The Outcomes of Patients Following Cardiac Arrest At A Tertiary Hospital in Saudi Arabia

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Abstract: In-hospital cardiac arrest is a critical and terminal event for some patients and a transient complication for many others. It is a stressful event for healthcare providers, patients, and family members. In 1960s, the effectiveness of closed chest compression was discovered (1, 2) and since then cardiopulmonary resuscitation (CPR) has been utilized as an effective intervention and became a standard for all hospitalized patients in cases of cardiac arrest.

Objectives: The objective of our study is to measure the characteristics of in-hospital cardiac arrests at King Khalid University Hospital (KKUH) and to evaluate the outcome of those patients after the code and at 6 months.

Patients and methods: Included in this study were all adult patients who sustained a cardiac arrest at KKUH between January 2012 and December 2013. The code forms were reviewed according to the Utstein style.

Results: We identified 445 patients who had a total 628 cardiac arrests during the study period at KKUH. Out of the 445 patients 270 (60.7%) were males. The mean age was 57.8±19.7. The most common initial rhythm was asystole/ pulseless electrical activity in 37% of the codes. Return of spontaneous circulation (ROSC) occurred in 178 (40%). Survival to hospital discharge occurred in 80 (18%) patients. Six months survival was documented in 55 (12.36%) of the original cohort.

Conclusions: Return of spontaneous circulation happens after successful CPR but survival to hospital discharge remains poor after in hospital cardiac arrest. Providing patients and families with this crucial information can enable informed decisions regarding resuscitation.

Keywords: Cardiac arrest, Utstein Style, ROSC and CPR.

I.   INTRODUCTION

In-hospital cardiac arrest is a critical and terminal event for some patients and a transient complication for many others. It is a stressful event for healthcare providers, patients, and family members. In 1960s, the effectiveness of closed chest compression was discovered(1, 2) and since then cardiopulmonary resuscitation (CPR) has been utilized as an effective intervention and became a standard for all hospitalized patients in cases of cardiac arrest.

Management of a disease or condition is routinely based on the chances of success. However, In the case of resuscitation, such knowledge about post in-hospital cardiac arrest is scarce. Studies of in-hospital cardiac arrest report survival rates to hospital discharge within the range of 5-37%(3) with patients arresting on general wards having lower survival rates than those in monitored settings(4-7).

Providing family with accurate information regarding the likelihood of survival from CPR event is crucial to enable informed decisions(8). Such information has been shown to influence patient's preferences regarding resuscitation (9, 10). Unfortunately, there is limited data regarding this in Saudi Arabia.

The aim of this study is to report the experience with in-hospital cardiac arrests at King Khaled University Hospital (KKUH) over a 2-year period.

II.   LITERATURE REVIEW

In-hospital cardiac arrest is a very stressful event for patients, family members, and healthcare providers during a hospital admission. Since the development of cardiopulmonary resuscitation (CPR) over 50 years ago(1, 2) resuscitation has become the standard of care for all in-hospital cardiac arrests with physicians requiring consent from patients or family members to withhold it.

Treatment of a disease or condition is routinely based on the chances of success but in the case resuscitation post in-hospital cardiac arrest such information is scarce. In-hospital cardiac arrest studies show survival rates to hospital discharge in the range 5 to 37% (3). The big variation of the survival rates for in-hospital cardiac arrests is related to whether the arrest happened in a monitored or non-monitored setting, with patients arresting on general wards having lower survival rates than those in monitored settings (4-7).

Peatfield et al. reported the survival after in-hospital cardiac arrest at a district general hospital in London, England. During the 10-year period, there were 1063 cardiac arrests in the general areas of the hospital excluding the coronary and intensive care units. In 718 (67.5%) the initial resuscitation was unsuccessful; in 252 (23.7%) the patient died later in hospital, 93 patients (8.7%) were discharged alive. After discharge from hospital there was a progressive annual mortality of about 7% for the first five years, but there after no patient died. The probability of successful resuscitation was greater in patients with primary cardiac disease (11.8% survival), drug overdose (22.2% survival), or undergoing anesthesia (20.0% survival). The success rate was significantly greater in the accident and emergency department (7.9%) than on the wards (2.1%), they reveal that this difference was due entirely to the more successful resuscitation of patients with myocardial infarction in the accident and emergency department. Within each diagnostic category the survival-rate was independent of the age of the patient (7).

Studies that have reported a higher survival rate after in-hospital cardiac arrest had a large percentage of the arrests happening in monitored areas (intensive care unit or other monitored beds). Hershey et al. reviewed all patients who had CPR at Cleveland metropolitan hospital over a 6-month period. They found that the number of patients surviving to hospital discharge varied from 3% on general wards to 19% in the intensive care unit and the emergency department (6).

About twenty years later, Herlitz et al. reviewed all patients who suffered an in-hospital cardiac arrest and attempted to be resuscitated during a 4-year period in Sweden. They aimed to describe the characteristics and outcome among patients with in-hospital cardiac arrest in relation to whether the arrest took place in areas with or without monitoring facilities. They showed that the outcome of in-hospital cardiac arrest depended on multiple factors such as the degree of training and expertise of the nurses, in advanced and basic cardiac life support, the distance from, and the ability to use, emergency equipment and the location of the ward within the hospital. Survival to discharge was higher at 43.2% when the arrest took place in a monitored setting compared to 31.1% in non-monitored setting. A shortening of the interval to between collapse and defibrillation in these patients might increase survival even further(5).

Schwartz et al. reported on the survival to discharge post in-hospital cardiac arrests on an internal medicine clinical teaching unit. They showed that although return to spontaneous circulation happened in 34.9% of the patients but only 2.4% of them survived to hospital discharge(11).

Providing families with accurate information regarding the likelihood of survival from a resuscitation event is crucial to enable informed decisions (8). Such information has been shown to influence patient's preferences regarding resuscitation attempt(9, 10). There is especially very little data regarding survival after non-monitored in-hospital cardiac arrest in Saudi Arabia.

Abdulaziz Aldawood evaluated the outcome of patients who were admitted to the intensive care unit after cardiac arrest in a tertiary care hospital in Saudi Arabia over a 7-year period (2000 to 2007). During this period 495 survived their cardiac arrest and were admitted to the intensive care unit. He reported that only 7.7% of those survived to hospital discharge. The most common reason for cardiac arrest among those patients was primary cardiac disease (24.2%), followed by respiratory disease (22.4%)(12).

Rehmani et al. reported the outcome of 49 adult in-hospital cardiac arrests at King Abdulaziz Hospital in AlAhsa, Saudi Arabia. Of the reported arrests 32 occur in the monitored area (intensive care unit, coronary care unit, special duty unit). The remainders 17 cardiac arrests occurred on the wards (non-monitored area). The overall survival to discharge was 30.6%. The survival rate of in-hospital cardiac arrests in monitored areas was 37.5% compared to 17.6% in non-monitored areas(13).

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The in-hospital "Utstein Style":

The Utstein Style was developed for reviewing, reporting, and conducting research on cardiac arrests. It arose from a 1990 conference at the ancient abbey of that name on an island near Stavanger, Norway. Many researchers and system directors have adopted the Utstein style to report results of pre-hospital resuscitation (14, 15). The success of this international initiative led to uniform international styles for reporting the results of pediatric resuscitation(16), experimental (laboratory) resuscitation(17), and In-Hospital Resuscitation(15).

This style was adopted to unify nomenclature and definitions across reports without which it would be impossible to assess the effectiveness of in-hospital resuscitation. The Utstein Style collects data related to the hospital, patient, arrest and outcome, which are needed to report cardiac arrest cases. Task force members suggest that all the four critical intervals must be included in all reports of in-hospital resuscitation; collapse to cardiopulmonary resuscitation, collapse to first defibrillation applied to the patient, collapse to advanced airways management and collapse to the time when they resuscitated him with medications(15).

The Utstein Style has been used to report in-hospital cardiac arrest. Fredriksson et al. reported seven years experience with in-hospital cardiac arrest from the Sahlgrenska University Hospital in Sweden. They showed that 37% of 833 cardiac arrests survived to hospital discharge. 94% of them had a good cerebral outcome and 86% were still alive one year after discharge(18).

III.   RATIONAL OF THE STUDY

This study may explores where is the defect in resuscitation and rise the points which can improve the outcome of in-hospital cardiac arrest and this study will provide the factors which may affects the outcome between monitored and non-monitored patients. Also, providing families with accurate information regarding the likelihood of survival after in-hospital cardiac arrest is crucial to enable informed decisions. Such information can help patients and families decide regarding resuscitation.(18).

IV.   METHODOLOGY

Our study is a retrospective cohort study that documents the characteristics and measures the survival rate of In-hospital cardiac arrests among adult patients at King Khalid University Hospital in Riyadh, Saudi Arabia.

This study took place at King Khalid University Hospital in Riyadh, Saudi Arabia. The hospital is one of the main hospitals in the northern region of Riyadh. It is a tertiary care University Hospital that has 800 beds with all general and subspecialty services.

We reviewed all cardiac arrests that happened at King Khalid University Hospital over the period between January 2012 and December 2013.

We studied adult patients who developed cardiac arrest at King Khalid University Hospital during the study period. This included cardiac arrests that happened in the intensive care units, coronary care unit, emergency department, operating room, and general adult wards. We excluded arrests in the pediatric age group (defined as below 12 years of age) and codes with insufficient patient identification.

We did not calculate a sample size as we included the whole population of patients that had a cardiac arrest in the study period.

Data was collected from the cardiopulmonary resuscitation reports at King Khalid University Hospital and the patient's medical records. The data points reviewed were based on the Utstein style.

Data points include: baseline demographics, date, location, whether it is witnessed, monitored, and if there is advanced cardiac life support (ACLS) interventions at the time of the event. It also includes: event variables e.g.: the cause, patient's

initial condition and initial rhythm, event times and the resuscitation attempted details. The last section in the Utstein style form covers outcome variables including: awakening time, in-hospital event outcome, if the patient is alive after 6 months, 1 year or died and the principle cause of death.

The data was entered and analyzed by using Statistical Product and Service Solutions (SPSS) version 16.0. Continuous variables were quantified by mean and standard deviation (SD). Means were compared using student's t-test. Chi-square test was used to compare categorical data.

To facilitate our access to the nursing department records our research supervisor granted us a consent letter addressed to the head of nursing department. We also requested permission (consent) to access the hospital mortality records to confirm deaths in the data.

In this study we insisted to ensure confidentiality of the involved patients by de-identifying their personal data.

This work will benefit authorities providing resuscitation services at different health care institutions mainly in Saudi Arabia.

V. RESULTS

We identified 445 patients who had a total 628 cardiac arrests during the study period at KKUH. Out of the 445 patients 270 (60.7%) were males. The mean age was 57.8±19.7. Only 5(1.1%) of the patients had were found to have a do not resuscitate order after the code blue was called.

Of the 445 patients who had an in-hospital cardiac arrest 121(27.2%) patients had more than one codes. Of the total cohort of patients 18.2% had two codes, 5.2% had three codes, 2.9% had four codes, 0.7% had five codes, and 0.2% had 6 codes. (figure 1)

Fig1: Percentages of Codes
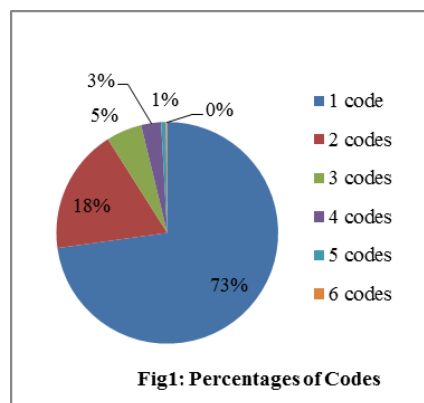
Of the 628 codes during the 2-year period, 255 (40.66%) codes happened in the intensive care unit, 215 (34.29%) happened in the general wards, 134 (21.37%) happened in the emergency department, 2 (0.3%) happened in the operating room, and 21(3.3%) happened in other locations within the hospital (Radiology Department, Out-Patient Clinics, etc.). (table 1),(figure2)
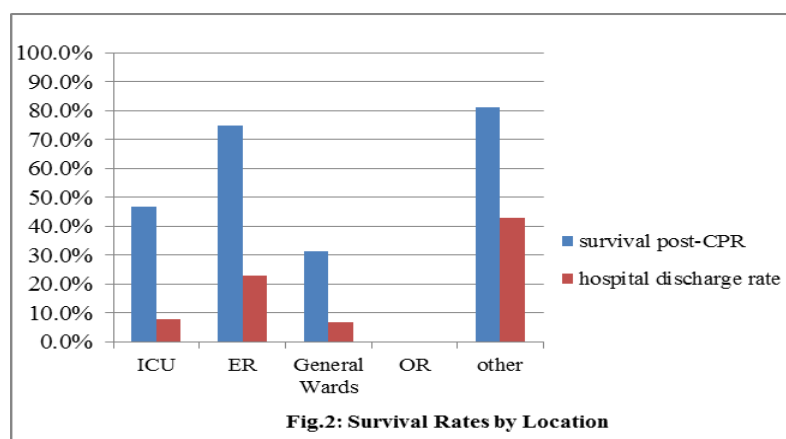

Fig.2: Survival Rates by Location

Table 1: Survival Rates by Location

Location	Total	Survival rate post-CPR	Survival rate post-CPR within location	Hospital discharge rate within location
ICU	255	35.1%	46.7%	7.8%
ER	134	12.4	31.3%	6.7%
General Ward	215	47.5%	74.9%	22.8
OR	2	0.0%	0.0%	0.0%
Other	21	5%	81%	42.9%

The first recorded rhythm in the arrest was Asystole in 171(27.2%) codes, Pulseless Electrical Activity (PEA) in 61(9.7%) codes, Ventricular Fibrillation in 28(4.6%) of the codes, and Ventricular Tachycardia in 22(3.5%) of the codes. Other initial rhythms, as defined by Ustein style, were Bradycardia in 119(18.9%) of the codes, Perfusing Rhythm in 62(9.9 %) of the codes, and Heart block in 4(0.6 %) codes. The initial rhythm was not documented in 161(25.6 %) of the codes. (table 2),(figure3)
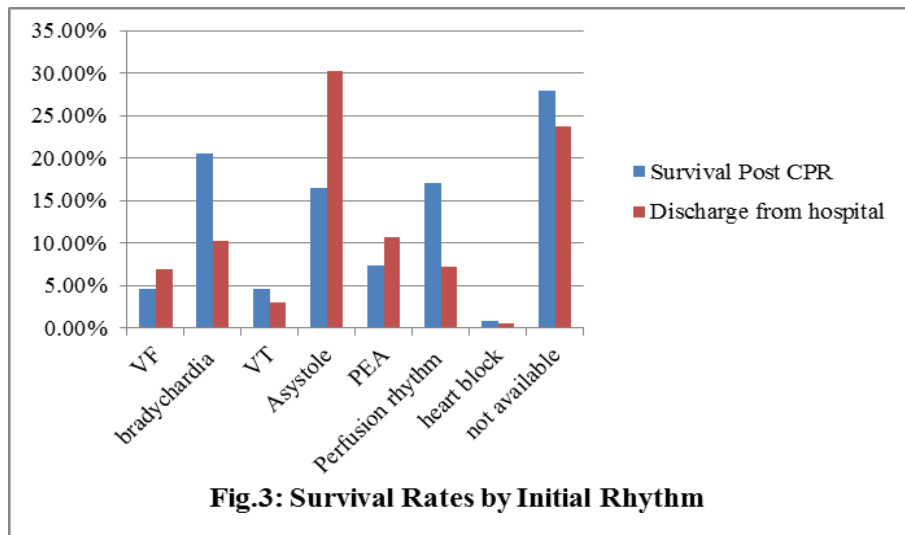

Fig.3: Survival Rates by Initial Rhythm

Table2: Survival Rates by Initial Rhythm

Initial Rhythm	Count	Survival within initial rhythm	Survival Post CPR	Discharge from hospital
VF	28 (4.5%)	16 (57.1%)	16 (4.7%%)	6 (6.9%)
Bradycardia	119 (19%)	70 (58.8%)	70 (20.6%)	9 (10.3%)
VT	22 (3.5%)	16 (72.7%)	16 (4.7%)	6 (3.0%)
Asystole	171(27.3%)	56 (32.7%)	56 (16.5%)	7 (30.3%)
PEA	61 (9.7%)	25 (41.0%)	25 (7.4%)	3 (10.7%)
Perfusing Rhythm	62 (9.9%)	58 (93.5%)	58 (17.1%)	23 (7.2%)
Heart block	4 (0.6%)	3 (75.0%)	3 (0.9%)	1 (0.6%)
Not Available	160 (25.5%)	95 (59.4%)	95 (28.0%)	32 (23.8%)
Total	627 (100%)	339	339 (54.1%)	87 (13.9%)

Return of spontaneous circulation (ROSC) occurred in 338 (53.85%) arrests. ROSC was higher after codes in the general wards at 74.9% compared to codes in the intensive care unit at 46.9%. Odds ratio and 95% confidence interval is 0.293; 0.198 – 0.435 (p-value ≤ 0.001). ROSC was also higher for codes with an initial rhythm of VT/VF at 64% compared to codes with an initial rhythm of AS/PEA at 34.9%. Odds ratio and 95% confidence interval is 3.314; 1.752 – 6.269 (p-value ≤ 0.001). (table 3),(table 4)

Table 3: Comparison Between Locations

The comparison	P-value	Confidence interval	Odds ratio
ICU+ER vs. General Wards in post-CPR survival rate	≤ o.oo1	(0.164 - 0.342)	0.237
ICU+ER vs. General Wards in hospital discharge rate	≤ o.oo1	(0.166 – 0.446)	0.272
ICU vs. General Wards in post-CPR survival rate	≤ 0.001	(0.198 – 0.435)	0.293
ICU vs. General Wards in hospital discharge rate	≤ o.oo1	(0.165 – 0.501)	0.287
ER vs. General Wards in post-CPR survival rate	≤ 0.001	(0.095 – 0.247)	0.153
ER vs. General Wards in hospital discharge rate	≤ o.oo1	(0.115 – 0.515)	0.244

Table 4: Comparison Between Initial Rhythms

| Initial Rhythm	Count	Survival Within Initial Rhythm	Survival Post CPR	Discharge from the Hospital
VT or VF	50	32 (64.0%)	28.3%	12 (54.5%)
AS or PEA	232	81 (34.9%)	71.7%	10 (45.5%)
Total	282	113	113 (40.1%)	22 (7.8%)

Survival to hospital discharge occurred in 80(18%) patients. Survival up to three month was documented in 51 (11.5%) patients of the total cohort while Six months survival was documented in 36 (8.1%) of the original cohort. (figure4)

Fig.4: Survival Rates
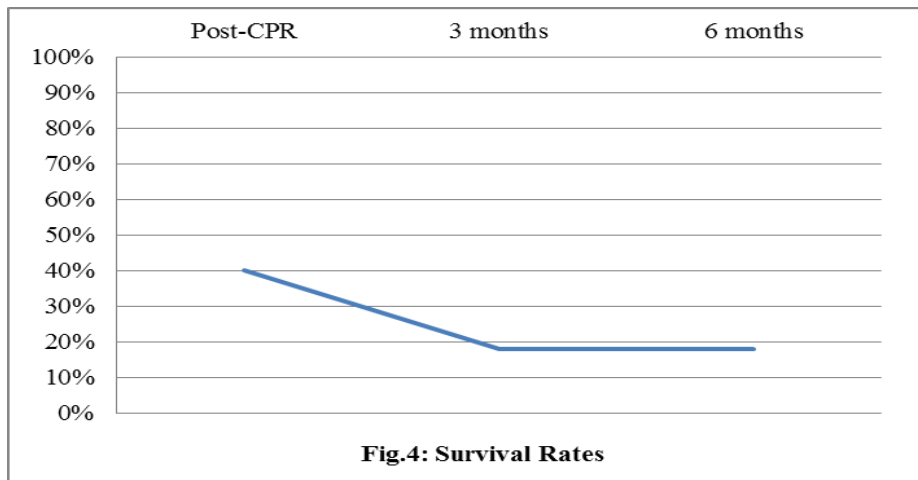
Survival to hospital discharge was higher after codes in the general wards at 22.8% compared to codes in the intensive care unit at 7.8%. Odds ratio and 95% confidence interval is 0.287; 0.165 – 0.501 (p-value ≤ 0.001). It was also higher for codes with an initial rhythm of VT/VF at 24% compared to codes with an initial rhythm of AS/PEA at 4.3%. Odds ratio and 95% confidence interval is 7.011; 2.830 – 17.364 (p-value ≤ 0.001) (table 3),(table 4).

Table 5: Survival Rates by Causes

Causes of Cardiac Arrest	Total	Percentages	Post-CPR survival rate within the cause	Hospital discharge rate within the cause
Arrhythmias	39	6.21%	66.7%	12.8%
Hypotension	36	5.73%	61.1%	13.9%
Respiratory	89	14.17%	58.4%	18%
Metabolic	46	7.32%	69.6%	13%
Cardiac	65	10.35%	43.1%	9.2%
Sepsis	46	7.32%	39.1%	4.3%
Other	139	22.13%	58.3%	23%
Unknown	168	26.75%	53.2%	11.5%

Figure5: Percentages of Causes
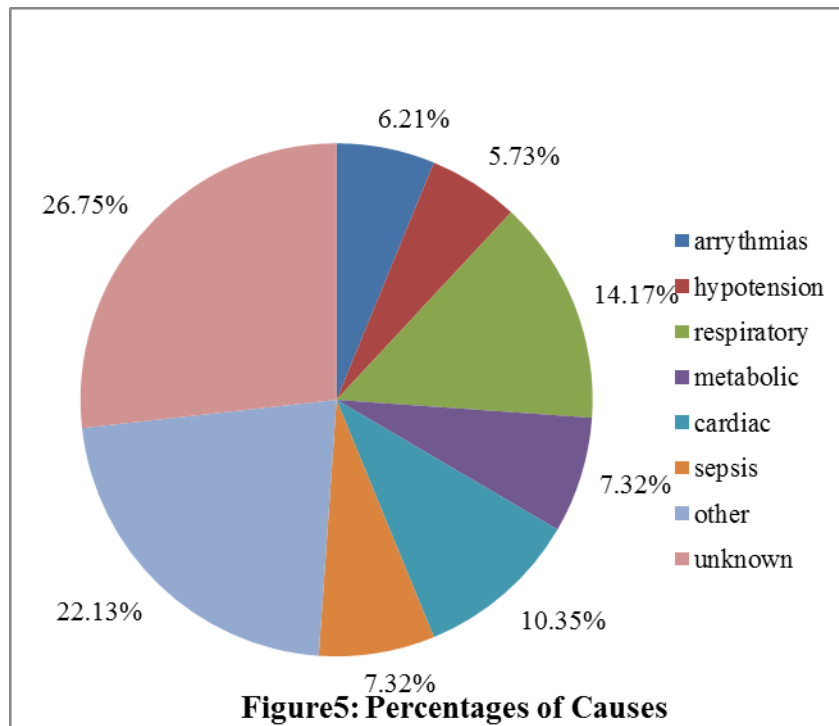
VI. DISCUSSION

In our study, the focus of attention is to provide information about the likelihood of survival from resuscitation attempts applied on KKUH in-hospital cardiac arrests between emergency department, Intensive care units and general wards. Out of 628 cardiac arrest codes resuscitated at KKUH 215 (34.2%) had cardiac arrests in general wards. The initial resuscitation was unsuccessful in 54 (25.1%) of the patients and 165 (76.7%) who had successful resuscitation died later in hospital which means only 50 (23.3%) of the patient were surviving to hospital discharge. Our study has shown that the patients arresting in general wards having higher survival rates than those in the other settings, and when we compared our results with the previous studies we found that the general wards have lower survival rates, and they described the reason behind that is when cardiac arrest occurs in monitored areas, expert help is immediately available and advanced life support (ALS) is provided by first responders, while in the wards the staff are usually skilled only in basic life support (BLS), so that defibrillation and ALS depend on the arrival of a cardiac arrest team (CAT), activated in an emergency. In addition, it was mentioned in the study that the cardiac arrests happened between 05:00 p.m. and 09:00 a.m. have their chances of survival lower than those who have it during the day. And they stated the reasons behind that are low number of working staff at night, insufficient training of the staff or both. Those could cause a delay in the detecting and responding to the arrested patients (20, 4).

Out of 628 patients who have cardiac arrest in king Khalid university hospital 256 patients about 40.8% have cardiac arrest in intensive care unit. The initial resuscitation was unsuccessful in 137 (53.7%) of the patients and 236 (92.2%) who had successful resuscitation died later in hospital that's mean only 20 (7.8%) of the patient were surviving to hospital discharge. When we compered our results with other studies we found the surviving to hospital discharge is equal to Previous studies was done by Abdulaziz Aldawood(12) indicate that only 7.7% survived to hospital discharge however Rehmani et al(13) reported that The survival rate of in-hospital cardiac arrests in intensive care unit was 37.5% which is much higher than our results.

Among 628 managed arrests, there were 134 (21.3%) patients who had cardio-pulmonary arrest at the emergency room (ER) in which had the least cases of CPR. Approximately, 92 subjects died after the initial resuscitation which means 68.7% was unsuccessful resuscitation and 125 patients (93.3%) had a successful CPR died later in hospital. Consequently, only nine patients (6.7%) survived to hospital discharge.

Comparing our study to a previous study done by Masoud Saghafinia(21) who found that the emergency room had the most cases of CPR compared to other locations, there were 116 subjects (37%)at the ER, 82 patients (70.7%) died after the initial resuscitation which is similar to our study results. On the other hand, a study conducted by Hugh Tunstall-Pedoe (22), 68% of patients in the ER survived to discharge, which is much higher than our result.

Among 628 resuscitated codes 381 (60.4%) of them were male patients and 247 (39.3%) were female. The resuscitation of 176 (46.4%) of the male was unsuccessful and patients died during the initial resuscitation while 203 patients (53.6%) had survived the initial resuscitation, Only 49 of them have return there normal pulse and survived to hospital discharge and the rest had died later in the hospital.

In the female 134 patients (54.5%) survived the initial resuscitation and 112 (45.5%) patients died. Only 39 female patients had survived to hospital discharge and the rest (96 patients) had died later in the hospital. In conclusion, 15.8% of female patients and 12.9% of male patients had survived to hospital discharge.

Previous study done at the Sahlgrenska University Hospital[18] found that 38% of the males and 37% of the females survived. Also a study conducted by Claudio Sandroni[20] found that there was no outcome difference between males and females.

In a study done by Abdulaziz Aldawood in Saudi Arabia he observed that patients with ventricular fibrillation or ventricular tachycardia have better survival outcomes among patients who survived initial CPR[12]. Also, previous American study had concluded that Survival outcomes following cardiac arrest with initial rhythm of VT and VF are similar, and substantially better than the outcomes of those with PEA and asystole[21]. These results are correspondent to what we observed in our study.

For the prognosis of cardiac arrests, the underlying medical condition has a major influence. Those causes are categorized under arrhythmias, hypotension, respiratory, metabolic, cardiac, sepsis, other, and unknown. It is shown that sepsis and cardiac causes accounts for the highest mortality rates whether post-CPR or in-hospital mortality rates. Unlike in other study (7) that shows good prognosis for arrested patients with myocardial infarction. In addition, patients with respiratory causes appeared to relatively good prognosis and higher chance of hospital discharge, while in another study it was documented that respiratory causes are one of the bad prognostic causes.

VII.   CONCLUSION

After all, this paper has clearly shown that return of spontaneous circulation after a successful CPR is relatively good in comparison to what have been documented in the other studies, but survival to hospital discharge remain s poor after in-hospital cardiac arrest. By providing patients and their families with this crucial information can enable informed decisions regarding resuscitation and DNR. Based on the results, it can be summed that the cardiac arrest patients at the General Wards have a higher chance of post-CPR survival and hospital discharge, while OR cardiac arrest patients have the lowest chance of survival. In the study, the most common initial rhythm was Asystole with the highest post-CPR mortality rate. And the most common cause of cardiac arrest was respiratory while the least common was hypotension. Last but not least, the general outcomes reveal a serious low rate of survival to hospital discharge, which indicates the need for more attention and improvement.

VIII.   RECOMMENDATIONS

The study shows a significant low survival rate and that could be improved by implementing a trained rapid response team composed of Physician (senior resident or intensivist or hospitalist), Physician's assistant, Critical care RN, Clinical nurse specialist, Respiratory therapist in each hospital building, to provide faster and effective CPR.

Poor documentation of information regarding the cardiac arrest forms is one of the major limitations we faced during research conduction. So, in order to overcome this problem the documentation should be electronic, where it does not accept the cardiac arrest case with missing information. And it should follow the Utstein-Style Guidelines for uniform reporting of cardiac arrest.

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