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Original Research Article

PROFILE OF ARRYTHMIAS AMONG THE PATIENTS WITH MYOCARDIAL INFARCTION ADMITTED AT TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Myocardial infarction (MI) remains a leading cause of morbidity and mortality worldwide, with arrhythmias and electrolyte imbalances significantly impacting outcomes. This study aimed to evaluate the demographic characteristics, arrhythmia profile, clinical presentation, and complications in patients with acute myocardial infarction.

Material and Methods: A prospective observational study was conducted at a tertiary care center from June 2022 to January 2024. A total of 302 patients aged >18 years with ECG-confirmed MI were enrolled after ethical clearance and informed consent. Exclusion criteria included pre-existing conduction disorders, valvular disease, or prior ischemic heart disease. Patients were monitored clinically and via serial ECGs. Cardiac biomarkers, serum electrolytes, and echocardiography were assessed. Arrhythmias were classified by type and timing, and outcomes were documented.

Results: The majority of patients were male (65.2%) and aged 50–59 years (44.7%). STEMI was more prevalent (72.4%), with the anterolateral wall being the most commonly affected site. Arrhythmias were noted in 80.1% of patients, most frequently sinus bradycardia (27.27%) and ventricular tachycardia (21.4%). Electrolyte disturbances, especially hyponatremia (30.1%) and hypocalcemia (40%), were significant. Mortality was 12.3%, with STEMI accounting for 83.3% of deaths. Highest case fatality was observed in patients with ventricular tachycardia (60%).

Conclusion: Arrhythmias, particularly within the first 12 hours of hospitalization, are a major complication of MI, often linked with electrolyte disturbances and higher mortality. Early recognition and prompt management of arrhythmias and metabolic derangements are crucial to improving survival in MI patients.

Keywords: Myocardial infarction, Arrhythmia, STEMI, Ventricular tachycardia, Electrolyte imbalance, Mortality.

INTRODUCTION

Acute myocardial infarction (AMI), commonly known as a heart attack, remains a leading cause of morbidity and mortality globally. It is categorized into ST-elevation MI (STEMI) and non-ST-elevation MI (NSTEMI). Globally, over 3 million STEMI and 4 million NSTEMI cases are reported

annually. In India, the burden of AMI is particularly high, with an incidence of 64.37 per 1000 individuals and accounting for approximately 31.7% of all deaths. Indians are nearly four times more susceptible to AMI compared to other populations, due to genetic predisposition and lifestyle-related metabolic risks.[1] AMI results from sudden blockage of coronary arteries, usually due to rupture of an atherosclerotic plaque, causing irreversible myocardial damage. Typical symptoms include chest pain radiating to the arm, neck, or jaw.[1] However, the diagnosis of AMI is based on characteristic symptoms, elevated cardiac biomarkers, ECG changes, or imaging evidence of myocardial damage. AMI has both modifiable (e.g., smoking, diabetes, hypertension, obesity) and non-modifiable (e.g., age, sex, family history) risk factors.[2,3] Despite advancements in treatment, post-MI complications, particularly arrhythmias, remain a significant challenge, often contributing to early mortality and adverse outcomes. Understanding the profile of arrhythmias in AMI patients is crucial for timely diagnosis and effective management.[1]

Arrhythmias occur in about 90% of patients with AMI, with 25% developing them within the first 24 hours. The risk of ventricular fibrillation is highest in the first hour. These arrhythmias are primarily caused by reperfusion-related electrical instability and reentry mechanisms due to heterogeneous electrical properties of ischemic myocardium. Ion washout from the ischemic zone, including lactate, potassium, and other toxic metabolites, further contributes to arrhythmia development.[4,5] Arrhythmias are well-known complications of AMI and significantly contribute to mortality across all age groups and sexes. Prompt emergency intervention is often required when AMI is complicated by arrhythmias. Advances in early diagnosis and treatment, including temporary pacemakers and percutaneous coronary intervention (PCI), have markedly improved survival rates in these patients.[6]

Patients' outcomes both within and outside of the hospital are associated with peri-infarction arrhythmias. Ventricular arrhythmias (VT/VF) are fatal arrhythmias that are severe complications of AMI and can cause cardiac collapse,[7] as elevated rates of heart contraction can lead to a reduction in blood flow, exacerbating heart failure and hemodynamic instability.[8,9] Thus, this study of arrythmias in patients of AMI admitted to a tertiary care hospital had been undertaken to help early detection of arrythmias, severity of arrythmias and related complications of myocardial infraction so as to enable early intervention and prevent early mortality and morbidity of these patients.

MATERIALS AND METHODS

After obtaining Institutional Ethical Committee approval and written informed consent from all the patients, this prospective observational study was conducted in the Department of General Medicine, at a tertiary care center over a period of 18 months, from June 2022 to January 2024. A total of 302 patients aged over 18 years, presenting with ECG changes suggestive of acute coronary syndrome (ACS) and willing to participate were included. Patients were recruited from the outpatient department, emergency unit, and those admitted to the Medicine ward or ICU. Patients were excluded from the study if they exhibited arrhythmias without evidence of myocardial infarction, had a known history of congenital conduction defects or arrhythmogenic heart disease, or had a prior diagnosis of ischemic heart disease (IHD). Additionally, individuals with known valvular heart disease and those who did not provide informed consent were not included in the study.

Detailed demographic information including age, gender was recorded. Clinical history was obtained with emphasis on typical retrosternal chest pain, radiation, associated symptoms such as palpitations, dyspnea, vomiting, and sweating. A thorough general examination was done including pulse, blood pressure in both upper limbs, respiratory rate, oxygen saturation, JVP, and presence of pallor, icterus, cyanosis, clubbing, lymphadenopathy, and edema. All patients were assessed for cardiovascular risk factors such as smoking, hypertension, diabetes mellitus, COPD, dyslipidemia, and family history of coronary artery disease. Systemic examinations of CVS, respiratory system, abdomen, and CNS were performed as per standard clinical protocols. Electrocardiographic (ECG) evaluation was performed at admission, and patients were continuously monitored for arrhythmias. Diagnostic criteria for STEMI included ST elevation in contiguous leads, new or presumed new LBBB, and development of pathologic Q waves. For NSTEMI, horizontal or down-sloping ST depression ≥0.5 mm and T wave inversion were considered significant. Patients with preexisting LBBB or those who developed LBBB on admission were excluded. Arrhythmias were classified based on standard definitions into sinus tachycardia, supraventricular tachycardia, atrial fibrillation and flutter, junctional ectopics, ventricular premature complexes, ventricular tachycardia, flutter, fibrillation, and conduction blocks such as AV blocks and bundle branch blocks. Serial ECG monitoring was done at 1 hour post-admission, then every 4 hours for 2 days, followed by 12-hour intervals during hospitalization. Routine investigations included complete blood count, liver and kidney function tests, serum electrolytes (calcium, magnesium, sodium, potassium), and chest X-ray (PA view). Cardiac biomarkers, particularly Troponin I (TnI), were measured using CLIA, with a normal reference range of 0–0.04 ng/mL. A 2D echocardiogram was performed where feasible.

Patients were managed according to standard ACS protocols. STEMI cases underwent immediate

reperfusion therapy via percutaneous coronary intervention (PCI) or thrombolysis with streptokinase if PCI was not available. NSTEMI patients were risk-stratified and underwent angiography as indicated. All patients received guideline-directed medical therapy including antiplatelets, beta-blockers, statins, ACE inhibitors, and diuretics as needed. Arrhythmias were managed according to their type. Supraventricular arrhythmias were treated with vagal maneuvers, adenosine, or cardioversion. Atrial fibrillation and flutter were managed with rate or rhythm control strategies and anticoagulation as per CHA_2 DS_2 - VASc score. Ventricular arrhythmias were treated with amiodarone, lidocaine, or cardioversion; implantable cardioverter-defibrillators (ICDs) were considered for sustained cases. Bradyarrhythmias and AV blocks were managed with isoproterenol or pacemaker insertion when indicated. Patients were followed clinically and monitored throughout their hospital stay to document the type, timing, and management outcomes of arrhythmias in the setting of myocardial infarction.

Statistical Analysis: Data were entered in Microsoft Excel and analyzed using SPSS version 21.0 (IBM, Chicago, USA). Categorical variables were expressed as numbers and percentages, while normally distributed quantitative data were presented as mean ± SD. Independent t-test was used for age comparison. Chi-square test assessed qualitative variables like gender, ejection fraction, serum sodium, and calcium. Fisher's exact test was applied when expected cell values were below 5. A p-value <0.05 was considered statistically significant.

RESULTS

Out of 302 patients, majority were aged 50–59 years (135 patients; 44.7%), followed by 60–69 years (86 patients; 28.5%) and 40–49 years (47 patients; 15.5%). Myocardial infarction was more prevalent among males than females. Tobacco use, both smoking and chewing, emerged as significant risk factors for myocardial infarction, as shown in Table 1.

Table 1: Demographic data and risk factor for myocardial infarction

Demographic data		No of patients	Percentage
Age group in years	≤39	06	1.98
	40 to 49	47	15.5
	50 to 59	135	44.7
	60 to 69	86	28.47
	≥70	26	8.6
Gender	Female	105	34.7
	Male	197	65.2
Risk factors	Diabetes	67	22.1
	Hypertension	81	26.8
	Smoking	142	47.0
	Tobacco chewing	230	76.2
	Alcohol	134	44.3

Among myocardial infarction patients, the most common site was anterolateral wall MI (ALWMI), seen in 43% of cases. This was followed by inferior wall MI (20%), inferoposterior wall MI (19.8%), extensive anterior wall MI (10.9%), and anteroseptal wall MI (5.9%), as shown in Table 2.

Table 2: Infarction site

Infarction site	No of patients	Percentage
ALWMI	95	43.0
IWMI	44	20.0
Extensive AWMI	24	10.9
Inferoposterior WMI	43	19.8
Anteroseptal WMI	13	5.9

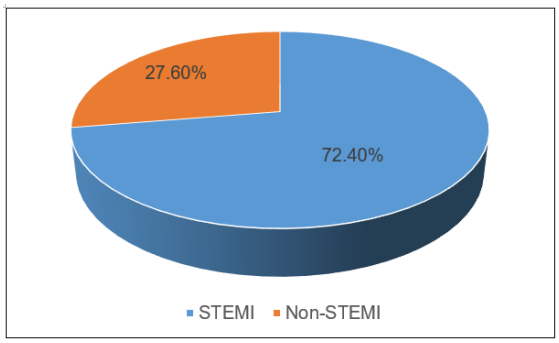

Figure 1: Type of MI- STEMI/NSTEMI status

The majority of patients (219; 72.4%) had ST-Elevation Myocardial Infarction (STEMI), while 83 patients (27.6%) had Non-ST-Elevation Myocardial Infarction (NSTEMI), as shown in Figure 1. [Figuer 1]

Chest pain was the most common symptom, reported by 271 patients (89.7%). Dyspnea occurred in 90 patients (29.8%), followed by vomiting in 60 (19.8%) and sweating in 54 (17.8%). Less common symptoms included palpitation in 30 patients (9.9%) and epigastric pain in 12 (3.9%), as depicted in Figure 2. [Figure 2]

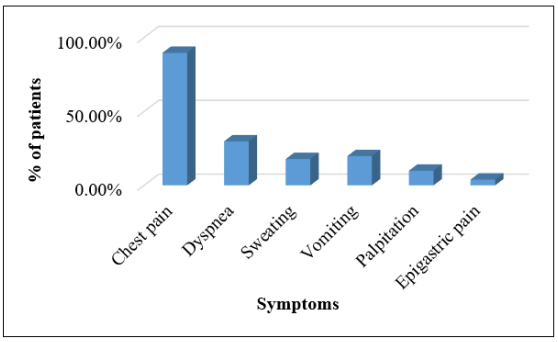

Figure 2: Symptoms of myocardial infarction

Electrolyte analysis in myocardial infarction patients showed that 69.8% had normal serum sodium levels, while 30.1% had hyponatremia. Normal potassium levels were seen in 84.1%, with 12.9% showing hypokalemia and 2.9% hyperkalemia. Serum calcium was normal in 59.9%, whereas 40% had hypocalcemia. Normal magnesium levels were observed in 75.1% of patients, while 17.8% had hypomagnesemia and 6.9% had hypermagnesemia. [Table 3]

Table 3: Electrolytes levels in patients of myocardial infarction

Electrolytes		No of patients	Percentage
Serum sodium, mEq/L	134-146 (normal sodium)	211	69.8
	<134 (Hyponatremia)	91	30.1
Serum potassium, mEq/L	3.5-5.4 (normal)	254	84.1
	<3.5 (hypokalemia)	39	12.9
	>5.4 (hyperkalemia)	09	2.9
Serum calcium, mg/dL	8.5-10.5 (normal)	181	59.9
	<8.5 (hypocalcemia)	121	40.0
Serum magnesium, mg/dL	1.6-2.6 (magnesium)	227	75.1
	<1.6 (Hypomagnesemia)	54	17.8
	>2.6 (Hypermagnesemia)	21	6.9

Arrhythmia was the most common complication, affecting 242 patients (80.1%), with a higher prevalence in males (66.5%) compared to females (33.5%). This was followed by mitral regurgitation in 102 patients (33.7%), heart failure in 44 patients (14.5%), cardiogenic shock in 27 patients (8.9%), and pericardial effusion in only 5 patients (1.6%).
Anterolateral wall MI (ALWMI) had the highest incidence of complications, including arrhythmias (90 cases) and mitral regurgitation (51 cases). Inferior wall MI (IWMI) accounted for 39 arrhythmias and 22 mitral regurgitation cases. Extensive anterior wall MI showed a notable number of cardiogenic shock cases (15) and 19 arrhythmias. NSTEMI cases were free of heart failure but showed a high number of arrhythmias (73), indicating different risk profiles among MI types. [Table 4]

Table 4: Complications associated with various types of myocardial infarction

Type of MI	Heart failure	Cardiogenic shock	Mitral regurgitation	Pericardial effusion	Arrythmias
ALWMI	18	02	51	00	90
IWMI	12	04	22	01	39
Extensive AWMI	07	15	11	04	19
Inferoposterior WMI	04	01	10	00	13
Anteroseptal WMI	03	00	05	00	08
NSTEMI	00	05	03	00	73
Total	44	27	102	05	242

Among MI patients, bradycardia was the most common arrhythmia, seen in 66 patients (27.3%), followed by ventricular tachycardia (VT) in 52 patients (21.4%), and atrial fibrillation (AF) in 28 patients (11.5%). Other types included ventricular premature complexes (VPCs) in 26 patients (10.7%), second-degree AV block in 25 patients (10.3%), supraventricular tachycardia (SVT) in 16 patients (6.6%), third-degree AV block in 13 patients (5.3%), first-degree AV block in 10 patients (4.1%), and sinus arrhythmia in 6 patients (2.4%).
Most arrhythmias occurred early, with 31.2% (75 patients) developing them within the first 1–4 hours, followed by 4–8 hours (24.2%), 8–12 hours (20.1%), and 12–24 hours (16.4%). Fewer cases occurred after 24 hours.
The table 5 highlights the distribution of arrhythmias across different types of myocardial infarction (MI). Bradycardia is most frequent in NSTEMI (30 cases) and Anterolateral wall MI (22 cases). First-degree heart block is mainly seen in Anterolateral MI (10 cases), while second-degree and third-degree blocks are more common in Inferior wall MI (9 and 8 cases, respectively). Ventricular tachycardia (VT) is prevalent in Inferoposterior wall MI (13 cases) and Extensive anterior MI (12 cases). Atrial fibrillation occurs primarily in Anterolateral MI (17 cases) and NSTEMI (11 cases). Sinus arrhythmia is rare, noted in Anterolateral MI (5 cases) and NSTEMI (3 cases).

Table 5: distribution of various arrhythmias across different types of myocardial infarction

Type of MI	Sinus Bradycardia	1degree AV block	2degree AV block	3degree AV block	VT	A. Fib	SVT	VPCs	Sa
ALWMI	22	10	10	00	06	17	15	05	05
IWMI	14	00	09	08	06	00	01	01	00
Extensive AWMI	00	00	00	01	12	00	00	06	00
Inferoposterior WMI	00	00	00	00	13	00	00	00	00
Anteroseptal WMI	00	00	00	03	05	00	00	00	00
NSTEMI	30	00	06	01	10	11	00	14	03
Total	66	10	25	13	52	28	16	26	08

In this study, 30 myocardial infarction-related deaths were observed, with STEMI accounting for the majority (25 deaths; 83.33%) and NSTEMI contributing 5 deaths (16.66%). Overall, 12.3% of patients (30 out of 242) died, while 87.6% (212 patients) survived, indicating higher mortality associated with STEMI.

Table 6: Mortality Comparison in MI and Post-MI Arrhythmias

Types of MI and arrythmia		Number of Deaths	% of total deaths
Types of MI	STEMI	25	83.33
	NSTEMI	05	16.66
Mortality amongst patients who developed arrythmia after MI	Not survived	30	12.3
	Survived	212	87.6

The table 7 summarizes mortality rates associated with different types of arrhythmias in myocardial infarction patients. Ventricular tachycardia showed the highest case fatality, with 18 deaths (34.6% of affected cases and 60% of total deaths). Ventricular premature beats led to 5 deaths (19.2% case fatality, 16.6% of total deaths), and third-degree heart block caused 3 deaths (23.07% case fatality, 10% of total deaths). Atrial fibrillation accounted for 2 deaths (7.14% case fatality), and both supraventricular tachycardia and second-degree heart block caused 1 death each. No deaths occurred in patients with sinus bradycardia, first-degree heart block, or sinus arrhythmia.

Table 7: Case fatality rates among various arrhythmias in myocardial infarction patients

Type of arrythmia	Number of deaths (n=30)	% of patients of a particular arrythmia type that died (out of 242)	% of total deaths (out of 30)
Sinus bradycardia	00	0.0	0.0
Ventricular tachycardia	18	34.6	60.0
Atrial fibrillation	02	7.14	6.66
First degree AV block	00	0.0	0.0
Second degree AV block	01	4.0	3.33
Third degree AV block	03	23.07	10.0
Ventricular premature beats	05	19.2	16.6
Supraventricular tachycardias	01	6.25	3.33
Sinus arrythmia	00	0.0	0.0

DISCUSSION

This study analyzed 302 patients with MI admitted to a tertiary care hospital, focusing on demographic characteristics, symptoms, risk factors, electrolyte disturbances, complications (especially arrhythmias), and outcomes. Most patients were aged 50–59 years (44.7%) with male predominance (65.2%) which is comparable with the study done by Hurwitz M. et al,[10] and Martin et al.[11] Tobacco chewing (76.2%) and smoking (47%) were the most common risk factors, followed by alcohol use (44.3%), hypertension (26.8%), and diabetes (22.1%). These findings emphasize the need for addressing tobacco use and managing chronic conditions to mitigate myocardial infarction risks. The findings of our study were consistent with the research done by Abidov et al,[12] and Djousse L et al.[13] Chest pain was the most common symptom (89.7%), followed by dyspnea (29.8%), vomiting (19.8%), and sweating (17.8%). These results align with findings from Sean Whitaker et al,[14] and Benjamin EJ et al.[15]

In the present study on electrolyte imbalances in MI patients, a significant proportion showed abnormalities. While most patients had normal serum levels 69.8% for sodium, 84.1% for potassium, 59.9% for calcium, and 75.1% for magnesium hyponatremia (30.1%), hypokalemia (12.9%), hypocalcemia (40%), and hypomagnesemia (17.8%) were also observed. These disturbances may worsen myocardial instability, contribute to arrhythmias, and influence outcomes. Our findings align with previous studies by Zhao L et al,[16] Anderson et al,[17] and Sabah Z et al,[18] supporting the clinical relevance of monitoring and correcting electrolytes in MI management.

The majority of MI cases were STEMI, observed in 219 patients (72.4%), while 83 patients (27.6%) had NSTEMI. The most common infarction site was the anterolateral wall (43%), followed by the inferior wall (20%). These findings are consistent with those reported by Hurwitz et al,[10] and Sathvik M et al.[19] As evident from our study, arrhythmias were the most common complication of myocardial infarction, observed in 80.1% of patients (242 out of 302), followed by mitral regurgitation (44%), heart failure (14.5%), cardiogenic shock (8.94%), and pericardial effusion (1.6%). Among the causes of death, cardiogenic shock (40%) and left ventricular failure (33.33%) were predominant. These findings emphasize the severity of hemodynamic complications in MI and are consistent with previous studies.[20,21] Basavaraj M Patil reported arrhythmias in 76% of MI patients,[20] while Hurwitz et al.,132 out of 164 patients (80.5%) who were monitored during their myocardial infarction (MI) developed some form of arrhythmia, which includes disorders of rate, rhythm, or conduction.[10]

However, in the present study, arrhythmias were more prevalent in males (66.52%) than females (33.47%) among the 242 affected patients, consistent with findings by Jagtap SB et al,[22] who also observed a higher incidence in males. The most common arrhythmias were bradycardia (27.27%) and ventricular tachycardia (21.4%), followed by atrial fibrillation (11.5%), aligning with the findings of Hurwitz et al.[10]

The bradycardia was most common in NSTEMI (30 cases) and anterolateral MI (22 cases); first-degree heart block occurred mainly in anterolateral MI (10 cases), while second- and third-degree blocks were more frequent in inferior wall MI (9 and 8 cases, respectively). Ventricular tachycardia was seen in extensive anterior (12 cases) and inferoposterior MI (13 cases), atrial fibrillation in anterolateral MI (17 cases) and NSTEMI (11 cases), and supraventricular tachycardia in anterolateral MI (15 cases). Ventricular premature complexes (14 cases) and sinus arrhythmia (3 cases) were more common in NSTEMI. Most arrhythmias (75.5%) occurred within the first 12 hours of hospitalization, peaking at 31.2% between 1–4 hours, and declined significantly after 24 hours. These findings align with the previous studies.[10,22,23]

In the current study, 30 patients were (12.3%) died, while 212 (87.6%) survived. Among the deaths, 25 (83.3%) were due to STEMI and 5 (16.6%) due to NSTEMI. These findings are consistent with Greene et al,[24] who reported 51% arrhythmic, 42% non-rhythmic, and 9% non-cardiac deaths. Marceau et al,[25] in a meta-analysis of 52,441 patients, found STEMI had higher short-term (30-day) mortality than NSTEMI (OR = 1.55), though long-term (1-year) mortality was similar for both.[25]

There are some limitations of the study which include- this study, conducted in a single tertiary care hospital with 302 patients, may lack generalizability due to regional variations in healthcare practices and limited sample size, which might not capture the full spectrum of MI presentations and complications. It focused only on in-hospital outcomes, omitting long-term follow-up data crucial for understanding chronic impacts. Additionally, the study did not analyze interventional treatments like PCI or CABG, nor did it specify the frequency or timing of electrolyte assessments or account for confounding factors affecting electrolyte levels. Socioeconomic, lifestyle, genetic, and environmental influences were also not evaluated, potentially overlooking key determinants of MI incidence and outcomes.

CONCLUSION

Arrhythmias are a common and serious complication of myocardial infarction, especially within the first 12 hours of hospitalization, and are often associated with electrolyte imbalances and higher mortality. This study found that most MI patients were middle-aged males with STEMI, predominantly involving the anterolateral wall. Over 80% experienced arrhythmias, with sinus bradycardia and ventricular tachycardia being most frequent. Hyponatremia, hypokalemia, and hypocalcemia were notable electrolyte disturbances. Mortality was higher in STEMI cases and those with ventricular tachycardia or third-degree AV block. Early detection and management of arrhythmias and metabolic derangements are essential to improve outcomes.

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