventricular tachycardia). An initial interview with the responder and/or individual accompanying the patient was done by the attending physician to determine the circumstances surrounding the arrest. The patient's outcome after resuscitation was explained to the accompanying individual. The emergency room physician or nurse on duty who attended to the patient obtained informed consent after the delivery of resuscitative efforts, and the patient's status was explained to the accompanying individual. Accompanying individuals were asked to read the research information sheet and sign the informed consent. Once informed consent is secured, a data collection form was completed using the patient's medical chart and data gathered from the patient's history. Data gathered will be consolidated using Microsoft Excel and subject to statistical analysis.

Statistics. Descriptive statistics was used to summarize the demographic and clinical characteristics of the patients. Frequency and proportion were used for categorical variables, median and interquartile range for non-normally distributed continuous variables, and mean and standard deviation for normally distributed continuous variables. *STATA 13.1* was used for data analysis.

Abbreviations and Acronyms

ACLS	Advanced cardiac life support
AED	Automated external defibrillator
ARMMC	Amang Rodriguez Memorial Medical Center
BLS	Basic life support

CARES	Cardiac Arrest Registry to Enhance Survival
CKD	Chronic kidney disease
COVID-19	Coronavirus disease 2019
CPR	Cardiopulmonary resuscitation
ECG	Electrocardiogram
EMS	Emergency medical services
ER	Emergency room
OHCA	Out-of-hospital cardiac arrest
PEA	Pulseless electrical activity
SCA	Sudden cardiac arrest
SCD	Sudden cardiac death

Results

A total of 6008 adult patients were seen and attended at the emergency room of ARMMC during the study period, and 102 of these consults were cases of out-of-hospital cardiac arrest presenting as dead on arrival. Of the 102 OHCA patients, 63 were included in the study. Restoration of spontaneous circulation was not achieved in any of the subjects.

The mean age of the study participants was 54.86 years, with a range of 38 – 71 years. There were 46 (73.02%) male subjects and 17 (26.98%) female subjects. The majority of the arrests occurred at the patient's residence (90.48%) and were brought to the hospital via self-conduction (60.32%). 44 (69.84%) of the participants had co-morbid conditions and risk factors identified, while none were identified in 19 (30.16%) of the participants. The top comorbidities identified include hypertension, diabetes mellitus, heart failure, and chronic kidney disease. 12.7% and 11.11% of the participants were found to be alcoholic drinkers and smokers, respectively. The majority of the arrests were found to be of medical etiology.

As part of the description of the participant's demographics, the location where the arrest occurred was also identified. Since ARMMC caters to patients mostly from Marikina City and the province of Rizal, it is evident that the majority of the OHCA cases came from these areas. Still, they were also noted locations outside Marikina and Rizal, particularly Quezon City, Pasig City, and Caloocan City (*Figure 2*).

Of the 63 patients in the study, only 26 individuals received resuscitation prior to emergency room consult (41.27%), 23 of which were done by individuals (whether bystanders, EMS personnel, or other medical professionals) with some background in BLS training. A greater number (58.73%) of the patients did not receive any pre-hospital intervention (*Table II*).

Table II. Responder Factors (n=63)

	Frequency (%)
Intervention done pre-hospital	26 (41.27)
With training	23 (88.46)
Without training	3 (11.57)
No intervention done	37 (58.73)
Intervention/CPR provider	
EMS	11 (42.3)
Bystander	6 (23.08)
Medical professional	9 (34.62)

Table III. Transport Factors (n=63)

Mode of conduction	Frequency (%)
Self-conduction	41 (65.08)
Ambulance	22 (34.92)
Available equipment	
AED	0
Advanced airway	0
ECG machine	0
IV fluids	0
Drug	0
Travel time in minutes from dispatch to ER arrival	20 (12 to 35)

Table III describes the factors related to the transport of patients. The majority of the participants were brought to the emergency room via self-conduction, while 22% were brought via ambulance. However, ambulances that bring patients to the ER have no available equipment to provide proper and effective resuscitation, such as an AED machine, advanced airway, drugs, or ECG machine to determine on-site cardiac rhythm. The average travel time from dispatch to arrival at the ER is 20 minutes, ranging from 12 to 35 minutes.

Since most study participants were brought to the hospital via self-conduction and the remainder were brought via unequipped ambulances, the on-site cardiac rhythm was identified in none of the patients. ECG
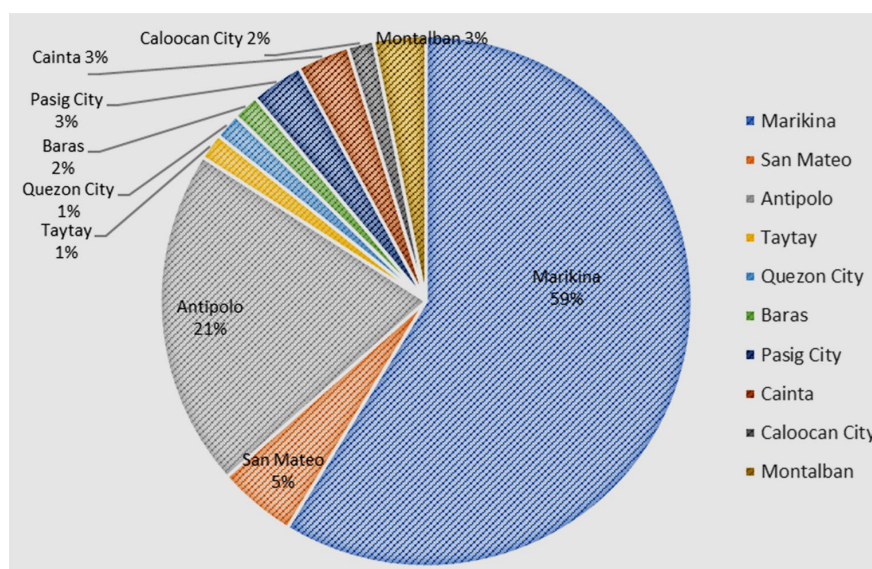
Figure 2 Specific Location of OHCA

determination was done only upon emergency room arrival, and *Figure 3* shows that the arrest rhythms identified in the patients were asystole and PEA.

Discussion

In this study, we present the data surrounding adult OHCA in ARMMC, including the clinical profile of patients, responder factors, and transport factors. For the clinical and demographic data of the patients, the results showed that the majority of the patients who suffered cardiac arrest were male, with a mean age of 54 years, ranging from 38 to 71 years. According to data from the CARES registry, of the reported OHCA events in 2020, patients were also predominantly male at 62.1%.[2] In a registry that included OHCAs from 2009 – 2021 in Singapore, Japan, the Republic of Korea, Malaysia, Thailand, Taiwan, and the United Arab Emirates, it was also found that OHCA was more common in males compared to females at 60%.[14] This may be due to the higher prevalence of cardiovascular and lifestyle risk factors in men and the possible cardioprotective effect of female estrogen and progesterone hormones on the reduction of cardiac arrest risk in women.[14] Women also have a lower incidence of sudden cardiac death (SCD) and sudden cardiac arrest (SCA) than men. However, the gender difference in SCD/SCA incidence and survival is poorly understood and warrants further study and research. [1]

Nearly all of the cardiac arrests occurred at home at 90.48%, which was also consistent with the data gathered at the CARES registry, wherein the most common place for an OHCA to occur is in a residential setting, with 74.2% of cardiac arrests occurring at home.[2] The location of the arrest may be correlated with the likelihood of the victim receiving bystander intervention, as patients arrested in a public setting were more likely to have a witnessed event and receive intervention than those arrested at home.

The initial cardiac rhythm on-site was not identified in any patients in the study. Hence, those who may have presented at the outset with a shockable rhythm and may have received the intervention were not identified, thus leading to the majority of the patients already presenting with asystole and PEA at the emergency room. Treatment and prognosis depend on the presenting rhythm, and patients with a shockable rhythm (ventricular fibrillation or ventricular tachycardia) were shown to have better survival after OHCA.[2] The rapidity with which defibrillation/cardioversion is achieved is an important predictor of outcome. The use of AEDs by lay responders and trained personnel can improve cardiac arrest survival rates.

Among the risk factors for SCD, coronary heart disease, and heart failure are the most prevalent predisposing cardiac conditions, contributing to four- to ten-fold increases in SCD. Likewise, hypertension, diabetes, hypercholesterolemia, obesity, smoking, and alcohol intake are also strong risk factors for sudden cardiac death. [1]
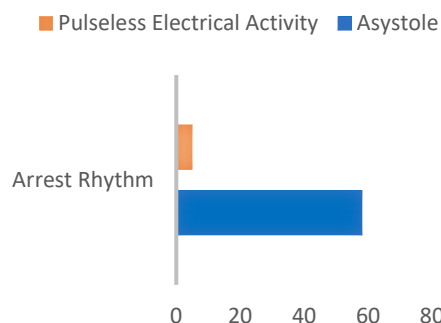
Figure 3 Arrest Rhythm Upon Arrival at the Emergency Room

During a cardiac arrest, the administration of early CPR is valuable because it can buy time by maintaining some blood flow to the heart and brain until such time that defibrillation or advanced cardiac life support (ACLS) measures are available. Early defibrillation is also key to a more favorable outcome and survival of the victim. Unfortunately, in the Philippines, defibrillators are not widely and readily available for use by lay responders, except in select locations such as hospitals and private institutions, and in comparison to developed countries and other Southeast Asian neighbors, established emergency medical response systems are yet to be instituted with properly trained personnel on CPR and defibrillation.[4] Hence, the victim only receives CPR, defibrillation, or ACLS upon arrival at the hospital emergency room. As shown in the study, out of the 63 patients brought to the emergency room, only 26 (41.27%) patients received pre-hospital intervention in the form of hands-only CPR and provision of oxygen support via nasal cannula, with the majority (58.73%) receiving intervention only upon arrival at the emergency room.

Limitations and Recommendations

All patients included in the study did not achieve a return of spontaneous circulation, even those who received pre-hospital intervention or resuscitation. Hence, factors contributing to a favorable outcome cannot be identified. The study was also conducted in a short time frame (4 months); therefore, the researchers recommended a longer study period to enhance data collection further. Improvements are necessary in the documentation and qualification of resuscitation efforts done pre-hospital. This may be done by providing questionnaires or surveys to give a better assessment of the knowledge, skills, and practices of CPR providers.

A large-scale study on OHCA and pre-hospital CPR may be done which will better characterize the efficiency and points for improvement of the emergency medical services in the local setting end eventually, in a national level. Advocacies on strengthening EMS policies, campaigns on raising CPR awareness in the community, and establishing local registries to improve data

collection mut be put in place to determine how it affects the population and to assess the effectivity of current protocols and practices. In addition, monitoring and reporting of the incidence and outcomes of OHCA will improve understanding of its epidemiology.

Conclusion

Demographic data collected showed that OHCA patients were predominantly male with a mean age of 54 years. Among the common morbidities and risk factors noted in these patients include hypertension, diabetes mellitus, heart failure, CKD, smoking, and alcohol drinking. Majority of the arrests occurred in a residential setting; hence majority were also brought to the emergency room via self-conduction. In general, patient demographics and clinical profiles were consistent with other studies. Overall survival of OHCA in our local setting remained dismal, as return of spontaneous circulation was not achieved in any of the patients.

The small number of patients having pre-hospital or bystander CPR in our study, especially those patients who suffered cardiac arrest at home and not attended to by EMS or medical professional, indicates that there is a need to give CPR training to the community. It also demonstrates that further training in BLS, especially for the EMS personnel and the laymen must be emphasized in order to achieve favorable post-arrest outcomes.

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