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RESEARCH ARTICLE

Incidence and Types of Arrhythmias in Acute Coronary Syndrome: An Observational Study

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ABSTRACT

Background: The occurrence of arrhythmias among acute coronary syndrome patients is very common. However, their diagnosis is not considered in contemporary acute coronary syndrome patients. This study investigates the incidence and types of arrhythsmias among acute coronary syndrome patients presenting to the emergency department, as well as their association with various factors and patient outcomes.

Methods: The current prospective observational study was conducted at a tertiary care center in Kolkata, India. Data were collected from 76 acute coronary syndrome patients admitted between October 2020 and May 2021 to the emergency department. Information was gathered through semi-structured interviews and relevant investigations.

Results: The majority of the patients were aged 61-70 years, with three fourth of the study population being male. The incidence of arrhythmia was diagnosed in 77.6% of the patients. The most common arrhythmias were sinus tachycardia, ventricular premature complex, atrial fibrillation, sinus bradycardia, and complete heart block. Arrhythmias were more prevalent among ST-elevation myocardial infarction (62.7%) and unstable angina (8.5%) patients. Patients with Left Ventricular Ejection Fraction ≤ 40% had a higher incidence of arrhythmias (93.5%). The mortality rate during hospital stay was 11.9% among acute coronary syndrome patients with arrhythmias, while all acute coronary syndrome patients without arrhythmia had a 100% survival rate.

Conclusion: This study highlights the incidence and types of arrhythmias in acute coronary syndrome patients presenting to the emergency department. It reveals a higher prevalence of arrhythmias in specific subgroups, such as patients with ST-elevation myocardial infarction and those with a reduction in left ventricular function. These findings contribute to our understanding of arrhythmias in acute coronary syndrome and their association with patient outcomes, emphasizing the importance of appropriate management and monitoring in this population.

Keywords: Arrhythmias; Acute coronary syndrome; Sudden cardiac death; Atrial fibrillation; ST-elevation myocardial infarction.

Introducution

Arrhythmias are abnormalities of the heart rate and rhythm that may result in serious symptoms of lightheadedness, dizziness, and syncope. Different types of arrhythmias are seen in acute coronary syndromes (ACS). Atrial fibrillation (AF) is a frequently encountered arrhythmia among patients with acute ST-elevation myocardial infarction (STEMI) and ACS[1-6]. A population-based study demonstrated that the incidence of AF in the setting of acute myocardial infarction (AMI) tended to increase up to 13.3% during the last decade[1].

The incidence of sudden cardiac death is estimated to be around 4.2 per 1000 person-years with a declining trend over the years[7,8]. ST segment elevation in any lead (including AVR), shockable initial rhythm, and the order chest pain before Out of Hospital Cardiac Arrest (OHCA) are predictors of AMI possibly resulting in a cardiac arrest[9]. Survival in OHCA is highly influenced by prompt recognition, quick bystander-initiated resuscitation, activation of the emergency call, prompt application of an automated external defibrillator, and early advanced life support.[10] Ventricular arrhythmias and supraventricular arrhythmias are commonly reported in emergency presentations and are associated with the revascularization of ACS. Atrial Fibrillation is a very common arrhythmia observed during or immediately post PCI. Up to one in four patients with an MI incident will develop AF during follow-up, and the development of AF is associated with significantly increased mortality[10]. Pre-reperfusion Ventricular Arrhythmias (VAs) are one of the most common types of arrhythmias among STEMI patients. Identification of the type of arrhythmia is of therapeutic and prognostic importance[10].

Studies prior to the standardized use of early reperfusion therapy have reported a high incidence of clinically important arrhythmias. However, contemporary clinical practice lacks knowledge of the occurrence and types of arrhythmias associated with ACS. Recent research on arrhythmias is focused on the aspects of genetics and interventions rather than being centered on clinical conditions such as ACS. During the developmental era of early reperfusion, which refers to the time when reperfusion therapies were being introduced for the treatment of ACS, VAs were commonly observed. These arrhythmias, including sustained ventricular tachycardia (VT), non-sustained VT, and ventricular fibrillation (VF), were studied to evaluate the risk associated with ACS and to assess the effectiveness of different treatments. It is becoming increasingly relevant to diagnose the nature of arrhythmias among ACS patients, in order to use ECG monitoring only when clinically indicated. The observational study aims to determine the incidence of arrhythmias and the pattern of arrhythmias in patients presenting with ACS to the emergency department and their association with patient outcomes.

Materials and Methods:

A prospective hospital-based observational study was conducted over eight months from October 2020 to May 2021 at Tertiary Care Center in Kolkata, India. The study population included 76 patients over 18 years of age presenting with ACS to the emergency department and admitted within 24 hours of the onset of chest pain. Acute coronary Syndrome was diagnosed based on history, ECG changes, and other biochemical markers like Troponin T. Patients with prior history of arrhythmia before the onset of ACS or chest

pain due to other causes or with chronic AF or MI (onset before 48 h), with a history of conduction blocks or congenital heart block and congenital QT prolongation syndrome were excluded from the study.

Sample size estimation:

According to the estimate of (11), the prevalence of arrhythmias was 78% in what population. Using this estimate, and considering a 10% absolute error and 95% CI, the minimum sample size required was estimated to be 66. Accommodating for about 15% non-response rate or lack of follow-up or missing data, the final desired sample size was estimated to be 76. For operational feasibility, purposive sampling was used in this study.

Data collection procedure:

Acute coronary syndrome was assessed based on history, ECG, and cardiac isoenzyme (Troponin I). Acute coronary syndrome will either be classified as STEMI, unstable angina, or non-ST-segment elevation myocardial infarction (NSTEMI). Patient demographics such as age, gender, and clinical history regarding the status of co-morbid illnesses such as diabetes, hypertension, and habits such as smoking status were recorded. The types of interventions provided for the patients were also recorded. The patients were followed for the total duration of hospital stay for the development of arrhythmias, with baseline ECG performed in patients when admitted and once daily post-admission. In case of any abnormal rhythm observed, a 12-lead ECG recording was conducted to confirm the rhythm. The type of ACS, age, sex, and clinical characteristics (like hypertension, diabetes, and dyslipidemia) were correlated with the occurrence of arrhythmias. Atrial Fibrillation detected on electrocardiographic assessment on ED presentation or during in-hospital stay without a prior history of persistent atrial flutter or paroxysmal, persistent AF was classified as new-onset AF. Data was kept confidential, and the privacy of study participants was maintained.

Data analysis:

The demographics of the study population, such as gender, co-morbidities, and treatment modalities were represented in frequencies and their corresponding percentages. For continuous variables, the mean and standard deviation were calculated and stratification was done for the following variables: gender, age, hypertension, diabetes mellitus, smoking status, ACS type (STEMI, NSTEMI or Unstable Angina), and type of treatment (medical management, thrombolysis, primary PCI). The chi-square and Fischer exact tests were applied to look for any association between arrhythmias and socio-demographics, behavioral characteristics, clinical profile, and the study participant's outcome. A p-value ≤ 0.05 was considered statistically significant.

Ethical consideration:

The study was conducted with prior permission from Institutional Ethics Committee. After adequately explaining the procedure, each study participant provided written consent before inclusion.

Results:

The study involved 76 individuals with a mean age of 64.7 ± 6.7 years, presenting with ACS to the emergency department. The majority (70%) of the population were in the age group of more than 60 years. Table 1 presents the socio-demographic characteristics of the

included population. Co-morbid conditions such as asthma, COPD, hypothyroidism and CKD was observed in 6.6%, 10.5%, 17.1% and 7.9% respectively.

Table 1: Socio-demographic and behavioral characteristics of the study population

Parameters	**Total** n (%)	**Arrhythmia** n (%)		**p-value**
		Yes	No	
N	76	59	17	
Age distribution				
<60 years	24 (31.6)	20 (33.9)	4 (23.5)	
61-70 years	31 (40.8)	26 (44.1)	5 (29.4)	0.126
> 70 years	21 (27.6)	13 (22.0)	8 (47.1)	
Male	57 (75.0)	44 (74.6)	13 (76.5)	0.874
Female	19 (25.0)	15 (25.4)	4 (23.5)	
Hindu	59 (77.6)	44 (74.6)	15 (88.2)	0.302
Muslim	14 (18.4)	13 (22.0)	1 (5.9)	
Christian	3 (3.9)	2 (3.4)	1 (5.9)	
Married	65 (85.5)			
Unmarried	1 (1.3)			
Widower	10 (13.2)			
Nuclear Family	47 (61.8)			
Joint Family	29 (38.2)			
Behavioral characteristics				
Vegetarian diet	19 (25.0)			
Non-vegetarian diet	57 (75.0)			
Regular Exercise	10 (13.2)	9 (15.3)	1 (5.9)	0.314
Smoking history	48 (63.2)	39 (66.1)	9 (52.9)	0.322
Tobacco chewing	47 (61.8)	39 (66.1)	8 (47.1)	0.154
Alcohol intake	29 (38.2)	23 (39.0)	6 (35.3)	0.783
Extra salt intake	57 (75.0)			
Diabetes mellitus	56 (73.7)	41 (69.5)	15 (88.2)	0.122
Hypertension	38 (50.0)	31 (52.5)	7 (41.2)	0.409
Obesity	56 (73.7)	44 (74.6)	12 (70.6)	0.108
Dyslipidemia	66 (86.8)	50 (84.7)	16 (94.1)	0.314

COPD – Chronic Obstructive Pulmonary Disease; CKD – Chronic Kidney Disease

More than 56% of the ACS patients had STEMI (Figure 1A). Among myocardial infarction patients, anterior wall MI (39.5%) was most common, followed by almost equally prevalent anteroseptal wall MI (23.3%), inferior wall MI (20.9%), and lateral wall MI (16.3%) (Figure 1B).

Incidence of cardiac arrhythmias:

Among the ACS patients, 77.6% of them were presented with arrhythmia (Figure 1C). Specifically, the prevalence was significantly higher among those who presented with LVEF ≤ 40% (Figure 1D).

Among the total study population, the most common was sinus tachycardia (23.7%), followed by ventricular premature complex (15.3%), AF (13.6%), and sinus bradycardia (11.9%) (Table 2). Among STEMI patients, the highest incidence was AF, sinus tachycardia, and ventricular premature complex (Table 2). Complete heart block was observed only among STEMI patients.

Figure 1: Distribution of the study population according to A) Type of acute coronary syndrome and B) type of myocardial infarction C) Incidence of arrhythmia in ACS patients D) Incidence of arrhythmia based on LVEF.

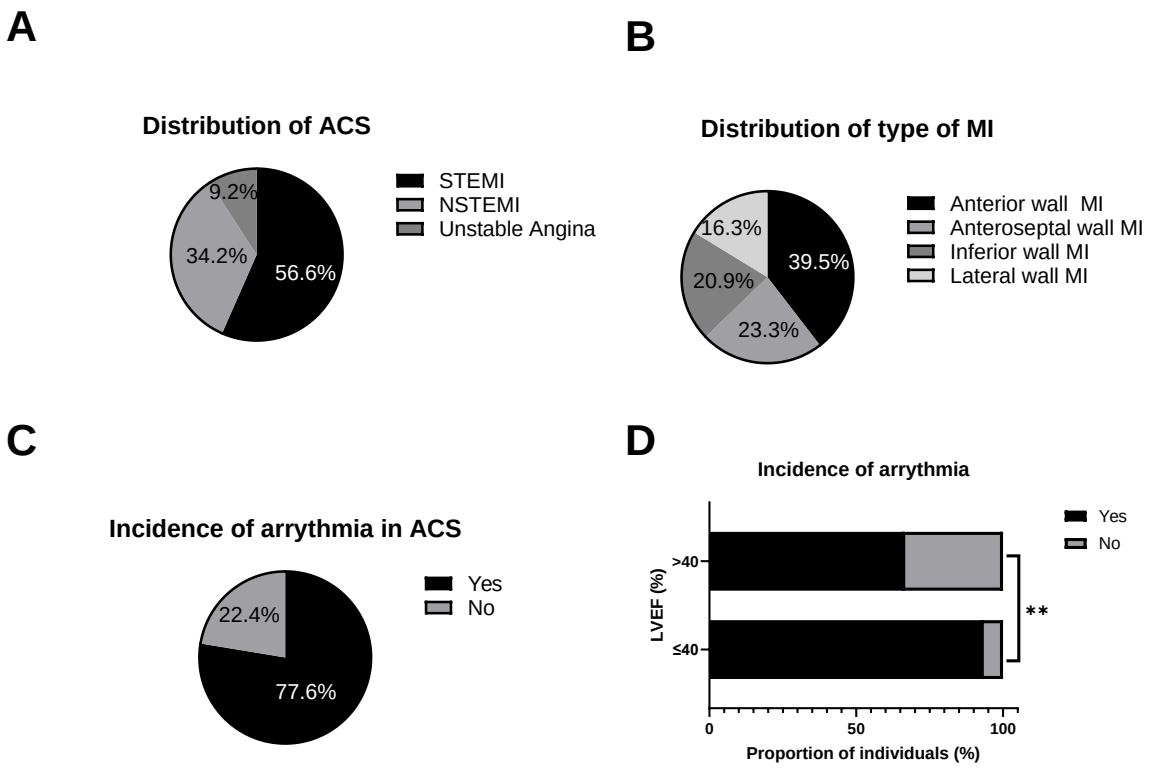

Table 2: Distribution of type of arrhythmias according to the type of ACS

	All ACS	Type of ACS		
Type of Arrhythmia	n (%)	STEMI n (%)	NSTEMI n (%)	Unstable Angina n (%)
N	59	37	17	5
Atrial Fibrillation	8 (13.6)	8 (21.6)	0 (0.0)	0 (0.0)
Ventricular Fibrillation	3 (5.1)	2 (5.4)	1 (5.9)	0 (0.0)
Ventricular Tachycardia	4 (6.8)	3 (8.1)	1 (5.9)	0 (0.0)
Sinus tachycardia	14 (23.7)	7 (18.9)	4 (23.5)	3 (60.0)
Ventricular Premature Complex	9 (15.3)	4 (10.8)	3 (17.6)	2 (40.0)
First-degree heart block	1 (1.7)	1 (2.7)	0 (0.0)	0 (0.0)
Complete heart block	5 (8.5)	5 (13.5)	0 (0.0)	0 (0.0)
LBBB	2 (3.4)	2 (5.4)	0 (0.0)	0 (0.0)
Premature Atrial Complex	4 (6.8)	0 (0.0)	4 (23.5)	0 (0.0)
Atrial Flutter	1 (1.7)	0 (0.0)	1 (5.9)	0 (0.0)
Sinus Bradycardia	7 (11.9)	4 (10.8)	3 (17.6)	0 (0.0)
Bifascicular block	1 (1.7)	1 (2.7)	0 (0.0)	0 (0.0)

Association of arrhythmia with socio-demographic characteristics, clinical profile, and outcomes

The mean duration of hospital stay was 4.21 ± 1.06 days. Almost 90% of arrhythmias occurred within the first 12 h of hospital admission (Table 3). Majorly the incidence was highest (75%) within the first 6 hours. The results did not indicate any significant association between the incidence of arrhythmia with sociodemographic factors or preexisting comorbid conditions.

The majority of the patients were managed conservatively (43.4%), followed by PCI (28.9%), thrombolysis (18.4%), PCI-TPI (6.6%), and CABG (2.6%).

The mortality rate among the participants of the study was 9.2%. Although not statistically significant, among ACS patients with arrhythmia, 11.9% of patients died during their hospital stay, and no deaths occurred among ACS patients without arrhythmia till the day of their discharge.

Table 3: Distribution of time of onset of arrhythmia from time of admission

Time of onset of Arrhythmia	Total N = 59 n (%)
Less than 1 hour	6 (10.2)
1 to 6 hours	38 (64.4)
6 hours to 12 hours	9 (15.3)
12 hours to 24 hours	4 (6.8)
More than 24 hours	2 (3.4)

Discussion

Arrhythmias are a common phenomenon in ACS patients, with region-centric India-based studies observing the incidence to be 76-79%[11-13]. The current observational study conducted in individuals with ACS (n = 76) indicate a high incidence of arrhythmia (77.6%) (Figure 1C) and seems to be more associated with increasing age and mortality outcomes. The incidence was specifically higher among the age group of 60 – 70 years (44.1%), with an increased male preponderance (3:1).

Higher incidences of arrhythmias within 24 hours of hospitalization were associated with an increase in in-hospital mortality among ACS patients[20-14]. Other studies have reported a mortality rate of 13% within the first 48 h of hospitalization[12,] which was high among patients with VA[19-15]. The mortality among ACS patients with arrhythmia was 11.9% among patients with ACS who had VF and complete heart block during their hospital stay. All the ACS patients without arrhythmia survived till the day of their discharge from the hospital.

Left ventricular dysfunction has been considered an important predictor for the development of arrhythmia. In a registry study with more than 200,000 patients, ventricular arrhythmias were significantly associated with LVEF<40%[16]. Demidova et al found that hemodynamic instability, cardiogenic shock, LVEF <40%, and the sum of ST-segment deviations (change from isoelectric line expressed in microvolt) in all leads are independent predictors of VT, VF, or both in STEMI and NSTEMI patients[17]. Studies on animal models have observed that persistent tachycardia affects LV dysfunction, decrease myocardial blood flow and increases LV wall stress. This leads to decrease in ejection fraction and cardiac output over time. Persistent tachycardia is associated with disruption of calcium homeostasis. Calcium signaling has demonstrated strong correlation with decrease in LVEF.[15-18] The current study also observed arrhythmias in a higher proportion of patients with LVEF ≤40% (93.5%) compared to patients with LVEF > 40% (66.7%). Hence, LVEF levels in patients with ACS can help determine the risk of arrhythmia.

Arrhythmias (VA, VT, and/or VF) may occur at any period during MI, as early as minutes after an acute infarction, and till the remote post-MI period. Post-MI, the risk of cardiac arrest

and sudden cardiac death remains high, especially the highest during the first 30 days (1.2–2.3%)[10, 23,24-19,20]. Studies have indicated a majority of arrhythmias occurred during the first hour of hospitalization[11,13]. Patil RR also found that most arrhythmias (90%) occurred during the first 24 hours of symptoms.[13] In the present study, most of the arrhythmias occurred between 1 to 6 hours of admission (64.4%), followed by 6 hours to 12 hours of admission (15.3%) and less than 1 hour (10.2%) (Table 3). The most common arrhythmia was polymorphic VT, which degenerates into VF during the early in-hospital phase. Complex VT or VF is common in the first 48 hours of AMI and has a significant prognostic impact.[21] Among ACS patients, Sinus Tachycardia was the highest (23.7%), followed by Ventricular Premature Complex (15.3%), Atrial fibrillation (13.6%), and Sinus Bradycardia (11.9%) (Table 2). Although occurrence of arrythmias after re-perfusion is considered to indicate successful thrombolysis, they are also a consequence of existing myocardial cell damage and ischemia[25-22]. The present study showed arrhythmias occurred commonly in those thrombolysed (85.7%), similar to the findings of a study done by Patil RR.[13]

Although previous studies have identified a higher incidence of arrhythmia among patients with comorbidities such as diabetes[23], hypertension[24], and those with smoking habits[15,25], our study findings do not identify any significant correlation with the patient history of comorbid conditions or other socio-demographic factors. This could be attributed to our small sample size for evaluating the association of these factors.

In patients with STEMI, arrhythmias are observed to be common with an incidence as high as 90%.[14] Hersi et al reported a four-fold higher incidence of VA among STEMI patients as compared to patients with NSTEMI/Unstable Angina (6% vs 1.5%; *P*<.001).[15] Ventricular action potential caused by ion currents are responsible for the contraction of myocardial cells. Conduction abnormalities are common among STEMI patients. Disturbances in action potential generation, from ischemia associated with STEMI can lead to the development of arrythmias[26]. In our study population, arrhythmias were more common among STEMI patients, followed by NSTEMI and Unstable angina (Table 2). In STEMI patients, AF was highest, followed by sinus tachycardia, complete heart block, ventricular premature complex, and sinus bradycardia (Table 2)

Limitation

Although the sample size is sufficient for the primary outcome estimation of the incidence of arrhythmia in ACS patients, the study sample may be small to evaluate statistically significant associations with diverse socio-demographic and other clinical factors.

Conclusion

The present study showed that the incidence of arrhythmia was very high in ACS patients. Arrhythmias were more common in the elderly population and males. Arrhythmia was more common in diabetic, hypertensive, obese, and dyslipidemic patients. Arrhythmias were more common among patients having STEMI, followed by NSTEMI and unstable angina. In STEMI patients, AF was highest. Mortality was seen among patients with ACS who had VF and complete heart block during their hospital stay.

Conflict of Interest Statement:

The authors have no conflicts of interest to declare

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