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A Clinical Study of Arrhythmias In Acute Myocardial Infarction In The Emergency Department: An Observational Study.

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Abstract

Background: Acute myocardial infarction (AMI) is a major cause of mortality globally with arrhythmia being the most common determinant during the hospital stay. Our study aimed to estimate the incidence of cardiac arrhythmia in AMI patients within 48 hours of admission and to correlate the type of arrhythmia with the site of myocardial infarction, its outcome, and other risk factors.

Methods: An observational study was conducted on patients, admitted to the emergency ICU, aged more than 18 years having chest pain with features suggestive of AMI. These patients were closely monitored with Holter monitoring for continuous 12-lead ECG continuously.

Results: 0ne hundred five patients were recruited in our study. The mean age of the patients was 58.97±10.31 with male predominance over female (75.2 % vs 24.8%). 83.8% of patients developed arrhythmia within 24 hours of admission, while 16.2% developed arrhythmia after 24 hours of admission. The most common arrhythmias detected were ventricular premature contraction (22.85%) and complete heart block (21%). The highest mortality was observed with complete heart block (60.9%), followed by ventricular tachycardia (26.1%,) and ventricular fibrillation (8.6%).

Conclusion: Thirteen different types of cardiac arrhythmia occurred, potentially determining the patient's prognosis. The most common arrhythmia observed was a premature ventricular contraction, and the majority of arrhythmias occurred during the first 24 hours of presentation. Overall mortality was 21.9% and the maximum was due to a complete heart block. The outcome of patients with ventricular fibrillation, ventricular tachycardia, and atrial fibrillation was poor irrespective of AMI type.

Keywords: Coronary artery disease, myocardial infarction, Arrhythmia, heart block

Introduction

Coronary artery disease (CAD) is one of the world's leading causes of mortality. [1] According to the National Health and Nutrition Examination Survey (NHANES) data from 2013 to 2016, an estimated 18.2 million Americans aged ≥ 20 years have CAD. Males had a higher prevalence of CAD than females

at all ages. In US adults over 20 years old, the overall prevalence of CAD is 6.7%. The frequency of CAD is 7.4% for men and 6.2% for women. [2] In general, population expansion and aging have led to a rise in the absolute burden of CAD worldwide, which has shifted significantly toward low and middle-income nations like India. In India and the United States, it was projected that CAD caused around 62.5 and 12.7 million years of premature loss of life in 2016 respectively. [3] In India in 1990, there were 10.2 million cases of CAD (95% UI 9.8-10.6); its total number increased to 23.8 million cases (22.6-25.0) in 2016. [4]

Following an acute myocardial infarction, several forms of arrhythmias can develop (AMI). Atrial fibrillation (AF), atrial flutter (AFL), and supraventricular tachyarrhythmias (SVT), including sinus tachycardia, are prevalent but not life-threatening occurrences. Approximately 90% of patients experience ventricular premature contraction (PVC), 40% experience ventricular tachycardia (VT), and 5% experience ventricular fibrillation (VF). The first 24 to 48 hours following AMI are when VF is most prevalent and potentially fatal. Bradyarrhythmia and other conduction blockages appear after an AMI. Third-degree or complete AV block (CAVB) occurs in about 5-8% of patients. The occurrence of total AV block is linked with a bad prognosis, most likely due to the extent of the infarction. [5] AMI with bundle branch block (BBB) has a poor prognosis. This has been linked to the severity of the myocardial injury as well as the frequency of ventricular asystole. [6]

The majority of deaths occur within the first few hours of an AMI. Observations from the monitoring unit indicate that the mechanism of early fatalities is not related to the severity of the infarct, but rather arrhythmias and cardiac asystole in the majority of cases. Proper monitoring of ECG patterns and timely intervention can prevent the adverse outcome of AMI.

The primary objective of the current study was to determine the prevalence of various cardiac arrhythmias in patients who presented with AMI to the emergency department (ED). Our secondary objective was to evaluate the predictive significance of associated risk variables, different arrhythmia, and their kind in connection to the site of infarction.

Methods:

It was an observational study conducted for one year, from July 2019 to June 2020. Ethical approval for this study was obtained from Institutional Ethics Committee in Guwahati Medical College and Hospital on the date of 10/04/2019, with decision number of MC/190/2007/pt-11/MAR-2019/PG/119.

Our study included patients admitted to the emergency ICU, aged more than 18 years having chest pain with features suggestive of AMI. One hundred and five patients admitted with features of ACS were recruited in our study. Patients below 18 years of age, with electrolyte imbalance, previous history of myocardial infarction, and having unknown and undefined arrhythmias of known premorbid condition were excluded from our study.

Criteria for AMI were defined as the detection of a rise and/or fall in cardiac biomarker values (preferably cTn), with at least one value above the 99th percentile URL (upper reference limit) and with at least one of the following: Symptoms of ischemia, new or presumed new significant ST-segment-T wave (ST-T) changes or new left bundle branch block(LBBB), development of pathologic Q waves on the ECG, imaging evidence of new loss of viable myocardium or new regional wall motion abnormality, identification of an intracoronary thrombus by angiography or autopsy.[7]

Patient on arrival at the ED, an immediate survey was done and the patients were examined for any abnormality in ABCDE, i.e. airway, breathing, circulation, disability, exposure, and relevant examination and resuscitation were done.

The primary survey & initial resuscitation was followed by a secondary survey including sample history taken and management done as usual. A predefined electronic pro forma was prepared to include all relevant data from history, physical examination, investigations, and outcomes for every patient included in the study.

Written informed consent was taken from all patients or their attendees if the patient is altered sensorium. Consent was taken again in those patients for whom attendees gave consent when they became alert and eligible to give consent. All personal identifiers were kept strictly confidential and stored separately from the clinical information collected. Demographic data,

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clinical data, and ECG presentation were documented at the time of admission. Subsequent ECG changes during the hospital stay were recorded and documented through continuous 12-lead ECG monitoring.

Various investigations like Cardiac Biomarkers-Troponin T(Qualitative), CK-MB, 2D-Echocardiography using ACUSON CV 70 by PHILIPS to evaluate regional wall motion abnormality and LV function, random blood sugar, serum electrolytes (Na+. K+, Mg+2, Ca+2), urea, creatinine, serum cholesterol was done and assessed.

The incidence of different arrhythmias was recorded and managed accordingly. Cases are classified according to the 'Killip' classification into four groups. Class I: No signs of pulmonary or venous congestion; Class II: Moderate heart failure as evidenced by rales at the lung bases, S3 gallop, tachypnea, or signs of failure of the right side of the heart, including venous and hepatic congestion; Class III: Severe heart failure, pulmonary edema; and Class IV: Cardiogenic shock.

A potential source of bias like confounding bias and selection bias was minimized by following exclusive diagnostic criteria of AMI and eliminating cases of exclusive criteria after proper history taking, clinical findings, and laboratory testing.

The sample size was calculated using online Raosoft statistical software. The sample size was estimated by observing our previous year's electronic data of patients who were admitted to ED with ACS. It was found that 70% of patients developed mild and severe cardiac arrhythmia within 48 hours of admission. Considering a level of confidence of 95% and a margin of error of 8.5%, a total of 105 patients were required for our study.

Statistical Analysis:

The data were entered into MS Excel spreadsheets and analyzed using SPSS (Version: 21.0) statistical package. The description of the data was in the form of mean ± SD for quantitative data while in the form of % proportion for qualitative (categorical) data. D Agostino's K-squared test and Kolmogorov- Smirnov test were done to test the normality of the distribution of a continuous variable. The differences in the proportion were tested for statistical significance using a non-parametric Chi-square test for variables measured on a nominal scale. A p-value of less than 0.05 was considered statistically significant.

Results:

The mean age of the patients was 58.97±10.31 with a range of 18 to 86 years. 75.2 % of cases were male and 24.8% of cases were female. Demographic profile, associated risk factors. ST-segment on ECG, Killip classification, and blood chemistry at the time of admission are shown in Table 1.

The distribution of wall involvement is shown in Table 2. Inferior wall myocardial infarction (IWMI) was the commonest, followed by anterior wall myocardial infarction (AWMI), and the least one was posterior wall myocardial infarction (PWMI).

Thirteen different types of arrhythmias were observed in the study population as shown in Table 3 and each occurred at a different frequency. VPC (22.85%) was the most common arrhythmia observed

In the present study, 83.8% of patients developed arrhythmia within 24 hours of admission, while 16.2% developed arrhythmia after 24 hours of admission (Figure 1).

Using the chi-square test overall outcome is compared with the different age groups of the cases. There was a significant relationship between the age group and the outcome. Mortality was highest in the 58- 67 age group and least in the 18-27 age group (Figure 2).

The majority (56.2%) of arrhythmias underwent spontaneous resolution. It persisted in 14.3% of patients for 48 hours, 20% required pharmacological intervention, and 9.5% required electrical intervention.

Out of the 105 cases of acute MI studied, 78.1 % of cases were recovered, and 21.9% of cases died. 63.8% (67) patients were thrombolysed and 36.2% (38) were not thrombolysed (Table 2).

Sex, alcohol intake, and hypertension did not significantly affect mortality in our study(p-value>0.05). However, there was a significant association between smoking and diabetes Mellitus (DM) and mortality (p-value<0.05).

Using the Chi-square test various arrhythmias were assessed for relation with the wall involved in MI. The pattern of arrhythmias is shown in Table 2.

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The overall outcome was compared with various types of arrhythmias observed in this study and is shown in Figure 3. It was found that the type of arrhythmia significantly affects mortality.

The overall outcome was compared with the wall involved in AMI (Table 2). It was found that the wall involved affected the prognosis significantly. The highest mortality was observed in IWMI, followed by AWMI and no mortality was seen in LWMI, PWMI, and non-ST segment elevation myocardial infarction (NSTMI).

Table:

Table 1:Demographic Profile, risk Factors, ST-Segment in ECG, Killip classification, and blood chemistry at the time of admission.

Parameters		Mean±SD/No (%)
Age		58.97±10.31
Body Mass Index		35.2390±4.58
Gender	Male	79(75.2%)
	Female	26(24.7%)
St-segment in ECG	STEMI	100(95.2%)
	NSTMI.	5(4.7%
	smoking	71(67.6%)
	Alcohol	33(31.4%)
	T2DM	69(65.7%)
Risk factors	Hypertension	62(59%)
	Dyslipidemia	31(29.5%)
	Family history of CAD	27(25.7%)
Killip classification at	KILLIPS 1	87(82.8%)
The time of admission	KILLIPS 2	14(13.3)
	KILLIPS 3	2(1.9%)
	KILLIPS 4	2(1.9%)
	B. Glucose	183.46±59.21
	S. Cholesterol	197.49±57.27
	CPK-MB	51.02±19.94
Blood chemistry	Urea	34.58±10.98
	Creatinine	0.812±.22
	Sodium	139.27±2.98
	Potassium	4.226±.49

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SD: Standard deviation, STEMI: ST-segment elevation myocardial infarction, NSTEMI: Non-ST segment elevation myocardial infarction, T2DM: Type 2 Diabetes Mellitus, CAD: Coronary Artery Disease, CPK-MB: Creatine phosphokinase -MB.

Table 2: **Showing wall involvement and outcome**

	Distribution of cases with wall involvement(no&%)			
ACS Types	Cases	Dead	Recovered	p-value
AWMI	38(36.2%)	3(7.8%)	35(92.1%)	<.001
IWMI	59(56.2%)	20(33.89%)	39(66.1%)	<.001
PWMI	1(.95%)	0(0%)	1(100%)	>.05
LWMI	2(1.9%)	0(0%)	2(100%)	>.05
NSTMI	5(4.8%)	0(0%)	5(100%)	>.05
Total	105	23(21.9%)	82(78.09%)	
Thrombolysis	67(63.8%)			

ACS: Acute coronary syndrome, AWMI: Anterior wall myocardial infarction, IWMI: Inferior wall myocardial infarction, PWMI: Posterior wall myocardial infarction, LWMI: lateral wall myocardial infarction, NSTMI: Non-ST segment elevation myocardial infarction. *p-value<.001* was very significant; *p-value>.05* was insignificant.

Table 3: Distribution of arrhythmia with respect to different types of ACS

	Types of ACS										
Type of arrhythmia	AWMI		IWMI		LWMI		PWMI		NSTMI		p-value
	f	%	f	%	f	%	f	%	f	%	
VPCs	19	50%	2	3%	1	100%	1	50%	1	20%	
AIVR	6	16%	5	9%	0	0%	0	0	0	0%	
AF	0	0%	1	2%	0	0%	0	0	2	40%	<0.05
VT	5	13%	3	5%	0	0%	0	0	1	20%	
VF	1	3%	1	2%	0	0%	0	0	0	0%	
Sinus tachycardia	2	5%	5	9%	0	0%	1	50%	0	0%	
Sinus bradycardia	1	3%	5	9%	0	0%	0	0	0	0%	
1st-degree AV block	1	3%	7	12%	0	0%	0	0	0	0%	
2nd degree AV block	1	3%	5	9%	0	0%	0	0	0	0%	
CHB	2	5%	19	32%	0	0%	0	0	1	20%	
BFHB	0	0%	1	2%	0	0%	0	0	0	0%	
RBBB	0	0%	3	5%	0	0%	0	0	0	0%	
LBBB	0	0%	2	3%	0	0%	0	0	0	0%	

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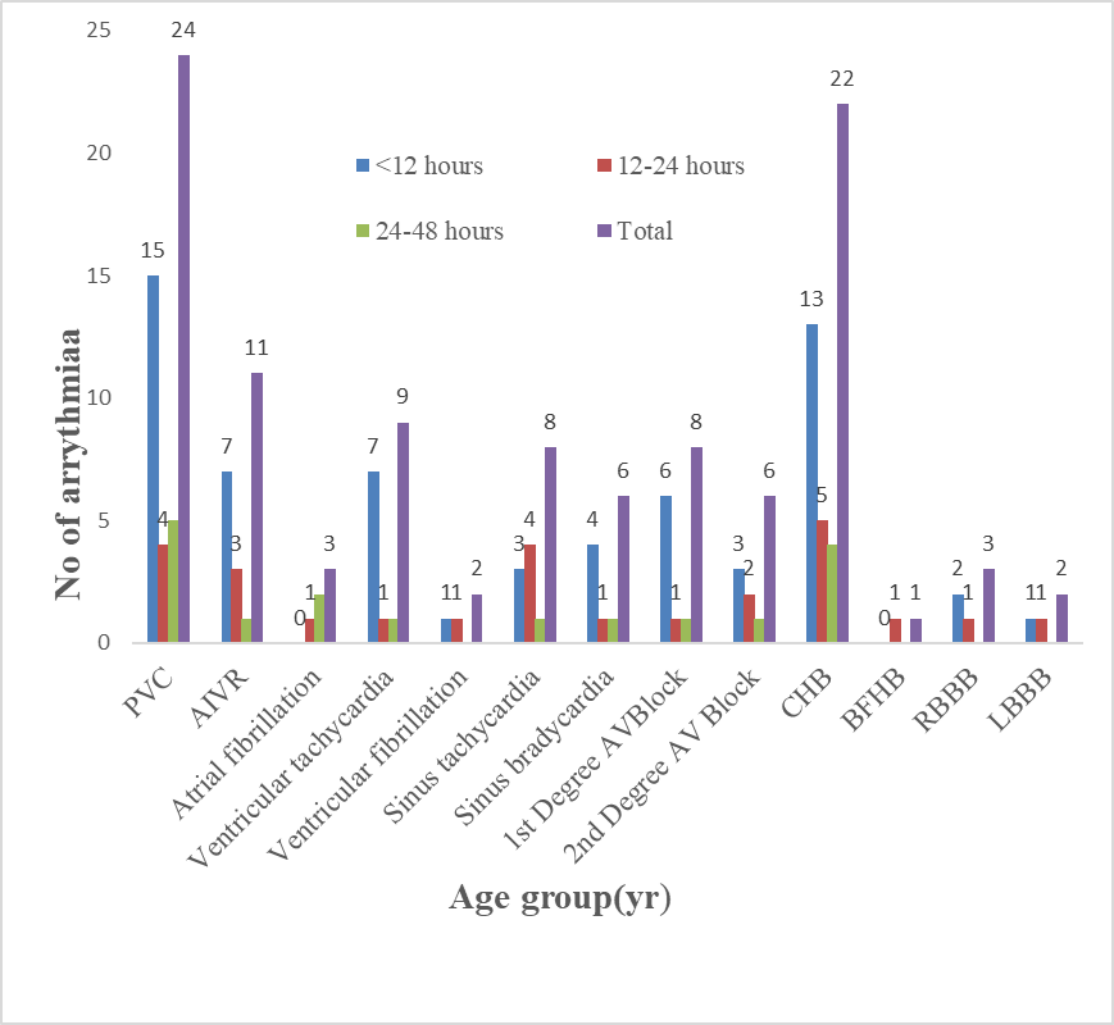
Total	38	100%	59	100%	1	100%	2	100%	5	100%

ACS: Acute coronary syndrome, f: frequency, VPC: Ventricular premature contracture, AIVR: Accelerated idioventricular rhythm, AF: Atrial fibrillation, VT: Ventricular tachycardia, VF: Ventricular fibrillation, CHB: Complete heart block BFHB: Bi-fascicular heart block, RBBB: right bundle branch block, LBBB: left bundle branch block. AWMI: Anterior wall myocardial infarction, IWMI: Inferior wall myocardial infarction, LWMI: Lateral wall myocardial infarction, PWMI: Posterior wall myocardial infarction, NSTMI: Non-ST segment elevation myocardial infarction.

p-value<.05 was statistically significant. (chi-square test).

Figure And Illustrations:

Figure 1: Distribution of arrhythmia in the different age groups.



VPC: Ventricular premature contracture, AIVR: Accelerated idioventricular rhythm, AF: Atrial fibrillation, VT: Ventricular tachycardia, VF: Ventricular fibrillation, CHB: Complete heart block BFHB: Fascicular heart block, RBBB: Right bundle branch block, LBBB: Left bundle branch block. P -Value<.05.

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Figure 2: Comparison of outcomes at different age groups.

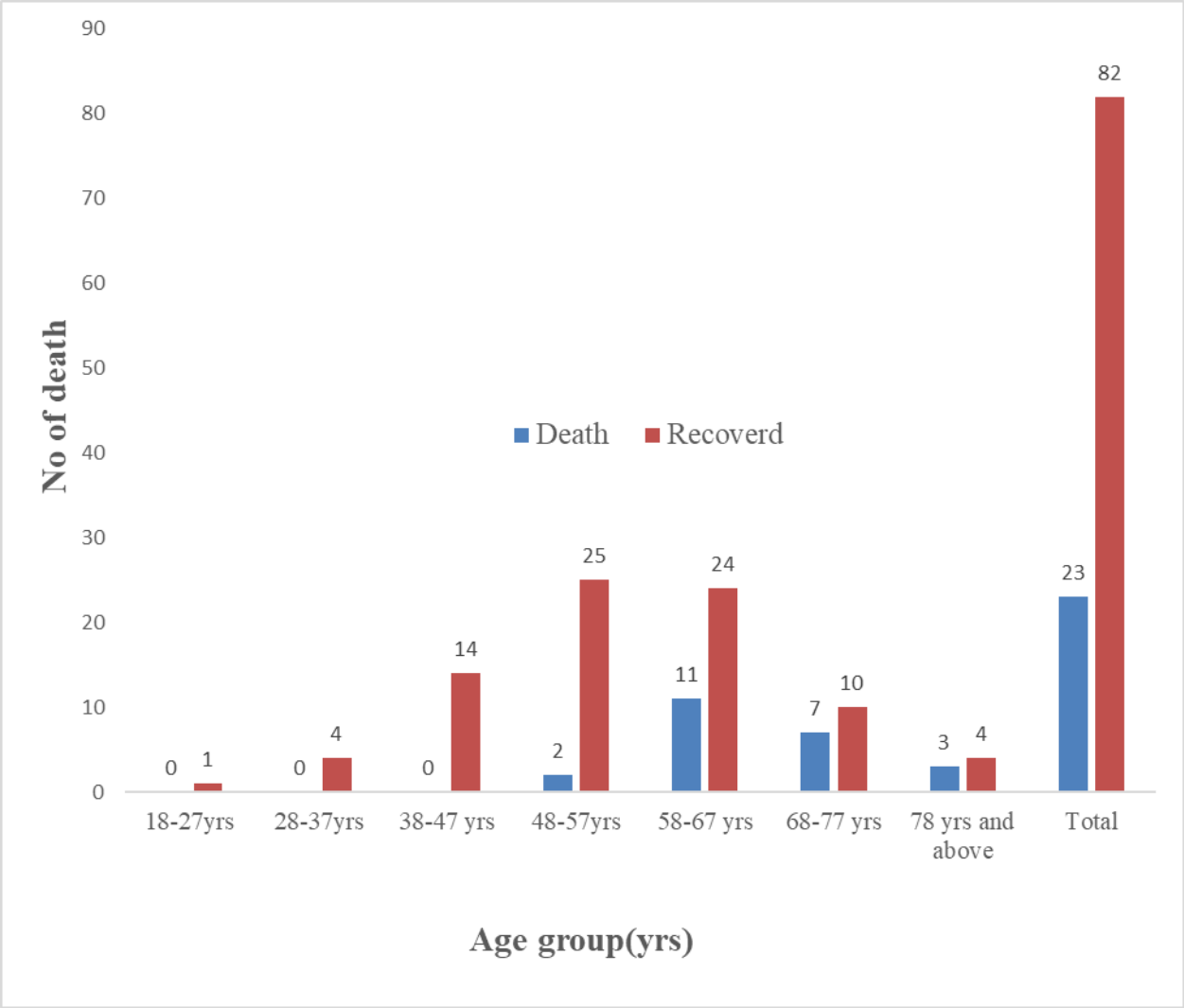

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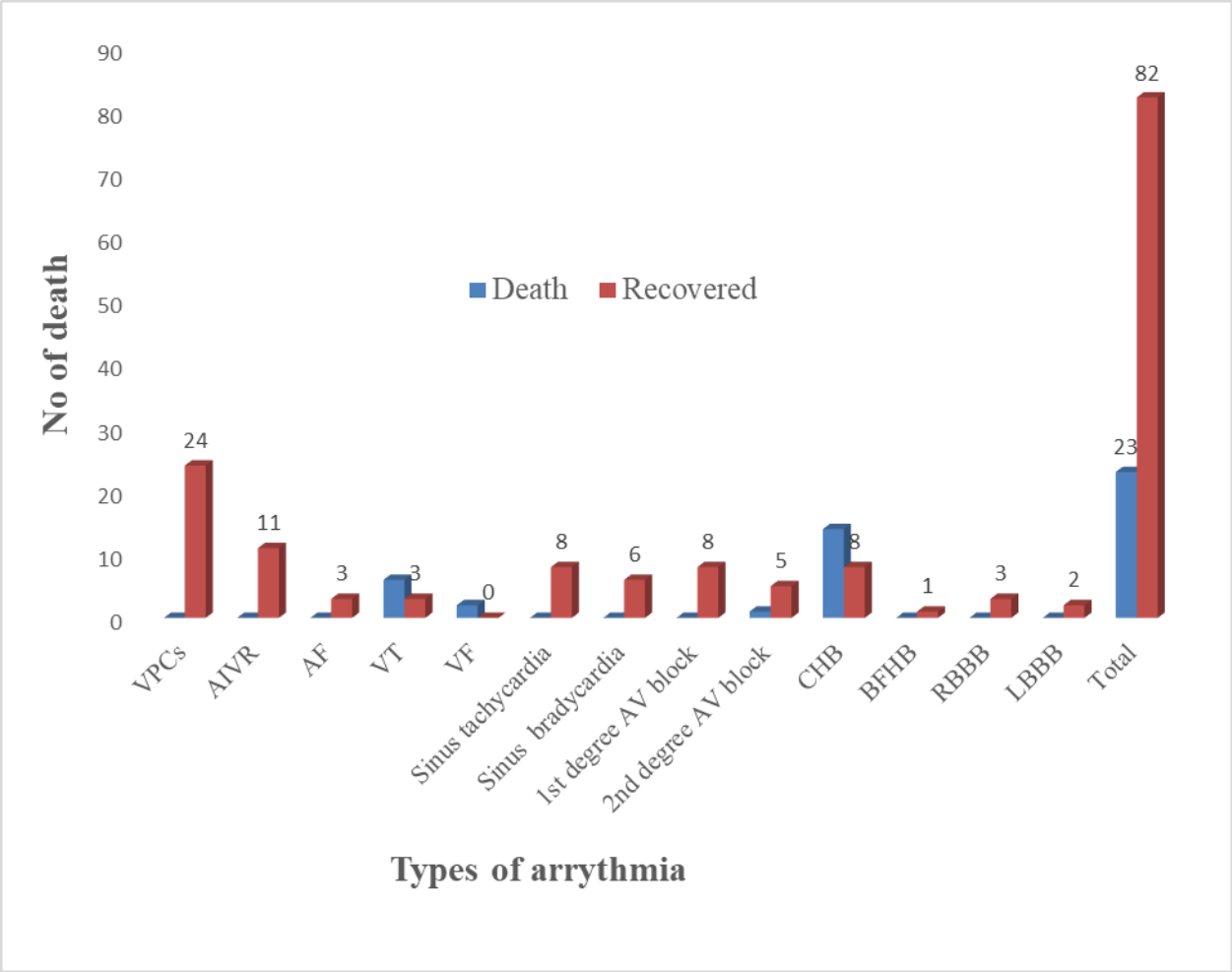
Figure 3: Comparison of outcome with different arrhythmia.



VPC: Ventricular premature contracture, AIVR: Accelerated idioventricular rhythm, AF: Atrial fibrillation, VT: Ventricular tachycardia, VF: Ventricular fibrillation, CHB: Complete heart block BFHB: Fascicular heart block, RBBB: Right bundle branch block, LBBB: Left bundle branch block.

Discussion:

In the settings of AMI, several types of silent and symptomatic life-threatening arrhythmia develop within 48 hours, potentially determining the patient's prognosis. Almost half of the deaths happen before they reach the hospital, and sudden cardiac death is most frequently associated with this pathophysiology. The mechanism for arrhythmias in AMI is multifactorial. Ongoing myocardial ischemia or left ventricular dysfunction or failure, sympathetic overactivity, hemodynamic instability and electrolyte abnormalities (hypokalemia, hypomagnesemia), metabolic abnormalities (acidosis, hypoxia), re-entry, and enhanced automaticity are the major contributors to the development of arrhythmia. [8] The main objective of our study was to determine the prevalence of various cardiac arrhythmias in AMI within 48 hours of hospital stay. Evaluation of risk factors of AMI, correlation of arrhythmia with the site of AMI, and prognosis of different arrhythmia was our secondary objectives.

The majority of the patients in our study belonged to the age group of 58 to 67 years (33.3%) with a range of 18 to 86 years. The mean age of presentation was 58.7 ± 10.6 years and the majority having ST-segment elevation myocardial infarction (STEMI) with a male predominance (75.2%) were comparable to several Indian studies. [9–11]

In our study, the association of the risk factors was observed to be highest in smoking (67.6%) followed

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by DM (65.7%), hypertension (59.05%), alcohol (31.4%), dyslipidemia (29.5%), family history of CAD (25.7%). According to Battula et al., the two main risk factors for CAD are smoking and hypertension. Khot UN et al. analyzed that more than 70% of the patient population aged 45 years or younger were cigarette smokers. They also highlighted the fact that the higher prevalence of DM in women than in men showed that diabetes is a powerful risk factor in women. [12]

The overall incidence of STEMI (95.2%) was the largest followed by NSTEMI (4.8%). Among STEMI, IWMI (56.2%) constituted the majority, followed by AWMI (36.2%), PWMI (1.9%), and LWMI (0.95%). The findings of our study were in agreement with the study conducted by Mohammad K A et al., Misiriya K et al., and Newman JD et al. [9, 13, 14]

Thirteen different types of arrhythmias were observed in our study. VPC (22.85%) was the most common arrhythmia observed followed by CHB-21%. The findings of our study were in agreement with Shah MJ et al. [11] Linda Marangmei et al. conducted a study on 100 AMI patients, of which 76% developed arrhythmia.[15] The most common conduction abnormality was PVC (23%) followed by sinus tachycardia. Mistry U A et al. observed VPCs (32%) were the most common arrhythmia. Conduction block was more common with inferior wall infarction than with anterior wall infarction. [16]Nagabhushana S et al. studied 100 patients of AMI admitted to ICCU of Mc Gann Hospital from April 2015 to June 2015. The incidence of arrhythmias in their study was 89%, with a majority (67%) of arrhythmias occurring in the first 24 hours. Sinus tachycardia (48%), PVC (24%), Sinus bradycardia (22%), and atrial premature complexes (15%) were the commoner arrhythmias. [17] Archbold RA et al. in their study group, comprised 1225 consecutive patients with AMI. Complete AV block occurred in 5.3%, LBBB, and RBBB in 2.4% and 3.6% respectively, BFHB in 2.9%, and CHB involving both bundle branches in 1.6%. [18]

The overall outcome was compared with various types of arrhythmias observed in our study. We found that the type of arrhythmia significantly affects mortality. Maximum mortality was noted with CHB (60.9%). The overall incidence of mortality was 15%. The majority of mortality occurred with VT & CHB. Mortality was more in males (16.25%) than in females (10%). Cardiogenic shock (40%) and left ventricular failure (33.33%) were the most common cause of mortality. [19]

Jones et al. investigated 556 patients admitted to the intensive care unit. A complete LBBB was present in 23 patients and carried a high mortality rate (61%). This study demonstrated that the existence of heart block affects prognosis. [20]

Shishido K et al. studied the relationship between the timing of VT or VF and prognosis in patients undergoing primary percutaneous coronary intervention (PCI) for AMI. In their study, the timing of VT/VF had two peaks, and late VT/VF was strongly related to the timing of the secondary peak of in-hospital cardiac mortality. [21]

During the study of 4799 patients with ACS conducted by Silvia Aguiar Rosa et al, 91 (1.9%) presented with CAVB. They concluded that CAVB conferred a worse outcome during hospitalization, including a higher incidence of cardiogenic shock, ventricular arrhythmias, and mortality. [22]

Limitations:

our study was a single-center study involving a lesser number of patients during a smaller period of one year. A multicentric study with a large number of patients is required for a better understanding of arrhythmia in acute myocardial infarction. Late-onset arrhythmias could not be studied since the study was conducted in the ED and the duration of stay was limited.

Conclusion:

Thirteen different types of cardiac arrhythmia occurred in our observational study, potentially affecting the patients' outcomes. PVC was the most common arrhythmia observed and the majority of the arrhythmia occurred within the first 24 hrs of the presentation. The majority of the patient were males between 58 to 67yrs of age group. Hypertension, smoking, and DM were our study's most common risk factors. Overall IWMI was the most common ACS type found in patients with arrhythmia. Overall mortality was 21.9% and the maximum was due to CHB. The outcome of patients with VF, VT, and AF was poor irrespective of ACS type.

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