International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 13, No. 11, November 2024 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_13.11.2024.124

ORIGINAL RESEARCH

Association Between Infarction Location and Arrhythmia Patterns in Acute Myocardial Infarction Patients

Sunit Kumar

Junior Resident, L.N. Mishra North Eastern Railway Hospital, Gorakhpur, Uttar Pradesh, India

Corresponding Author
Sunit Kumar
Junior Resident, L.N. Mishra North Eastern Railway Hospital Gorakhpur, Uttar Pradesh, India
Email: sunnysunit@gmail.com

Received Date: 22 September, 2024 Accepted Date: 26 October, 2024

ABSTRACT

Background: Acute Myocardial Infarction (AMI) is a leading cause of cardiovascular mortality, with arrhythmias as significant complications. Infarction location influences the type and frequency of arrhythmias. Understanding these associations aids in risk stratification and management. **Methods:** This hospital-based, prospective observational study was conducted over 1.5 years at L.N. Mishra North Eastern Railway Hospital, Gorakhpur. A total of 100 AMI patients aged 19 years or older were included. Exclusion criteria were prior MI, valvular heart disease, and thyroid disorders. Data on infarction site, arrhythmia type, and risk factors were recorded using 12-lead ECGs and 2-D echocardiography. Statistical significance was set at $p < 0.05$. **Results:** Of the 100 patients, 74% were male, and 26% were female. AWMI (45%) and IWMI (30%) were the most common infarction sites. Arrhythmias occurred in 70% of patients, with sinus bradycardia (25.71%) and ventricular premature contractions (VPCs, 20%) being most frequent. VPCs were associated with AWMI, while sinus bradycardia and conduction blocks were linked to IWMI. Most arrhythmias occurred within the first hour (70%). Hypertension (38%) and diabetes (40%) were strongly correlated with arrhythmias. **Conclusion:** Infarction location significantly influences arrhythmia patterns in AMI, with AWMI linked to VPCs and IWMI to sinus bradycardia. Early monitoring and management of risk factors like hypertension and diabetes are essential. These findings highlight the need for infarction-specific monitoring and targeted interventions in AMI care.

INTRODUCTION

Cardiovascular diseases, particularly coronary artery disease (CAD), are the leading global causes of mortality, responsible for nearly 12 million deaths annually. Despite advancements in treatment, acute myocardial infarction (AMI) continues to pose significant risks due to complications such as arrhythmias, which are major contributors to sudden cardiac death (1,2,3).

Arrhythmias in MI patients manifest in various forms, including bradyarrhythmia, ventricular arrhythmias, and atrioventricular (AV) blocks. The infarction site critically influences the type and frequency of arrhythmias observed. Studies indicate that anterior wall infarctions (AWMI) are commonly associated with sinus bradycardia and ventricular premature contractions (VPCs). In contrast, inferior wall infarctions (IWMI) lead to conduction blocks such as complete heart block (4.5).

In the North Eastern Railway population, data on the incidence and patterns of arrhythmias by infarction site are sparse. Understanding these associations is vital for risk stratification, personalized monitoring, and therapeutic interventions

MATERIALS AND METHODS

The study was conducted in a secondary care hospital setting over a period of one and a half years, from April 2018 to October 2019.

Study Site: The study was carried out at L.N. Mishra North Eastern Railway Hospital, Gorakhpur, Uttar Pradesh.

Study Design: A prospective observational cohort study was undertaken.

Study Population: A total of 100 patients admitted to the Intensive Coronary Care Unit (ICCU) with a confirmed diagnosis of Acute Myocardial Infarction (AMI) were included in the study.

DOI: 10.69605/ijlbpr_13.11.2024.124

Inclusion Criteria

1. Patients in the hyper-acute to the acute phase of MI.
2. Age above 19 years.

Exclusion Criteria

1. Patients with prior MI.
2. Known cases of valvular heart disease, thyroid disorders, or undefined arrhythmias.

Data Collection

- Demographic details, infarction site, and type of arrhythmia were recorded.
- 12-lead ECGs were performed at admission and during arrhythmia episodes.
- 2-D echocardiography was conducted wherever feasible.

Statistical Analysis

The Chi-square test was used to analyze associations between variables, with statistical significance set at $p < 0.05$.

RESULTS

A total of 100 patients were recruited upon admission to the Intensive Coronary Care Unit (ICCU). Among these, 74 were males and 26 were females. Only patients with a confirmed diagnosis of acute myocardial infarction (AMI) who met the inclusion and exclusion criteria were included in the study.

Table 1: Demographic Distribution

Sno.	Parameter	Value
	Total patient (N)	100
1	Male patients	74%
2	Female patients	26%
3	Age group 50–59	45%

Arrhythmias were more prevalent in males and older adults.

Table 2: Arrhythmia Types by Infarction Site

Sno.	Infarction Site	Common Arrhythmias	Frequency (%)
1	Anterior Wall	Sinus Bradycardia, VPCs	45
2	Inferior Wall	Complete Heart Block	30
3	Inferolateral Wall	VPCs	15

AWMI showed a higher incidence of VPCs and bradycardia, while IWMI had a higher frequency of conduction blocks.

Table 3: Risk Factor Correlation

Sno.	Risk factor	Patient(%)	Arrhythmias (%)
1	Hypertension	38	80
2	Diabetes Mellitus	40	85
3	Smoking	55	82
4	Alcohol	65	70

Diabetes and smoking were significantly associated with arrhythmia incidence.

Table 4: Time of onset and frequency of arrhythmia

Sno.	Time frame	Frequency (%)
1	First hour	70
2	1–12 hours	24
3	12–24 hours	3

The majority of arrhythmias occurred during the first hour of hospitalization.

Table 5: Arrhythmia Management and Outcomes

Sno.	Intervention Type	Frequency (%)
1	Spontaneous Resolution	70
2	Pharmacological	18
3	Electrical	12

Most arrhythmias resolved spontaneously, while severe cases required intervention.

DOI: 10.69605/ijlbpr_13.11.2024.124

Table 6: Percentage of Specific types of arrhythmias

Sno.	Type of arrhythmia	Frequency	Percentage
1	Vpc	14	20%
2	Vt	4	5.71%
3	Vf	2	2.85%
4	Sinus bradycardia	18	25.71%
5	Sinus tachycardia	2	2.85%
6	Atrial fibrillation	4	5.71%
7	Atrial tachycardia	2	2.85%
8	Lahb	2	2.85%
9	Second-degree block	6	8.57%
10	Complete heart block	6	8.57%
11	Chb+ 1st-degree block	2	2.85%
12	Vpc+ sinus bradycardia	4	5.71%
13	Vpc + sinus tachycardia	2	2.85%
14	Vpc+ rbbb	2	2.85%

Sinus bradycardia was the most common arrhythmia. VPCs occurred in isolation in 20% of patients and it also occurred along with other arrhythmia.

The analysis revealed that myocardial infarction was more common among the elderly, and the incidence was higher in males compared to females. Of the 100 patients, 70% experienced arrhythmias, with arrhythmias occurring in 77% of females and 67.5% of males.

Regarding the infarction site, anterior wall myocardial infarction (AWMI) was observed in 45% of patients, while 30% had inferior wall myocardial infarction (IWMI). Additionally, 15% of patients had inferior wall and right ventricular myocardial infarction, 6% had inferolateral myocardial infarction, and 4% had lateral wall myocardial infarction.

The distribution of risk factors showed that 38% of the patients were hypertensive and 62% were non-hypertensive. Similarly, 40% were diabetic, while 60% were non-diabetic. Smoking was prevalent in 55% of the patients, and 65% of the patients consumed alcohol. Thrombolysis was performed in 62% of the patients, whereas 38% were not thrombolysed.

The timing of arrhythmias was a significant finding, with 70% occurring within the first hour of admission. Additionally, 24% of arrhythmias occurred between 1 to 12 hours, and 3% were observed between 12 to 24 hours. These results highlight the correlation between infarction sites and arrhythmia types, along with the timing and prevalence of arrhythmias, providing crucial insights for patient management.

DISCUSSION

The current study is a descriptive analysis involving 100 patients, focusing on the pattern of cardiac arrhythmias in acute myocardial infarction (AMI) during the first week of hospitalization. Studying arrhythmias in hospitalized AMI cases provides an indirect estimate of mortality and holds clinical significance since the true mortality due to AMI is often underreported in the community due to inadequate reporting and low autopsy rates.

Demographics and General Observations

This study revealed that myocardial infarction was more common among the elderly, consistent with findings from Stern, S. (2003)(6), which highlighted that 85% of coronary heart disease deaths occur in individuals over 65 years of age. Similarly, SZ Abildstrom et al. noted that while the relative risk of sudden cardiac death is higher in younger populations, the absolute risk is significantly elevated in older individuals.(7)(8)

A male predominance was observed in AMI, consistent with the Framingham Heart Study(9), which showed men were at a higher risk of coronary events. However, arrhythmias were more prevalent in females (77%) compared to males (67.5%), aligning with Shmuel Gottlieb et al., who found that women fared worse than men in terms of outcomes post-AMI. This may be explained by delayed presentation and under-recognition of AMI in women, necessitating further research into gender-specific management strategies.(10)(11)(12)

Correlation Between Infarction Sites and Arrhythmia Types

Anterior wall myocardial infarction (AWMI) was the most common infarction site (45%), followed by inferior wall myocardial infarction (IWMI) (30%). Among arrhythmias, ventricular premature contractions (VPCs) were the most frequent, particularly associated with AWMI (55.5%), consistent with the findings of Mohit J. Shah et al., who observed a higher incidence of VPCs in anterior wall infarcts (13). In contrast, sinus bradycardia (85.7%) was predominantly associated with IWMI, similar to Serrano CV Jr., who reported bradycardia with proximal right coronary artery (RCA) occlusions in IWMI patients.(14)

Inferolateral (6%), lateral wall (4%), and combined IWMI-right ventricular infarctions (15%) were less common. Michael Rotman also noted a higher incidence of sinus bradycardia in IWMI than in AWMI, which could be attributed to the involvement of the RCA.

DOI: 10.69605/ijlbpr_13.11.2024.124

Timing of Arrhythmias

The timing of arrhythmias was a critical finding, with 70% occurring within the first hour of admission. This aligns with Aufderheide(15)

TP (1998), who found that 25% of conduction disturbances occurred within one hour of infarction onset. The remaining 24% of arrhythmias were observed between 1–12 hours, and 3% occurred within 12–24 hours. These findings underscore the importance of early monitoring and intervention, especially during the initial critical hours.(15)

Risk Factor Analysis

Hypertension (38%) and diabetes mellitus (40%) were prominent risk factors in this cohort. Among hypertensive patients, 80% developed arrhythmias, consistent with findings by Trappe HJ, who noted an increased prevalence of atrial fibrillation (AF) in hypertensives.(16) Similarly, 85% of diabetic patients experienced arrhythmias, reflecting the multifactorial nature of diabetes in arrhythmogenesis, as highlighted by the Framingham Offspring Study, which linked glucose variability with reduced heart rate variability. Smoking was prevalent in 55% of patients; however, no statistically significant association with arrhythmias was found, contrasting with the Framingham Study, which demonstrated a 2–3 fold increased risk of sudden cardiac death among smokers. This discrepancy may reflect sample size limitations or population-specific differences.(17)(18)(19)(20)(21)(22)(23)(24)(25)

Arrhythmia Patterns and Management

Sinus bradycardia (25.71%) and ventricular premature contractions (VPCs) (20%) were the two most common arrhythmias observed in this study. Sinus bradycardia was predominantly associated with inferior wall myocardial infarction (IWMI), while VPCs were more frequently linked to anterior wall myocardial infarction (AWMI). These findings are consistent with the study by Mohit J. Shah et al(13)., which reported a high prevalence of VPCs (36.23%) in anterior wall infarcts. Similarly, Serrano CV Jr. et al. found a strong association between sinus bradycardia and proximal right coronary artery (RCA) occlusions, often seen in inferior wall infarctions.(14)

This alignment underscores the influence of infarction location on arrhythmia patterns, emphasizing the need for infarction-site-specific monitoring and management strategies. Early identification of arrhythmias, particularly during the acute phase, can guide therapeutic decisions and improve patient outcomes.

Thrombolysis was performed in 62% of patients, with reperfusion arrhythmias such as VPCs and sinus bradycardia being the most common. These findings are consistent with the observations of Scott D. Solomon et al.(26), who reported ventricular arrhythmias and sinus bradycardia as frequent outcomes of thrombolytic therapy. The mechanisms of these arrhythmias may involve mitochondrial dysfunction and action potential destabilization, particularly during the early hours following reperfusion. (27)(28)

Clinical Implications

The findings highlight the need for aggressive monitoring and risk stratification in AMI patients, particularly during the first 24 hours of hospitalization. Tailored interventions, such as prompt thrombolysis and careful management of risk factors like hypertension and diabetes, could significantly improve outcomes. The gender-specific differences in arrhythmia prevalence also suggest the importance of considering sex as a biological variable in future studies.

Limitations and Future Directions

While this study provides valuable insights, it is limited by its observational design and relatively small sample size. Future research should explore the long-term implications of arrhythmias post-AMI and investigate the role of biomarkers in early prediction. Additionally, the gender-specific findings warrant further exploration to guide targeted interventions.

Financial Support

No financial support was provided for this study.

Abbreviations Used

AMI – Acute Myocardial Infarction
AWMI – Anterior Wall Myocardial Infarction
IWMI – Inferior Wall Myocardial Infarction
VPC – Ventricular Premature Contraction
ECG – Electrocardiogram
RCA – Right Coronary Artery

CONCLUSION

This study highlights the significant prevalence of arrhythmias in acute myocardial infarction (AMI) patients, with 70% experiencing arrhythmias, most commonly during the first hour of hospitalization. The findings emphasize the strong correlation between infarction sites and arrhythmia types, particularly the higher incidence of ventricular premature contractions (VPCs) in anterior wall myocardial infarction (AWMI) and sinus bradycardia in inferior wall myocardial infarction (IWMI).

Risk factors such as hypertension, diabetes, and advanced age were closely associated with arrhythmia development, underscoring the multifactorial nature of cardiac arrhythmogenesis in AMI. While gender analysis revealed a higher incidence of AMI in males, arrhythmias were more frequent in females, suggesting potential gender-specific differences in cardiac response that warrant further exploration.

The timing of arrhythmias highlights the critical importance of early monitoring and intervention, especially during the initial hours post-infarction. Thrombolysis, though lifesaving, was associated with

DOI: 10.69605/ijlbpr_13.11.2024.124

a notable prevalence of reperfusion arrhythmias, reaffirming the need for close patient monitoring during this therapeutic window.
In conclusion, this study underscores the need for comprehensive risk stratification and tailored management strategies for AMI patients to reduce the burden of arrhythmias and associated mortality. Further research, particularly on gender-specific outcomes and long-term arrhythmia implications, is essential to optimize patient care and improve prognoses in this high-risk population.

REFERENCES

1. Enas EA, Yusuf S, Mehta JL. Prevalence of coronary artery disease in Asian Indians. *Am J Cardiol.* 1992 Oct 1;70(9):945-9.
2. Mukharji, J., Rude, R. E., Poole, W. K., Gustafson, N., Thomas, L. J., Strauss, et al. Risk factors for sudden death after acute myocardial infarction: Two-year follow-up. *The American Journal of Cardiology*, 1984;54(1):31–36.
3. JOHNSON, C. C., & MINER, P. F. The Occurrence of Arrhythmias in Acute Myocardial Infarctions. *Diseases of the Chest*.1958;33(4):414–422.
4. Newby, K. H., Thompson, T., Stebbins, A., Topol, E. J., Califf, R. M., & Natale, A. Sustained Ventricular Arrhythmias in Patients Receiving Thrombolytic Therapy. Incidence and outcomes. *circulation*. 1998; 98(23): 2567–2573.
5. Meine, T. J., Al-Khatib, S. M., Alexander, J. H., Granger, C. B., White, et al. Incidence, predictors, and outcomes of high-degree atrioventricular block complicating acute myocardial infarction treated with thrombolytic therapy. *American Heart Journal*. 2005; 149(4): 670–674.
6. Stern S, Behar S, Gottlieb S. Aging and diseases of the heart. *Circulation*. 2003;108(14):1927-1932. doi:10.1161/01.CIR.0000086898.96021.B9
7. Abildstrom SZ, Rask-Madsen C, Ottesen MM, Andersen PK, Rosthøj S, Torp-Pedersen C, Køber L; TRACE Study Group. Trandolapril cardiac evaluation. Impact of age and sex on sudden cardiovascular death following myocardial infarction. Heart. 2002 Dec;88(6):573-8. doi: 10.1136/heart.88.6.573. PMID: 12433881; PMCID: PMC1767447.
8. Rich MW. Epidemiology, clinical features, and prognosis of acute myocardial infarction in the elderly. The American journal of geriatric cardiology. 2006 Jan;15(1):7-13.
9. Tsao CW, Vasan RS. Cohort Profile: The Framingham Heart Study (FHS): overview of milestones in cardiovascular epidemiology. Int J Epidemiol. 2015 Dec;44(6):1800-13. doi: 10.1093/ije/dyv337. PMID: 26705418; PMCID: PMC5156338.
10. Gottlieb, S., Harpaz, D., Shotan, A., Boyko, V., Leor, J., Cohen, M., Mandelzweig, L., Mazouz, B., Stern, S., & Behar, S. (2000). Sex differences in management and outcome after acute myocardial infarction in the 1990s: A prospective observational community-based study. *Circulation*, *102*(20), 2484-2490. https://doi.org/10.1161/01.CIR.102.20.2484
11. Gottlieb S, Harpaz D, Shotan A, Boyko V, Leor J, Cohen M, Mandelzweig L, Mazouz B, Stern S, Behar S. Sex differences in management and outcome after acute myocardial infarction in the 1990s: a prospective observational community-based study. Circulation. 2000 Nov 14;102(20):2484-90.
12. Towfighi A, Zheng L, Ovbiagele B. Sex-specific trends in midlife coronary heart disease risk and prevalence. Archives of internal medicine. 2009 Oct 26;169(19):1762-6.
13. Shah MJ, Bhatt NR, Dabhi A, Thorat PB, Chudasama K, Patel J. A study of 100 cases of arrhythmias in first week of acute myocardial infarction (AMI) in Gujarat: a high risk and previously undocumented population. Journal of Clinical and Diagnostic Research: JCDR. 2014 Jan;8(1):58.
14. Serrano Jr CV, Bortolotto LA, César LA, Solimene MC, Mansur AP, Nicolau JC, Ramires JA. Sinus bradycardia as a predictor of right coronary artery occlusion in patients with inferior myocardial infarction. International journal of cardiology. 1999 Jan 1;68(1):75-82.
15. Aufderheide TP. Arrhythmias associated with acute myocardial infarction and thrombolysis. Emerg Med Clin North Am. 1998 Aug;16(3):583-600, viii. doi: 10.1016/s0733-8627(05)70019-5. PMID: 9739776.
16. Trappe HJ. Tachyarrhythmias, bradyarrhythmias and acute coronary syndromes. Journal of Emergencies, Trauma and Shock. 2010 Apr;3(2):137.
17. Lerner DJ, Kannel WB. Patterns of coronary heart disease morbidity and mortality in the sexes: a 26-year follow-up of the Framingham population. American heart journal. 1986 Feb 1;111(2):383-90.
18. Grisanti LA. Diabetes and arrhythmias: pathophysiology, mechanisms and therapeutic outcomes. Frontiers in physiology. 2018;9.
19. Movahed MR, Hashemzadeh M, Jamal MM. Diabetes mellitus is a strong, independent risk for atrial fibrillation and flutter in addition to other cardiovascular disease. International journal of cardiology. 2005 Dec 7;105(3):315-8.
20. Yildirir A, Batur MK, Oto A. Hypertension and arrhythmia: blood pressure control and beyond. Europace. 2002 Apr 1;4(2):175-82.
21. Hallstrom AP, Cobb LA, Ray R. Smoking as a risk factor for recurrence of sudden cardiac arrest. N Engl J Med. 1986 Jan 30;314(5):271-5. Doi: 10.1056/NEJM198601303140502. PMID: 3941718.
22. Goldenberg I, Moss AJ, McNITT SC, Zareba W, Daubert JP, Hall WJ, Andrews ML, Multicenter Automatic Defibrillator Implantation Trial-II Investigators. Cigarette smoking and the risk of supraventricular and ventricular tachyarrhythmias in high-risk cardiac patients with implantable cardioverter defibrillators. Journal of cardiovascular electrophysiology. 2006 Sep;17(9):931-6.
23. Goldenberg I. Bezafibrate Infarction Prevention Study Group: Current smoking, smoking cessation, and the risk of sudden cardiac death in patients with coronary artery disease. Arch Intern Med. 2003;163:2301-5.
24. Kupari M, Koskinen P. Alcohol, cardiac arrhythmias and sudden death. InNovartis Foundation Symposium 1998 Nov 30 (pp. 68-85). Wiley.
25. Brunner S, Herbel R, Drobesch C, Peters A, Massberg S, Kääb S, Sinner MF. Alcohol consumption, sinus tachycardia, and cardiac arrhythmias at the Munich Octoberfest: results from the Munich Beer Related Electrocardiogram Workup Study (MunichBREW). European heart journal. 2017 Apr 25;38(27):2100-6.
26. Solomon SD, Ridker PM, Antman EM. Ventricular arrhythmias in trials of thrombolytic therapy for acute myocardial infarction. A meta-analysis. Circulation.

DOI: 10.69605/ijlbpr_13.11.2024.124

1993 Dec;88(6):2575-81.

27. Skoda R, Nemes A, Bárczi G, et al. Prognosis and clinical characteristics of patients with early ventricular fibrillation in the 6-week guideline-offered time period: is it safe to wait 6 weeks with the assessment? Results from the VMAJOR-MI Registry. PMCID: PMC7719948. PMID: 33392039.
28. Temporal trends on the risk of arrhythmic vs. non-arrhythmic deaths in high-risk patients after myocardial infarction: a combined analysis from multicentre trials. Eur Heart J. 2005 Jul;26(14):1385-93. doi: 10.1093/eurheartj/ehi268. Epub 2005 May 24. PMID: 15914501.