

Spectrum of Cardiac Arrhythmias During Initial 48 Hours of Acute Myocardial Infarction Patients and their Association with In-Hospital Outcome

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ABSTRACT

Objective: To determine the spectrum of arrhythmias during initial 48 hours of AMI and their impact on the in-hospital outcome.

Study Design: Analytical cross-sectional study.

Place and Duration of Study: This study was conducted at a Tertiary Cardiac Center of Rawalpindi Pakistan, from Jun 2021 till Jan 2022.

Methodology: Total (n=150) patients of Acute Myocardial Infarction (AMI) undergoing immediate or early revascularization and meeting the inclusion and exclusion criteria were included in the study. They were monitored for arrhythmias during initial 48 hours of hospitalization and their in-hospital outcomes were noted on a predesigned Performa. Chi square test applied for arrhythmia association with adverse outcome at 95% confidence interval and 5% margin of error.

Results: This study comprised (n=117; 78%) males and (n=33; 22%) females. Mean age was 62.9 years. ST elevation MI (STEMI) constituted (n=127; 84.7%) and Non-ST Elevation MI (NSTEMI) (n=23;15.3%) of total patients. Arrhythmias documented in overall (n=122;81.3%) patients, 81.8% (n=104) in STEMI and (n=18; 77.2%) in NSTEMI. Sinus tachycardia (n=52; 34.7%) was most common rhythm followed by accelerated idioventricular rhythm (n=20;13.4%) and sinus bradycardia 12.7% (n=19). In-hospital mortality was (n=25;16.7%) with p -value=0.009, mostly in patients with ventricular tachycardia/ventricular fibrillation, atrial fibrillation and complete heart block. Other outcomes included (n=23;14.7%) acute left ventricular failure, (n=9; 6%) cardiogenic shock (n=5;3.3%) acute stent thrombosis, (n=2; 1.3%) cerebrovascular accident (CVA) and (n=31; 20.7%) prolonged hospitalization (p -value 0.05).

Conclusion: Arrhythmias are common in acute myocardial infarction during initial 48 hours of presentation with sinus tachycardia being most common followed by accelerated idioventricular rhythm and sinus bradycardia. Arrhythmias are associated with increased in-hospital mortality and adverse outcome.

Keywords: Arrhythmias, Acute myocardial infarction, In-hospital mortality, NonST-Elevation myocardial infarction, Primary PCI, ST elevation myocardial infarction.

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INTRODUCTION

Ischemic heart disease is a major public health threat and its burden is increasing globally.¹ In Pakistan one in four adults has coronary artery disease.² Acute Myocardial Infarction(AMI) contributes to a significant proportion of mortality worldwide, much of which is attributed to life threatening arrhythmias.³ Both supraventricular and ventricular arrhythmias can occur in AMI. Although, with the advances in treatment, the incidence of arrhythmias has reduced significantly but still life threatening arrhythmias occur in considerable proportion of AMI patients undergoing primary Percutaneous Coronary intervention (PCI).⁴ Arrhythmias in AMI are a result of severe metabolic

and electrophysiological changes induced by ischemia and infarction.⁵ Most arrhythmias appear early in course occurring within 48-96 hours.⁶⁻⁸ Ventricular arrhythmias occurring after 48 hours have been associated with increased mortality but the association of early ventricular arrhythmias (<48 hours) with mortality remains vague, with some studies showing early ventricular arrhythmias not associated with long term risk while others reporting increased long term risk of mortality.^{4,9} Arrhythmias occurring during and after primary PCI are not necessarily due to successful reperfusion or vessel patency and may indicate ongoing ischemia.¹⁰ Prognostic significance of reperfusion induced arrhythmias is also debatable with some studies showing increased in hospital mortality and adverse outcome while others portraying a benign course⁴. Arrhythmias are more prevalent in ST elevation

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Myocardial infarction (STEMI) than in Non ST elevation Myocardial infarction (NSTEMI) but still, arrhythmias occurring in NSTEMI contribute to increased overall and arrhythmic mortality.^{4,7} Many studies suggest that early ventricular arrhythmias have an increased in-hospital short term mortality.^{4,8} However data from Pakistan is limited with very few studies available on the pattern of arrhythmias and the association of specific type of arrhythmias with in hospital outcome and mortality.³ Moreover previous regional studies included only STEMI patients. The purpose of this study is to examine the spectrum of arrhythmias during initial 48 hours of presentation in AMI patients (both STEMI and NSTEMI) undergoing PCI and to determine the association of various types of arrhythmias with in hospital mortality and adverse outcome.

METHODOLOGY

This was an analytical cross sectional study conducted at Armed Forces Institute of Cardiology/ National Institute of Heart Diseases, Rawalpindi Pakistan, from June 2021 till January 2022. AMI was characterized by either ST elevation on ECG or raised troponin without ST elevation on ECG in a patient with a history of chest pain and associated symptoms. ST elevation was defined as elevation of ST segment more than 2mm in V2-V3 (>2.5 mm in <40 years males or >1.5mm in all females) and >1mm in all other leads.

Sample Size: With reference to 89.1% prevalence of arrhythmias the sample size calculated was n=150 at 95% CI and 5% margin of error by using WHO calculator.

Inclusion Criteria: All patients >18 years of age presenting with AMI undergoing revascularization including patients with STEMI undergoing Primary PCI and NSTEMI undergoing immediate or early revascularization were included in the study using non probability consecutive sampling.

Exclusion Criteria: Patients with i) previous rhythm disturbances ii) dilated cardiomyopathy iii) previous structural/ valvular heart disease iv) on antiarrhythmic drugs v) chronic kidney disease with or without hemodialysis vi) thyroid illness were excluded from study.

Approval from IERB (IERB letter # 2/2/R&D/2022/150) was taken before data collection. Informed consent was taken. Demographic and clinical data was collected on pre-designed Performa, once patients

were stabilized. Patients were monitored for arrhythmias using telemetry system and serial ECGs. Arrhythmias were documented for up to 48 hours and patients were followed for any adverse outcome including Acute left ventricular failure (Ac. LVF), cardiogenic shock, acute stent thrombosis, cerebrovascular accident (CVA), death or prolonged stay. Data was analyzed using the SPSS 23. Continuous variables were expressed as Mean±SD and categorical variables expressed as frequencies and percentages. Chi-square test was applied for association of arrhythmia with adverse outcome at 95% confidence interval and 5% margin of error. *p*-value ≤0.05 was considered as significant.

RESULTS

A total of (n=150) patients were included in the study with (n=117;78%) females and (n=33;22%) males. Average age was 62.9±11.39 years with a mean BMI of 26.75±3.53kg/m². Mean chest pain duration was 8.78±8.69 hours. Diabetes mellitus was present in (n=58; 38.7%), hypertension in (n=91; 60.7%), while smoking and obesity were documented in 25.3% each (n=38). Single vessel disease was predominant in (n=63; 42%), followed by double vessel disease in (n=51; 34%). Left anterior descending (LAD) was the most common culprit vessel constituting (n=78; 51.3%) of total followed by right coronary artery (RCA) in 32.7% (n=49). Killip class on presentation was mostly Class-I (n=58; 61.1%) (Table-I).

STEMI was present in 84.7% (n=127) patients with anterior and inferior MI being most common contributing 32% each (n=48). NSTEMI was seen in (n=23; 15.3%) patients with T wave inversion in anterior leads being more common (n=8; 34.8%) (Table-II).

Arrhythmias were documented in (n=122; 81.3%) patients comprising (n=104; 81.8%) STEMI and (n=18; 77.2%) NSTEMI patients. At presentation, sinus tachycardia (n=35;21.2%) was the most common arrhythmia followed by complete heart block (CHB) (n=8; 5.5%) and sinus bradycardia (n=7;4.7%). During PCI, sinus tachycardia (n=32;19.6%) was most prevalent followed by accelerated idioventricular rhythm (AIVR) (n=18; 13.3%) and then sinus bradycardia (n=10;5.5%). During 24 hours post PCI, sinus tachycardia (n=34; 23.1%) was dominant rhythm followed by ventricular ectopy (n=8; 5.9%) and then sinus bradycardia (n=7;4.2%). During 24-48 hours post PCI, again sinus tachycardia (n=14; 11.1%) was predominant arrhythmia followed by sinus bradycardia (n=7;4.6%) (Figure-1).

Acute Myocardial Infarction Patients

In STEMI, arrhythmias were most common in inferior followed by anterior MI (Table-II) with sinus tachycardia being the predominant rhythm in both types of MI however, brady-arrhythmias were more common in inferior MI only. In NSTEMI, arrhythmias were more common in those with ST sags in inferior leads (Table-II) with sinus tachycardia being the pre-

dominant arrhythmia followed by sinus bradycardia (Table-III).

Overall, in-hospital mortality was (n=25;16.7%) which was more in STEMI and prolonged stay (>48 hours) was (n=31;20.7%) (Table-II). Both outcomes were higher in patients with arrhythmias (20.5% & 23.7%) with *p*-value 0.009&0.05 respectively (Table-III).

Table-I: Clinical, Laboratory and Demographic Parameters of Patients with Anterior wall myocardial infarction (n=150)

Parameter		n (%)	Parameter	Mean ± SD
Gender	Female	117(78.0%)	Age (years)	62.94±11.39
	Male	33(22.0%)		
Diabetes Mellitus		58(38.7%)	Weight (kg)	74.86±10.08
Obesity		38(25.3%)	Height (m)	1.67±0.057
Hypertension		91(60.7%)	BMI (kg/m ²)	26.75±3.53
Family History		113(75.3%)	Chest pain duration (hours)	8.78±8.69
Smoking		38(25.3%)	Heart Rate (bpm)	83.05±20.71
KILLIP Class			Systolic B.P (mmhg)	130.80±29.90
I		58(61.1%)	Diastolic B.P (mmhg)	80.04±18.32
II		25(26.3%)		
III		11(11.6%)		
IV		1(1.1%)	Hemoglobin(gm/dl)	13.89±2.12
Diseased Vessels			TLC (x10 ³ /μl)	13.24±19.82
Single Vessel		63(42%)	Platelets (x10 ³ /μl)	253.58±76.63
Double Vessel		51(34%)		
Triple Vessel		36(24%)	ALT(IU/L)	40.53±30.32
Culprit Vessel				
LAD		78(51.3%)	Ejection Fraction(%)	43.50±9.163
LCX		15(10.0%)		
RCA		49(32.7%)		
Diagonal		2(1.3%)		
LMS		3(2.0%)		
VG to RCA		10(0.7%)		
VG to LAD		1(0.7%)		
VG to OM		1(0.7%)		
Total		150 (100%)	N=150	

Table-II: Prevalence and Outcome of Arrhythmias in Various Types of MI

STEMI n(%) n=27	Arrhythmia n=122 n (%)	Death n=25 n(%)	Ac. LVF n=23 n(%)	Shock n=9 n(%)	CVA n=2 n(%)	Stent thrombosis n=5 n(%)	Prolonged Stay n=31 n(%)
Anterior 48(37.8%)	36(75%)	6(12.5%)	6(12.5%)	2(4.17%)	1 (2.0%)	1(2.1%)	8(16.7%)
Inferior 48(37.8%)	44(91.7%)	12(25%)	7(14.5%)	4(8.3%)	-	1(2.1%)	9(18.7%)
Anterolateral 20(15.7%)	16(80%)	4(20%)	5(25%)	1(5%)	-	3(15%)	5(25%)
Inferolateral 3(2.4%)	2(66.7%)	-	-	-	-	-	-
Anteroinferior 2(1.6%)	1(50%)	-	1(50%)	-	-	-	1(50%)
Lateral 2(1.6%)	1(50%)	-	-	-	-	-	-
Inferoposterior 2(1.6%)	2(100%)	-	-	1(50%)	-	-	1(50%)
Extensive 2(1.6%)	2(100%)	1 (50%)	-	-	-	-	1(50%)
Total 127(100%)	104(81.8%)	23(18.1%)	19(14.96%)	8(6.2%)	1(0.7%)	5(3.9%)	25(19.7%)
NSTEMI (n=23)							
T inv Anterior 8(34.8%)	5(50%)	-	2 (25%)	-	-	-	3(37.5%)
T Inv Inferior 3(13%)	3(100%)	1(33.3%)	-	1(33.3%)	-	-	-
ST Sag Inferior 5(21.7%)	5(100%)	-	-	-	-	-	1(20%)
ST Sag Anterior 4(17.4%)	3(75%)	-	1(25%)	-	-	-	2(50%)
ST sag Inferolat 1(4.3%)	-	-	-	-	-	-	-
T Inv Lateral 2(8.7%)	2(100%)	1(50%)	-	-	1(50%)	-	-
Total 23(100%)	18(78.2%)	2(8.7%)	3(13.04%)	1(4.3%)	1(4.3%)	-	6(26.1%)

Acute Myocardial Infarction Patients

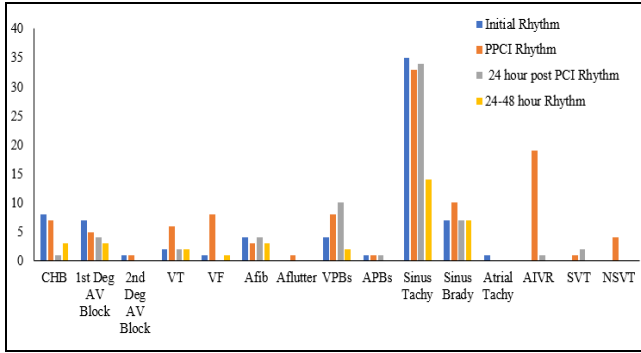


Figure-1: Arrhythmia Pattern in Relation to Timing During Hospitalization

(AF) (p -value=0.0001) and atrial tachycardia (p -value=0.02). There was more propensity for cardiogenic shock in CHB, VF/VT, atrial tachycardia and supraventricular tachycardia (SVT) (p -value <0.05). Ac. LVF was seen in patients with VF (p -value=0.02). CVA occurred in patients with VT/VF and AF (p -value<0.05). Patients with stent thrombosis and Ac. LVF had sinus tachycardia as the predominant rhythm. Moreover, patients with persistent sinus tachycardia had a prolonged stay in hospital (p -value=0.002) (Table-III).

Table-III: Association of Outcome with Various Types of Arrhythmias in STEMI and NSTEMI

Patients with Arrhythmias n=150 (81.3%)	STEMI patients with arrhythmias n=127 (81.8%)	NSTEMI Patients with arrhythmias n=23 (77.2%)	Death n(%) (p-value)	Ac. LVF n(%) (p-value)	Shock n(%) (p-value)	CVA n(%) (p-value)	Stent thrombosis n(%) (p-value)	Prolonged stay n(%) (p-value)
CHB 11(7.3%)	11 (8.6%)	-	7(63.6%) (<0.001)	1(9.1%) (0.5)	3(27.3%) (0.004)	- (0.6)	- (0.5)	3(27.3) (0.7)
1°AV Block 6(4%)	4(3.1%)	2(8.7%)	2(33.3%) 0.2)	1(16.7%) (0.8)	- (0.5)	- (0.7)	- (0.6)	1(16.7%) (0.8)
2°AV Block 7(4.7%)	5 (3.15%)	2(8.7%)	2(28.6%) (0.3)	1(14.3%) 0.9)	- (0.5)	- (0.75)	- (0.6)	1(14.3%) (0.7)
VT 12(8%)	12(9.4%)	-	8(66.7%) (<0.001)	3(25%) (0.29)	3(25%) (0.004)	1(8.3%) (0.03)	1(8.3%) (0.3)	2(16.7%) (0.70)
VF 10(6.7%)	10(7.9%)	-	8(80%) (<0.001)	4(40%) (0.02)	1(10%) (0.58)	1(10%) (0.01)	- (0.54)	2(20) (0.95)
AF 7(4.7%)	7(5.5%)	-	5(71.4%) (<0.001)	1(14.3%) (0.97)	- (0.49)	- (0.002)	- (0.61)	1(14.3%) (0.67)
Aflutter 2(1.3%)	1(0.7%)	1(4.3%)	- (0.52)	1(50%) (0.16)	0(0) (0.72)	- (0.87)	- (0.72)	1(50%) (0.3)
VPBs 16(10.7%)	15(11.8%)	1(4.3%)	3(18.75%) (0.8)	1(6.25%) (0.3)	- (0.28)	0(0) (0.62)	- (0.43)	2(12.5%) (0.39)
APBs 2(1.3%)	2(1.5%)	-	1(50%) (0.2)	1(50%) (0.155)	- (0.72)	- (0.87)	- (0.79)	- (0.47)
Sinus tachycardia 52(34.7%)	42(33.1%)	10(43.4%)	9(17.3%) (0.87)	12(23.1%) (0.03)	5(9.6%) (0.17)	1(1.9%) (0.65)	5(9.6%) (0.002)	18(34.6%) (0.002)
Sinus bradycardia 19(12.7%)	14(11%)	5(21.7%)	2 (10.5%) (442)	2(10.5%) (0.59)	2(10.5%) (0.37)	- (0.59)	- (0.39)	4(21.0%) (0.96)
Atrial tachycardia1 (0.7%)	None	1(4.3%)	1(100%) (0.02)	- (0.67)	1(100%) (0.0001)	0(0.9)	0(0.85)	0(0.6)
SVT 8(5.3%)	7(5.5%)	1(4.3%)	2(25%) (0.5)	3(37.5%) (0.06)	2(25%) (0.2)	- (0.73)	1(12.5%) (0.14)	3(37.5%) (0.23)
NSVT 4 (2.7%)	4(3.15%)	-	- (0.36)	- (0.401)	- (0.61)	0(0) (0.814)	- (0.7)	1(25%) (0.82)
AIVR 20(13.4%)	18(14.2%)	2(8.7%)	1(5%) (0.15)	1(5%) (0.186)	- (0.22)	- (0.57)	- (0.37)	2(10%) (0.2)
Total (177 episodes in 122 patients)	(152episode in 104)	(25 in 18 patients)	25 (20.5%) (0.009)	21(17.2%) (0.06)	9(7.4%) (0.14)	2(1.64%) (0.4)	5(4.09%) (0.27)	29(23.7%) (0.05)

Among patients with arrhythmia, mortality was higher in CHB, ventricular tachycardia/ventricular fibrillation (VT/VF), atrial fibrillation

DISCUSSION

AMI is a leading cause of mortality worldwide with arrhythmia being a major complication. In our

study, AMI was more in males 78% (n=117) than females 22% (n=33) as shown in other studies.^{3,16,17} Mean age (62.9±11.3) was comparable to study by Shah *et al.*³ Arrhythmia incidence (81.3%) is also comparable to study by Shah *et al.* and other studies.^{3,12,14,16-18} Arrhythmia incidence in NSTEMI (77.2%) was not much reported in regional studies. Sinus tachycardia was the most common arrhythmia in our study with incidence (34.7%) similar to other studies.^{3,12,14,18,4} Sinus tachycardia at presentation and afterwards could be due to sympathetic response of body to pain and anxiety. AIVR (13.4%) was the second most common arrhythmia in this study occurring mostly during PCI that is similar to the overall reported incidence,⁴ but less than that reported by Shah *et al.* (37.3%) and by Terkson (42%).¹⁹ Similar to study by Terkson, our study did not show significant association of AIVR with mortality.¹⁹ Sinus bradycardia in our study (12.7%) was comparable to study by Patil B (15%) but was higher than Shah (5.5%). CHB seen in only STEMI patients (7.3%) in our study was less than that reported by Shah J (20%), by Patil B (15%) and by Raman *et al.* (13%). Sustained VT/VF (8%/6.7% in STEMI patients only) was comparable to 6% by Raman *et al.* 10% by Patil *et al.* Similar VT/VF incidence was noted in other studies with 6-10% Pre-PCI, 4-5% during PCI and 1.6-4.4% in 24-48 hours post PCI.⁴ However our incidence of sustained VT was less than that of Shah *et al.* (22.7%). In Our study AF and SVT were present in 4.7% and 5.3% of patients respectively which was also comparable to the 5% reported incidence of AF in literature.⁴ Non-Sustained Ventricular Tachycardia (NSVT) (2.7%) in our study was similar to study by Shah *et al.* (2%). There was no case of malignant ventricular arrhythmia in NSTEMI, as was also seen in another study by Wildi.¹⁸ In our study, overall mortality was 16.7% and was more in Inferior STEMI (25%) followed by 14.7% in combined anterior STEMI. This was in contrast to studies by Patil and Raman *et al.* that showed majority of deaths in anterior MI, but it was similar to study by Chiwhane *et al.*¹⁵ that showed increased mortality in inferior MI. In our study, mortality was significantly associated with arrhythmias (*p*-value 0.009) with death being most common in malignant ventricular arrhythmias (72.7%), AF (71.4%) and CHB (63.6%). A similar trend in mortality was reported by Shah *et al.* (15.5%), Patil B (15%, mostly due to ventricular arrhythmias and CHB) and by Raman *et al.* (14%) with ventricular arrhythmias being the most common cause (66.6%) followed by supraventricular arrhythmias (50%). However, our mortality was higher

than that reported by Alam *et al.* (2%), which could be due to smaller sample size in that study. Ac. LVF (14.7%) and cardiogenic shock (6%) was comparable to studies by Alam *et al.* and Raman *et al.* Stent thrombosis and CVA were seen in 3.3% and 1.3% respectively. It was comparable to the 2.7% stent thrombosis in study by Shah. Prolonged hospitalization >48 hours (20.7%) had significant association with arrhythmias (23.7% with *p*-value 0.05) in our study which was not much studied in previous regional studies. Although sinus tachycardia had significant association with stent thrombosis but the absolute number of this complication was small. Moreover, predominant sinus tachycardia in Ac. LVF could be due to sympathetic drive. No regional studies were available for comparison of adverse outcome and arrhythmias in NSTEMI.

LIMITATIONS OF STUDY

This is a single center study with limited sample size, so results cannot be generalized to whole population. Moreover, in our set up 24-hour holter monitoring is not done routinely in all AMI patients, which could have an impact on arrhythmia incidence and outcome.

CONCLUSION

This study highlights that arrhythmias are common in both STEMI (81.3%) and NSTEMI (77.2%) patients during initial 48 hours of presentation. Sinus tachycardia is most common followed by AIVR and sinus bradycardia. Mortality is highest with ventricular arrhythmias, AF and CHB. Hence Acute MI patients with such arrhythmias should be observed for at least 48 hours and managed vigorously to avoid fatal complications.

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Conflict of Interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

SAS: Manuscript writing, drafting, data analysis and editing

MS: Intellectual contribution, concept and final approval

WUR: Intellectual contribution, concept & final approval

JA: Data collection, data entry and review of article

MAV: Formatting, critical review and data collection/entry

SM: Study design, concept and critical review

IA: Data management, data collection & manuscript writing

AI: Data collection, data entry and review of article

NA: Review of article, formatting and critical review

AAC: Proof reading, Intellectual contribution, final approval

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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