<u>Original research article</u>

A prospective observational study on initial rhythm during cardiac arrest versus outcome

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 Abstract
Background: In-hospital cardiac arrest (IHCA) is a major cause of death among patients. Extensive research has been performed regarding out-of-hospital cardiac arrest (OHCA), and efforts to improve prognosis have led to a dramatic increase in survival. However, IHCA has not been widely studied, and even basic data, such as incidence, has only been covered in a few reports. Research on cardiac arrest and cardiopulmonary resuscitation (CPR) has considerably increased in recent decades, and international guidelines for resuscitation have been implemented and have undergone several changes.
Objectives: To determine the association of initial rhythm and various factors during IHCA with outcome
Material and Methods: All Adult IHCA patients were included in the study. Study was conducted from June 2022 to March 2023 over 208 patients. Data is collected from the CPR forms of the patients and the survived patients are followed up till discharge. Data was analyzed with descriptive statistical tools.
Results and Conclusion: 208 IHCA patients were taken up for study. Incidence of IHCA is 8.1 per 1000 hospital admissions. In all age groups Males are more than Females. Sepsis is one of the causes of arrest in 44%, CAD (35%), CLD (11.5%) and cancer (8.1%). Though rate of survival to hospital discharge is more after VT as initial rhythm than Asystole/PEA, there is no statistically significant association between initial rhythm and 24hr survival, 48 hr survival, 72 hr survival and survival to hospital discharge. Though CAD was one of the causes of cardiac arrest in 64% of 24hr survival post CPR and 71.4% of survival to hospital discharge patients, the association of it with survival to hospital discharge is not statistically significant. The association of no. of doses of adrenaline given during IHCA is statistically significant with both hospital stay post CPR and survival to hospital discharge. Rate of survival to hospital discharge is 3.37% and it is more in females compared to males.
Keywords: In Hospital Cardiac arrest, Sepsis, PEA, CPR

Introduction
The Utstein-style definition of cardiac arrest is 'the cessation of cardiac mechanical activity... confirmed by the absence of a detectable pulse, unresponsiveness and apnoea (or agonal respirations)'. This definition distinguishes cardiac arrest from respiratory arrest, which is characterized by apnoea with palpable pulses. To ensure uniform reporting on in-hospital cardiopulmonary resuscitation, guidelines known as 'the Utstein style for in-hospital resuscitation research' were published in 1997 [1] and updated recently [2]. According to the Utstein criteria, a cardiac arrest is classified as 'in-hospital' if it occurs in a hospitalized patient who had a pulse at the time of admission.
Data from a number of emergency medical services systems suggest that advances in resuscitation care during the past decade have led to higher rates of survival among patients with out-of-hospital cardiac arrest [3-6]. In-hospital cardiac arrest (IHCA) is a major cause of death among patients [7, 8]. Extensive research has been performed regarding out-of-hospital cardiac arrest (OHCA) [9, 10], and efforts to improve prognosis have led to a dramatic increase in survival [11]. However, IHCA has not been widely studied, and even basic data, such as incidence, has only been covered in a few reports. Previously, the IHCA incidence of elderly patients was analyzed using Medicare data [12, 13] and that of adults was based on the United Kingdom National Cardiac Arrest Audit database [14]. Another study compared the incidence rates of IHCA and OHCA in specific hospitals in the United Kingdom [15]. The IHCA incidence rates in Australia and New Zealand were found [16].
Research on cardiac arrest and cardiopulmonary resuscitation (CPR) has considerably increased in recent decades, and international guidelines for resuscitation have been implemented and have undergone

several changes [17].

Most of the studies were done in the developed countries and very little is known about the prevalence and management of in-hospital cardiac arrest in low-resource settings. We therefore sought to determine the incidence, association of initial rhythm and other factors with outcome, survival to hospital discharge in adult in-hospital cardiac arrest patients in India which is a developing country.

Material and Methods

The present work is a prospective observational study conducted in department of emergency medicine, KAMSRC, LB Nagar, Telangana from June 2022 to March 2023.

After getting the clearance from the institutional ethics committee, a total of 208 patients who fulfilled the inclusion and exclusion criteria are included in the study.

Sample size has been calculated using Kish Leslie formula

$$Z^2 \times p \, (1\text{-}p)/d^2$$

Here

Z = standard normal variable of the confidence interval.

(1.96 For confidence level 95%)

p = prevalence of the disease

(0.246)

d = precision (level of error)

(0.1)

Using this formula the required sample size was found to be 72 patients. I wanted to conduct the study on convenient sample size i.e., as many as I get during my study period.

Inclusion criteria

1. All in-patients of KAMSRC who had IHCA.

Exclusion criteria

1. Age less than or equal to 18 yrs.
2. Patients who left the hospital against medical advice before the discharge.
3. Patients with CPR forms with inadequate information.

The data is collected from the CPR forms of the patients who underwent in-hospital cardiac arrest as per the proforma appended and the patients who survived the resuscitation have been followed up till the discharge.

Statistical methods

Descriptive statistical analysis has been carried out in the present study.

Results on continuous measurements are presented on Mean and results on categorical measurements are presented in number (%). Significance is assessed at 5% level of significance.

Student's t-test, chi-square test and fisher exact test have been used to find the significance of the study parameters on categorical scale between two or more groups. 95% confidence interval has been computed to find the significant features.

Statistical software

The statistical software namely SPSS 15.0, stata 8.0, Med Calc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Microsoft excel have been used to generate graphs, tables etc.
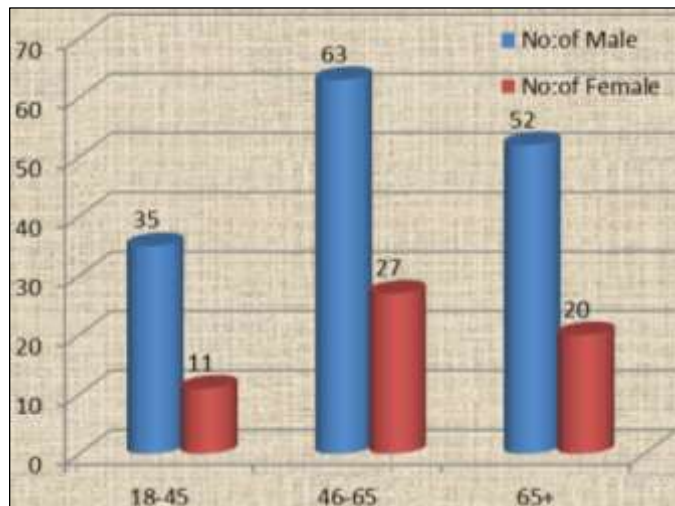
Observations and Results

Fig 1: Age distribution

In all age groups IHCA is more common in Males than Females.
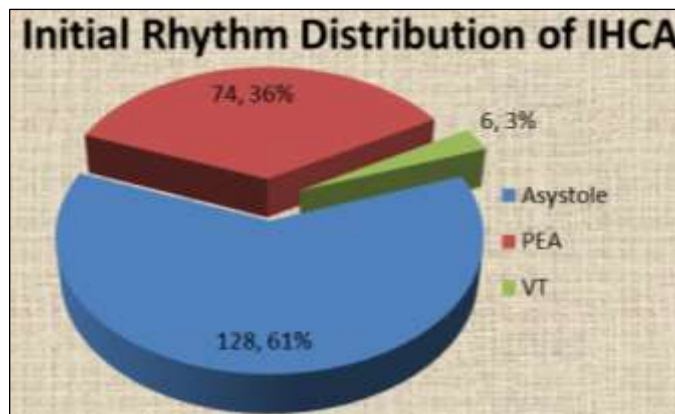
Initial rhythm distribution of IHCA

Fig 2: Initial rhythm distribution of IHCA

Most common Initial Rhythm in IHCA patients is Asystole (61%), followed by PEA (36%) and VT (3%).
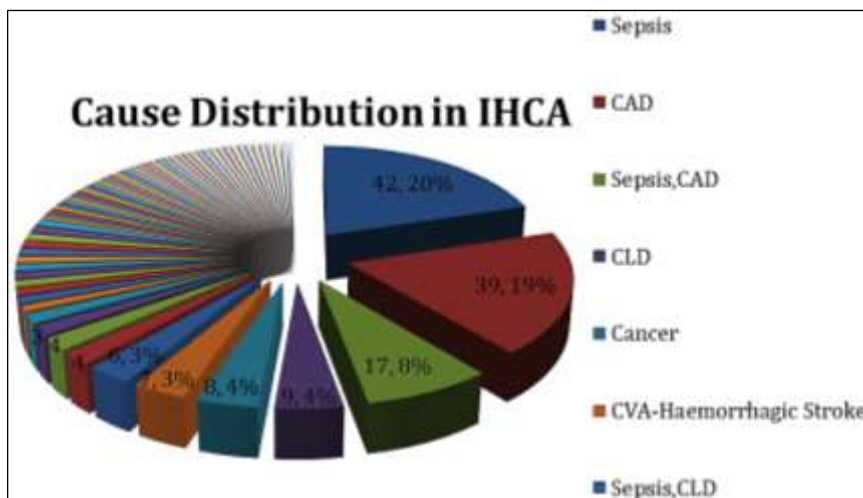
Cause distribution in IHCA patients

Fig 3: Cause distribution in IHCA patients

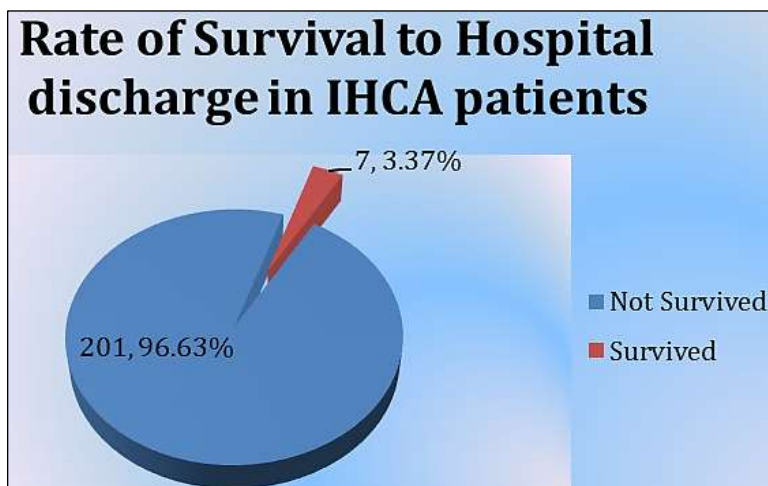**Rate of Survival to Hospital discharge in IHCA patients**

Fig 4: Rate of survival to hospital discharge in IHCA patients

Rate of survival to hospital discharge in patients who had IHCA is 3.37%.

Distribution of initial rhythm during cardiac arrest in IHCA patients who survived to hospital discharge
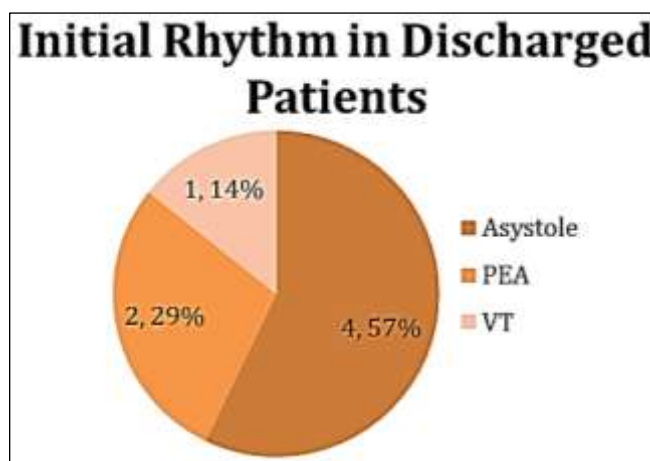

Fig 5: Initial rhythm in discharged patients

Among IHCA patients who survived to hospital discharge, most common Initial Rhythm during Cardiac Arrest was Asystole i.e., 57% followed by PEA & VT.

Cause distribution in 24hrs survival
▪ CAD alone was the most common cause of Cardiac Arrest in 24hrs survival patients which is contributing 29% followed by Sepsis alone-22%, Sepsis with CAD-21%, CAD with CKD-14%.
▪ Among IHCA patients who survived for 24hrs post CPR, CAD was one of the causes of cardiac arrest in 64%, sepsis as one of the causes of cardiac arrest in 43% and either CAD or sepsis as one of the causes of cardiac arrest in 86%.
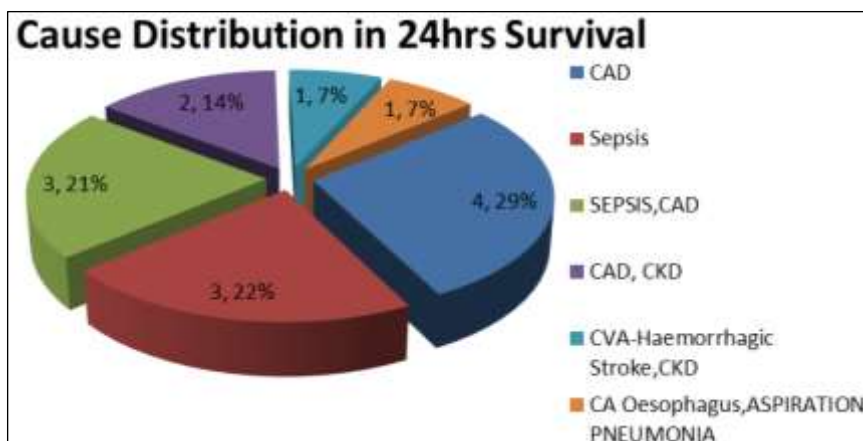
Fig 6: Cause distribution in 24 hrs survival

Table 1: Association of VT with 24hours survival

VT	Survival	Death
Present	1	5
Absent	13	189

Table 2: Association of Non-shockable rhythm with 24hours survival

Non-shockable rhythm	Survival	Death
Present	13	189
Absent	1	5

There is no statistically significant association between initial rhythm and 24hr survival.

Discussion

The Incidence of IHCA in my study is 8.1 per thousand hospital admissions, which is more when compared to the report mentioned in Journal article published in October 2016. In that it was reported as, incidence in Korea is reported as 2.46 per thousand hospital admissions. It was also reported that higher incidence (5.4) is seen in hospitals more than 600 in-patients in comparison to those that had less than 600 in-patients at 4.09. My study is done in more than 600 in-patient hospital in which incidence is found out to be 8.1 even then, it is 1.5 times more compared to Korea in which it is 5.4.

In that article, it was also reported as "A higher incidence was found among Men @ 3.18 compared to women @ 1.84". However in my study, I didn't calculate the incidence among Males & Females but in patients having IHCA, Males are more i.e., 72% compared to Females 28%.

In that article it was also reported as "By Primary disease, the incidence was the highest for infectious diseases". In my study, however I have not calculated the incidence of infectious diseases but Sepsis alone was found out to be the most common cause of IHCA which is 20% followed by CAD alone (19%), followed by Sepsis with CAD (8%).

In a Journal article, published in September 2016, it was reported as "Trauma was the most common admission diagnosis with 76.9% of all Trauma cases having severe head injury. Trauma was followed by Sepsis, Hypertension, CNS disease, Heart disease, Diabetes Mellitus and liver disease". Sepsis was the second most common cause of IHCA but in my study sepsis alone was the most common cause followed by CAD alone followed by sepsis with CAD. Sepsis was the most common cause in my study may be because of the high incidence of infectious diseases in India.

It was also reported that survival after initial CPR (ROSC) occurred in only 7.4 % and survival to 24 h in 1.6 % of the total study cohort. 1.6% of the total study cohort. In my study survival to 24hr s is found out to be 6.7% which is 4 times more compared to that study.

In a journal published on February 4th 2015, in which study was done from 2009-2011, the conclusion was reported as "strong predictors for survival and favourable neurological outcome were VT/VF as initial rhythm, cardiac etiology and time to ROSC <20 min". In my study though increased rates of survival are seen after VT as initial rhythm and presence of CAD as a cause (compared to sepsis), statistically significant association was not found between initial rhythm and CAD with survival. It was also found that there is no association betwen time to ROSC and survival to hospital discharge.

It was also reported that "There is a strong correlation between initial rhythm and etiology". But in my study it was found that association of sepias with initial rhythm and association of CAD with initial rhythm is not statistically significant.

The results of a journal published in November 2012 in which study was done among 84,625 patients were "the initial cardiac-arrest rhythm was Asystole or Pulseless electrical activity in 79.3% and

ventricular fibrillation or Pulseless ventricular tachycardia in 20.7%. During the study period, the proportion of cardiac arrests due to Asystole or Pulseless electrical activity increased from 68.7% in 2000 to 82.4% in 2009." But in my study I found that proportion of cardiac arrests due to Asystole or pulse less electrical activity was 97% and VT in remaining 3%. In that article it is seen that there is an increasing trend of prevalence of non-shockable rhythms from 2000-2009, so may be the prevalence of them have gone up since 2009 too.

It was also reported that the prevalence of septicemia, use of mechanical ventilation and use of intravenous vasopressors before the arrest event increased over time. In my study it was found that sepsis alone is the most common cause of cardiac arrest (20%) and sepsis is one of the causes in 44% of IHCA.

It was also reported that "The overall rate of survival to discharge was 17.0." In my study it was found out to be 3.37% which is 5 times less compared to that.

In a journal article published in January 2010, study performed during 1999 to 2005on 51,919 in-hospital cardiac arrest patients from 411 hospitals, results were "first documented Pulseless rhythm was ventricular tachycardia (VT) in 7%, ventricular fibrillation (VF) in 17%, Pulseless electrical activity (PEA) in 37% and Asystole 39%". In my study it was found that Asystole as a initial rhythm in 61%, PEA in 36%, VT in 3% and VF in none.

The conclusion from that study was "Survival to hospital discharge rate was not different between those with first documented VF and VT. Survival to hospital discharge was slightly more likely after PEA than Asystole; Survival to discharge was substantially more likely after first documented VT/VF than PEA/Asystole. Survival to discharge was also more likely after PEA/Asystole without subsequent VT/VF compared with PEA/Asystole with subsequent VT/VF". Even in my study it was found that survival to discharge is more likely after first documented VT than PEA/Asystole but it was slightly more likely after Asystole than PEA.

It was also reported that "the outcome from IHCA is consistently better when the first monitored rhythm is ventricular fibrillation/Pulseless ventricular tachycardia (VF/VT) rather than non-VF/VT, i.e. Asystole or Pulseless electrical activity (PEA). Survival rates range from 18% to 64% for VF/VT and from 1.2% to 14% for non-VF/VT. There are two major reasons for the better outcome reported in VF/VT rhythms. First, VF/VT rhythms can be treated promptly and successfully with defibrillation. Second, since VF/VT rhythms deteriorate to Asystole if not treated promptly, the presence of a VF/VT implies a recent onset of cardiac arrest. Unfortunately, in the majority of studies VF/VT is the first monitored rhythm in only 20–35% of IHCAs". Even in my study it was found that survival rates are significantly high after VT as initial rhythm (16.6%) than Asystole or PEA (2.9%) but the association between initial rhythm and survival is not statistically significant. But in my study VT is a initial rhythm in only 2.8%.

It was also reported that documented survival rates for IHCA range from 0% to 42%, although major studies report a survival to discharge of approx. 20%. Only 10-15% of patients who receive CPR following a cardiopulmonary arrest in the hospital environment will survive to be discharged. But it my study it was found out to be only 3.7%.

In a journal article published in February 2007, the results and conclusions were "The incidence of IHCA is rarely reported in the literature. Values range between 1 and 5 events per 1,000 hospital admissions, or 0.175 events or bed annually. Reported survival to hospital discharge varies from 0% to 42%, the most common range being between 15% and 20%." The incidence of IHCA in my study is 8.1 per 1000 hospital admissions and survival to hospital discharge is 3.37%. Incidence is more and survival to hospital discharge is less.

It was also reported that "Pre-arrest prognostic factors: the prognostic value of age is controversial. Among co morbidities, sepsis, cancer, renal failure and homebound lifestyle are significantly associated with poor survival. However, pre-arrest morbidity scores have not yet been prospectively validated as instruments to predict failure to survive after IHCA". In my study it was found that sepsis one of the co morbidities in 43%, CAD in 35%, CLD in 11.5% and cancer in 8.1%.

It was also reported that "Intra-arrest factors: ventricular fibrillation/ventricular tachycardia (VF/VT) as the first recorded rhythm and a shorter interval between IHCA and cardiopulmonary resuscitation or defibrillation are associated with higher survival. However, VF/VT is present in only 25-35% of IHCAs". In my study though survival rates are found to be high after VT as initial rhythm but the association is not statistically significant and VT is a initial rhythm in only 3% of IHCA.

Conclusions

208 IHCA patients were taken up for study. Incidence of IHCA is 8.1 per 1000 hospital admissions. In all age groups Males are more than Females. Sepsis is one of the causes of arrest in 44%, CAD (35%), CLD (11.5%) and cancer (8.1%). Though rate of survival to hospital discharge is more after documented VT as initial rhythm than Asystole/PEA, there is no statistically significant association between documented initial rhythm and 24hr survival, 48 hr survival, 72 hr survival and survival to hospital discharge. Though CAD was one of the causes of cardiac arrest in 64% of 24hr survival post CPR and 71.4% of survival to hospital discharge patients, the association of it with survival to hospital discharge is not statistically significant. The association of no. of doses of adrenaline given during IHCA is

statistically significant with both hospital stay post CPR and survival to hospital discharge. Rate of survival to hospital discharge is 3.37% and it is more in females compared to males.

Recommendations

- Sepsis is the most common cause of IHCA, therefore caution has to be taken while managing these patients.
- Most of the IHCA patients are Male and Rate of Survival to Hospital Discharge is less compared to Females, therefore more effective care has to be taken while managing these patients.
- No. of Adrenaline doses given during CPR are associated with increased hospital stay and decreased survival to Hospital Discharge. Therefore accurate documentation of all events of CPR is recommended to carry out further studies.
- Incidence of IHCA is 8.1 per 1000 hospital admissions; therefore staff should be adequately trained to provide ACLS to patients.
- Recurrent mock sessions of Code Blue in hospitals are recommended.

Conflict of interest: None.

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