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ORIGINAL ARTICLE

Survival Outcome of Chronic Kidney Disease Patients who Underwent Cardiopulmonary Resuscitation in the Emergency Department

Hamza Mustufa Khan[1], Hania Ahmer[2] ,Sajjeel Ahmed[3], Ibrahim Bhatti[4], Saad Altaf [5] , Ibrahim bin Huzaifa[6], Abdul Sattar[7]

Authors Affiliation:

Shifa College of Medicine, Islamabad, Pakistan[1-6]
Department of Emergency,

Medicine, Shifa International hospital, Islamabad, Pakistan[7]

Correspondence to:

hamz.m.khan656@gmail.com

ABSTRACT

OBJECTIVE

The purpose of this study was to determine the survival outcome of CPR (Cardiopulmonary resuscitation) in patients with Chronic Kidney Disease who underwent cardiopulmonary resuscitation in emergency department.

METHODOLOGY

This retrospective observational cohort study was conducted in a tertiary care hospital in Islamabad Pakistan. All the patients who underwent cardiopulmonary resuscitation over a period of three years were included in the study. All patients who were dead on arrival or whose ages were less than 16 years, were excluded from the study. Patients with CKD were isolated and were labeled as chronic kidney disease (CKD) group (Group A). For the rest of the patients, a similar number of patients were isolated by a consecutive sampling technique labelled as a non-CKD group (Group B). Mortality in the Emergency department and survival to discharge was calculated. Charlson Comorbidity Index was used to compare the mortality outcome in both groups.

RESULTS

From January 2017 to December 2020, we reviewed data from 439 patients, all of whom had undergone resuscitation attempts in the Emergency Department (ED). Out of these, 76 patients were received dead and 5 didn't have proper documentation of the outcome of resuscitation. From the remaining pool of 258 patients, 18 patients also remove from the study who were less than 16 years. 84 patients had chronic kidney disease (CKD Group) group A while 86 patients were randomized by consecutive sampling technique in non- CKD group (Group B). In the CKD group, 23 (27.3 %) patients expired in an emergency, while in the Non-CKD group 28 (32.5%) patients expired in an emergency. Survival to discharge in patients who were admitted to the hospital was much better in CKD group 14 (16.2 %) than in Non-CKD group28 (33.3%). Charlson Comorbidity Index (CCI) was also calculated for both almost identical groups. The mean CCI for the non-CKD group was 3.12 (SD = 1.20) and the mean CCI for the CKD group was 1.05 (SD = 1. 47). Comparison of the mean by independent sample T-test showed statistically significant (P= 0.01) results.

CONCLUSION

Survival of in-hospital cardiac arrest patients who undergo Cardiopulmonary resuscitation in an emergency is multifactorial but patients with CKD may have a better outcome due to more reversible causes provided other comorbid conditions are similar.

KEYWORDS

Emergency Department, Cardiopulmonary resuscitation (CPR), Chronic Kidney Disease (CKD)

INTRODUCTION

Resuscitation is an essential part of Emergency Department procedures. A past study has found that for every 1000 patients admitted to the hospital, 1 to 5 patients undergo In-Hospital Cardiac Arrests (IHCA).[1] Another research conducted in the United States estimates the number of cardiac arrests to be 290000 per year.[2] Although the resuscitation process is uniform as per ACLS guidelines in all patients, yet there is a remarkable difference in the outcome.

These cardiac arrest cases amount to 80% percent of deaths occurring in the hospital. The same research has found the odds ratio of mortality in the hospital to be 0.77 with a confidence interval of 95 % (1). A separate study performed in Sweden linked co-mor-

bidities, measured with the Charlson comorbidity index (CCI), with the outcome following cardiac arrest. They discovered that with increasing comorbidities, the survival rate over 30 days decreased.[3] In another study conducted in the Karolinska University Hospital, it was discovered that out of the 1373 patients in-hospital cardiac arrests, 376 (27%) survived for at least 30 days. Patients with low or moderate age-adjusted CCI had more than double the survival rate as compared to those with higher CCIs.[4]

Similar research has been conducted in Cleveland, Ohio, comparing the outcomes of in hospital cardiopulmonary resuscitation in patients with CKD.[5] Cardiac arrest and subsequent resuscitation are a very common incident in a hospital set up. In hospital cardiac arrest results in 1 to 5 events per 1000 admissions. Similarly, survival to discharge in another study conducted at another setup ranged from 0% to 42 %.[6] Co-morbidities such as congestive heart failure (CHF), myocardial infarction, renal disease, and diabetes with or without complications were found to be the most common causes leading to cardiac arrest in the above study.

The outcomes of patients with CKD have not been sufficiently investigated especially in an emergency department set up in a low socioeconomic country. In the United States, CKD affects approximately 13% of the population and this incidence continues to rise as the population ages. The elevated risk of cardiovascular symptoms is well established in conjunction with CKD.[6] The best place to conduct this research is the Emergency Department because there is a high incidence of sudden cardiac arrests in the Emergency Department.[7, 8]

Our research compares the mortality of CKD patients who develop cardiac arrest due to any reason and are resuscitated using ACLS in the Emergency Department and compare it with all other cardiac arrest patients who don't have CKD. Similar research has been conducted in Cleveland, Ohio, comparing the outcomes of in hospital cardiopulmonary resuscitation in patients with CKD.[5]

We hypothesize that due to reversible causes of cardiac arrest, the prognosis and outcome of patients with CKD are superior and they should be resuscitated more aggressively.

METHODOLOGY

The study is based on the data gathered from 443 CKD patients who underwent CPR in the emergency department of Shifa International Hospital, Islamabad. It is a retrospective observational cohort study. The duration of data review spans over three years where the oldest medical record being extracted from January 2017, and the most recent one being December 2019 from the electronic medical database of the Emergency Department. The sample size was calculated using the WHO sample size calculator where the level of confidence measure was 1.96 (95%) and the margin of error was estimated to be 0.5. After the application of the finite population, the correction sample size was estimated to be 328. Official approval was taken from the Institutional Review Board & Ethics Committee of our hospital. By using the electronic medical record, a proforma/questionnaire was filled for each patient while excluding the names and other identifiers of the patients to ensure privacy and a serial number was assigned to each proforma. Using this data the following key information was collected: whether the patient had the pulse on arrival or not, the date and time of admission, the duration of stay in the ER, mortality in ER or hospital, and finally disposition from ER. However, patients age under 16 years, and those who were received dead in an emergency (n-103) were excluded from the study. The data of 340 patients were included in the study all of whom underwent CPR in the emergency department. Data were analyzed using SPSS version 23. Data of the patients were divided into two groups i.e. patients with CKD (group A) and patients not suffering from CKD (group B). For the comparison of comorbidities in both groups, the mean of the Charlson Co-morbidity Index was used. The Charlson Co-morbidity is an index that assigns a value from a scale of 1-6 to co-morbidities that the patient might suffer from.[2] The values range for different comorbidities, e.g. 1 for congestive heart failure and 2 for renal disease. After assigning the values for the different comorbidities, they are added up producing a total score. The total scores of different patients are then compared with the outcome e.g. Mortality in the emergency department etc. This method gives the ability to quantify the comorbidities, making it easier to compare outcomes concerning the comorbidities. The data was then analyzed using SPSS version 23 and Pearson Correlation was done to determine the significance of our findings.

RESULTS

From January 2017 to December 2020, we reviewed data from 439 patients, all of whom had undergone the ACLS resuscitation upon their arrival at the Emergency Department (ED). Of these, 76 patients were received dead and 5 didn't have proper documentation of the outcome of resuscitation. These patients were removed from the study. From the remaining pool of 358 patients, 18 patients were under 16 years of age, so they were also not included in the study. In the remaining 340 patients, 84 (24.7%) patients had chronic kidney disease so they were included in group A (CKD group). To avoid selection bias out of the remaining 256 patients every 4th patient was chosen through consecutive sampling technique to form control group Bn = 86 (25.3%, Non-CKD group). Demographic data, Mean Charlson comorbidity Index, Expiry in an emergency, and survival to discharge in both groups are shown in table 1.

	Group A (CKD)	Group B (non-CKD)
Number of Patients	n = 84	n = 86
Gender	M/F = 53 / 31	M/F = 54/32
Age	62.1 (19 - 90)	59.5 (16 - 91)
Charlson co - Index	3.12 (SD = 1.20)	1.05 (SD = 1.47)
Expired in emergency	23 (27.3 %)	28 (32.5%)
Survival to discharge	28 (33.3%)	14 (16.2 %)

Table: 1 Demographics and Mortality in both Groups

Among those having CKD Group A (n=84), 23 (27.3%) expired in ED, 61 (72.6 %) were admitted to the hospital. On the other hand in the Non-CKD Group B (n= 86), 29 (32.5%) expired in ED, 57 (66.2 %) were admitted to hospital.

We performed some further analysis on our data and discovered that out of 237 (69.4%) patients who were admitted to the hospital, a total of 77(32.6 %) patients survived to hospital discharge.

Furthermore, a comparison of survival to discharge from hospital was done between Non-CKD group B and CKD group A. It revealed that out of 61 patients with CKD who were admitted, 28 (33.3%) patients survived and were successfully discharged from the hospital. Out of 56 non-CKD groups B, only 11 (21.4%) survived to be discharged, less than half of the number of those with CKD (P= 0.02).

DISCUSSION

CKD has a global prevalence of between 11 to 13%.[9] In our study, 30.8 % of patients who had CPR in an emergency were found to have CKD. A study found that the most common cause of hospitalization in patients with CKD was an infection, particularly of the urinary tract, followed by cardiovascular conditions such as volume overload and acute coronary syndrome.[10] Another study also found that isolated CKD is rare and is usually associated with multiple comorbidities.[11]

In addition to being an independent risk factor for cardiovascular diseases, all CKD stages are associated with increased cardiovascular morbidity. In cases of ESRD, there is a four times higher risk of Sudden Cardiac Death (SCD) due to ventricular arrhythmias.[12] In people with CKD, structural and electrophysiological remodeling of the heart, vascular calcification, autonomic dysregulation, and volume and electrolyte shifts are some of the underlying processes thought to explain the increased predisposition for SCD. There are several determinants of survival after in-hospital cardiopulmonary resuscitation, including heart rhythm at the time of cardiac arrest and age of the patient. One study found that compared with patients who had a normal sinus rhythm at the time of their arrest, patients who had a Brady arrhythmia had a nearly 2-fold increased risk of dying. In a similar study, it was also noted that the 3-year survival rate was 44.3% in the 70-year-and-older age group compared to 62.2% in the 18- to 69- year old age group.[13]

However, the effect of CKD as a determinant of survival or mortality after CPR has not been thoroughly investigated in Pakistan. Our study showed a statistically significant low mortality rate in CKD patients undergoing resuscitation, which is in contrast to a study conducted in 2016 which found slightly higher in-hospital mortality in patients with CKD undergoing in-hospital cardiopulmonary resuscitation.[14] The success rate of CPR in ESRD patients hasn't been high in the past, but in recent years due to improvements in the procedure, the success rate has gone up, with a higher number of patients being discharged from hospitals as indicated by a higher survival to discharge in CKD group B. However, patients with comorbidities, and especially older aged patients have seen, in general, high mortality, and low success to the treatment.[15] Survival after a cardiac arrest is usually poor. Few studies have been conducted to evaluate the predictors and outcome of cardiac arrest occurring during hemodialysis. Furthermore, heart disease patients, and females, are at greater risk for heart failure in these CKD patients who developed cardiac arrest and underwent CPR.[14]

Usually, in patients with CKD who are dependent on dialysis, the causes of SCD are reversible like hyperkalemia or fluid overload. In this study, the mortality of CKD patients was less than the Non-CKD group. Mortality outcomes of such patients in the scenario of getting timely ACLS have not been extensively studied. Another study published by Saeed et al in 2015 showed higher mortality rates in patients with ESRD undergoing going CPR due to in-patient cardiac arrest than the general patient population without any documented kidney disease (odds ratio, 1.24; 95% confidence interval, P, 0.001). The interesting finding in the 2015 study was that there was an improvement in mortality rates for a patient with ESRD undergoing CPR in the year 2011 as compared to the year 2005(31% vs. 21%, P,0.001). We would like to mention that ACLS guidelines undergo periodic changes after every 5 years and major changes were introduced in the year 2010. A study conducted in 2018 concluded that deviation from following ACLS guidelines was associated with lower survival to hospital discharge. The recent data suggest that survival after CPR is increasing as a result of better guidelines. Whether this better survival in CKD

patients was due to improved resuscitation standard or due to reversible causes in such patients needs further studies with large sample size and randomization.

CONCLUSION

Survival of in-hospital cardiac arrest patients who undergo Cardiopulmonary resuscitation in an emergency is multifactorial but patients with CKD may have a better outcome due to more reversible causes. Large and Multicenter studies are needed with interventions like dialysis during ongoing CPR.

LIMITATION OF THE STUDY

It is a single-center study and data represents cardiac arrest patients of emergency department only, the findings of this research cannot be generalized due to its low sample size. As this study was based on retrospective chart review so we were unable to categorize patients according to their symptoms or clinical severity.

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