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Original Article

Frequency and Factors of High-Degree Atrioventricular Block in Patients with Acute Anterior Wall Myocardial Infarction

Khadija Khan[1*], Mazhar Mahmood[1], Jebran Khan[2], Muhammad Farooq Azam Khan[1], Mashal Fatima[1] and Muhammad Waseem Hussain[2]

[1]Department of Cardiology, Rehman Medical Institute, Peshawar, Pakistan
[2]Department of Cardiology, Khyber Teaching Hospital, Peshawar, Pakistan

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ABSTRACT

High-degree atrioventricular block (HAVB) is a serious complication of acute anterior wall myocardial infarction (AWMI), contributing significantly to early morbidity and mortality. Early identification of high-risk patients is essential for timely intervention. **Objectives:** To determine the frequency, clinical predictors, and in-hospital outcomes of HAVB among patients presenting with acute AWMI. **Methods:** This cross-sectional study included 78 acute AWMI patients presenting at Rahman Medical Institute from June 2024 to July 2025. Demographic data, clinical characteristics, and ECG findings were recorded. Patients were monitored continuously for the development of HAVB. Outcomes included cardiogenic shock, ICU admission, pacing requirements, and in-hospital mortality. Associations were analyzed using chi-square and logistic regression, with $p<0.05$ considered significant. **Results:** The mean age of patients was 56.8 ± 8.2 years, predominantly male 51(65.4%). The majority of patients were in the age group 51–60 years, 31(39.7%). HAVB occurred in 7(9%) patients. Older age (>60 years) and diabetes mellitus were significantly associated with HAVB (p=0.03) and (p=0.04), respectively. HAVB was strongly associated with cardiogenic shock (p=0.01), ICU admission (p=0.002), and need for temporary pacing (p<0.001). In-hospital mortality was significantly higher in the HAVB group (p=0.04). On multivariate analysis, HAVB independently predicted mortality (aOR 4.9, p=0.03). **Conclusions:** HAVB is an important predictor of adverse outcomes in AWMI, particularly among older and diabetic patients. Early monitoring and timely pacing interventions are crucial to improving survival.

INTRODUCTION

Acute myocardial infarction (AMI) is a major global health burden characterized by obstruction of coronary blood flow leading to myocardial damage [1], with anterior wall myocardial infarction (AWMI) being particularly severe due to involvement of the left anterior descending (LAD) artery and a larger myocardial territory [2]. Despite advancements in treatment that have reduced in-hospital AMI mortality from 26.7% in the 1960s to 7.2% in recent years, AMI still accounted for approximately 8.9 million deaths worldwide in 2019 [3]. A critical complication during AMI is atrioventricular (AV) block, a conduction abnormality ranging from first-degree delay to complete third-degree block, with high-degree AV block, such as Mobitz II and complete heart block, representing the most clinically significant forms [4]. Patients who develop high-grade AV block during AMI experience substantially higher mortality rates (15% vs. 4.9%) [5], underscoring the importance of early recognition. This complication is particularly concerning in AWMI, where extensive septal involvement increases vulnerability to conduction disturbances and

contributes to adverse outcomes. The relationship between AWMI and AV block is clinically significant, primarily due to the involvement of the LAD artery, which supplies the septal branches responsible for maintaining normal cardiac conduction [6]. This complication is often accompanied by hemodynamic instability, heart failure, and arrhythmias, frequently requiring pacing interventions [7]. Early recognition is therefore essential, as timely management not only improves clinical outcomes but may also reverse conduction abnormalities in some cases following successful revascularization [8, 9].

Despite the recognized association between AWMI and HAVB, there remains a paucity of contemporary, region-specific data from Pakistan regarding its frequency, factors, and in-hospital outcomes. Most available evidence is derived from Western populations, which may not be fully generalizable due to differences in patient demographics, comorbidities, and healthcare infrastructure. Therefore, this study aims to determine the frequency and factors of HAVB among patients presenting with acute AWMI and to identify its clinical predictors and associated in-hospital outcomes.

METHODS

This cross-sectional study was conducted at the Department of Cardiology, Rehman Medical Institute from June 2024 to July 2025 on 78 patients, calculated using an Open epi software, keeping confidence level of 95%, anticipated prevalence of HAVB in AWMI as 5.34% [10] and 5% margin of error, using formula the following formula $n = DEFF \times N \times p(1-p)/d2/Z^2_{1-\alpha/2} \times (N-1) + p(1-p)$. The population was recruited through consecutive sampling. Data collection began after getting approval from the institutional review board under ref: RMI-REC/Ethical Approvals/CPSP Synopsis/57. Either gender patients, aged 40–70 years, presenting within 48 hours of symptom onset with acute anterior wall ST-segment elevation myocardial infarction (AW-STEMI) were included. AW-STEMI was defined as ST-segment elevation ≥0.1 mV in at least two contiguous anterior leads (V1–V6) on admission electrocardiography. High-degree atrioventricular (AV) block comprised second-degree block (2:1 conduction or Wenckebach phenomenon with narrow QRS) and third-degree block (complete AV dissociation with atrial rate exceeding ventricular rate). Patients with electrolyte abnormalities involving potassium, calcium, or magnesium were excluded. Eligible patients presenting to the cardiac emergency department were enrolled after written informed consent. Demographic characteristics, clinical variables, cardiovascular risk factors, and comorbidities were recorded using a structured proforma. Patients received primary percutaneous coronary intervention or thrombolytic therapy when indicated, followed by standard guideline-based management. All participants were monitored throughout hospitalization until discharge, with outcomes prospectively documented.

SPSS version 27.0 was used for analysis. Quantitative variables such as age, height, weight, BMI, time with symptoms, left ventricular ejection fraction, and hospital stay were checked for normality using Shapiro-Wilk tests and were expressed as mean ± SD. Qualitative variables like gender, residence, DM, Hypertension, Smoking status, Family history of cardiovascular diseases, and other comorbidities were expressed in frequency and percentage format. Post-stratification Fisher's Exact tests were used, with a significance level set at 0.05. Logistic regression analysis was conducted to predict risk factors for HAVB.

RESULTS

This study included 78 patients with acute AWMI, with a mean age of 56.8 ± 8.2 years. The majority of patients were aged 51–60 years, 31 (39.7%), followed by 61–70 years, 25 (32.1%), and 40–50 years, 22 (28.2%), predominantly male, 51 (65.4%). The mean body mass index (BMI) was 26.4 ± 4.1 kg/m², with 32 (41.0%) as overweight, and 18 (23.1%) as obese. Regarding symptom duration before presentation, 34 (43.6%) patients presented within 6 hours, 22 (28.2%) within 6–12 hours, 15 (19.2%) within 13–24 hours, and 7 (9.0%) within 25–48 hours. Two-thirds of the study patients resided in urban areas 52 (66.7%), while 26 (33.3%) were from rural areas. Additionally, 28 (35.9%) patients were active smokers, and 19 (24.4%) reported a family history of cardiovascular disease (Table 1).

Table 1: Demographic, Anthropometric, and Clinical Characteristics of Patients Presenting with AWMI (n=78)

Variables	n (%), Mean ± SD
Age	
Years	56.8 ± 8.2
Age Groups	
40-50 Years	22 (28.2%)
51-60 Years	31 (39.7%)
61-70 Years	25 (32.1%)
Gender	
Male	51 (65.4%)
Female	27 (34.6%)
BMI	
(kg/m²)	26.4 ± 4.1
Normal (18.5-24.9)	28 (35.9%)
Overweight (25.0-29.9)	32 (41.0%)
Obese (≥30.0)	18 (23.1%)
Duration of Symptoms	
<6 Hours	34 (43.6%)
6-12 Hours	22 (28.2%)
13-24 Hours	15 (19.2%)
25-48 Hours	7 (9.0%)

Residence	
Urban	52 (66.7%)
Rural	26 (33.3%)
Others	
Smoking Status	28 (35.9%)
Family History of CVD	19 (24.4%)

Regarding the comorbid status of these acute AWMI patients, the majority 53.9% was presented with dyslipidemia, followed by hypertension (48.7%) and DM (39.7%). Previous myocardial infarction was seen in 10.3% of cases (Figure 1).
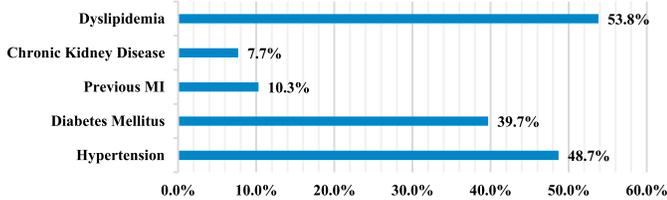

Figure 1: Comorbidity Status

Most of the patients 35.9% was presented with one comorbidity, closely followed by two-comorbidities 30.8%, and almost 17.9% of the patients had three or more related comorbidities. A small proportion of patients 15.4% has comorbid free status (Figure 2).
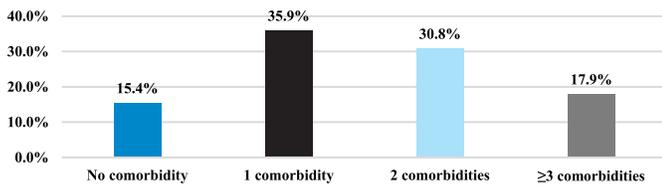

Figure 2: Patients Presented with Several Comorbidities

The frequency of HAVB was 7 (9.0%), among which 4 (5.1%) of patients had Second-degree AV block, including Type I (Wenckebach) in 2 (2.6%) and Type II (Mobitz II) in 2 (2.6%) patients. Third-degree AV block occurred in 3 (3.9%) patients. The onset of HAVB was most frequent within 6 hours of presentation in 4 (5.1%) patients, followed by 6–24 hours in 2 (2.6%) and after 24 hours in 1 (1.3%) patient. The mean time to HAVB resolution was 3.2 ± 1.8 days. Resolution occurred before discharge in 5 (6.4%) patients, while 2 (2.6%) patients had persistent HAVB at discharge (Table 2).

Table 2: Frequency, Types, Timing of Onset, and Resolution of HAVB among AWMI Patients (n=78)

Variables	n (%)	95% CI
HAVB		
Overall	7 (9.0%)	2.7-15.3
Type of HAVB		
Second-degree AV block	4 (5.1%)	0.2-10.0
Type I (Wenckebach)	2 (2.6%)	0.0-6.1
Type II (Mobitz II)	2 (2.6%)	0.0-6.1
Third-degree AV block	3 (3.9%)	0.0-8.2

Timing of HAVB Onset		
Within 6 hours	4 (5.1%)	0.2-10.0
6-24 hours	2 (2.6%)	0.0-6.1
>24 hours	1 (1.3%)	0.0-3.8
HAVB Resolution		
Time To Resolution (Days)	3.2 ± 1.8	—
Resolved Before Discharge	5 (6.4%)	0.8-12.0
Persistent At Discharge	2 (2.6%)	0.0-6.1

Patients with HAVB were older and had a higher prevalence of diabetes mellitus than those without HAVB, while sex, BMI, hypertension, family history, and symptom duration were comparable. Left ventricular ejection fraction showed a nonsignificant trend toward lower values in the HAVB group. Reperfusion strategy, procedural features, treatment timelines, and post-procedural TIMI flow did not differ significantly between groups. In contrast, HAVB was associated with significantly worse clinical outcomes, including prolonged hospitalization, higher in-hospital mortality, increased cardiogenic shock, greater need for mechanical ventilation and ICU care, longer ICU stays, and a higher requirement for temporary and permanent pacing (all p<0.05) (Table 3).

Table 3: Clinical Features, Management, and in-Hospital Outcomes Stratified by HAVB

Variables	HAVB Present (n= 7), Mean ± SD, n (%)	HAVB Absent (n= 71), Mean ± SD, n (%)	p-value
Age (Years)	62.1 ± 6.8	56.2 ± 8.1	0.042*
Male	4 (57.1%)	47 (66.2%)	0.619
Female	3 (42.9%)	24 (33.8%)	—
BMI (kg/m^2)	27.8 ± 3.9	26.2 ± 4.1	0.298
Hypertension	5 (71.4%)	33 (46.5%)	0.168
Diabetes Mellitus	5 (71.4%)	26 (36.6%)	0.046*
Family History of CVD	3 (42.9%)	16 (22.5%)	0.194
Symptom Duration (hours)	8.0 ± 5.7	7.0 ± 4.6	0.421
Left Ventricle Ejection Fraction (%)	38.2 ± 8.5	43.1 ± 9.2	0.165
Reperfusion Strategy (Primary PCI)	6 (85.7%)	54 (76.1%)	0.548
Reperfusion Strategy (Thrombolysis)	1 (14.3%)	17 (23.9%)	—
Door-to-Balloon Time (minutes)	82.1 ± 18.7	78.1 ± 22.7	0.632
Door-to-Needle Time (minutes)	35.0	32.2 ± 9.1	0.745
TIMI Flow Post-Procedure (TIMI 0-1)	2 (28.6%)	6 (8.5%)	0.068
TIMI Flow Post-Procedure (TIMI 2)	2 (28.6%)	13 (18.3%)	—
TIMI Flow Post-Procedure (TIMI 3)	3 (42.8%)	52 (73.2%)	—
Multivessel Disease	4 (57.1%)	30 (42.3%)	0.409
Culprit Vessel - LAD	7 (100.0%)	71 (100.0%)	—
Stent Deployment	6 (100.0%)	52 (96.3%)	0.652
Length of Hospital Stay (days)	6.7 ± 2.4	4.2 ± 1.8	0.001*
In-Hospital Mortality	2 (28.6%)	3 (4.2%)	0.014*
Cardiogenic Shock	3 (42.9%)	9 (12.7%)	0.025*
Re-Infarction	1 (14.3%)	2 (2.8%)	0.158
Mechanical Ventilation	3 (42.9%)	5 (7.0%)	0.004*
ICU Admission	6 (85.7%)	18 (25.4%)	0.001*

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ICU Stay (days)	4.5 ± 2.1	2.4 ± 1.7	0.018*	
Temporary Pacing	4 (57.1%)	0 (0.0%)	<0.001*	
Permanent Pacemaker	2 (28.6%)	0 (0.0%)	<0.001*	

Fisher's Exact Test was used to calculate the p-value. * p<0.05 is significant

On logistic regression analysis, age >60 years and DM were independent predictors of high-degree AV block (HAVB). Other variables, including female gender, BMI >30 kg/m², hypertension, smoking, family history of cardiovascular disease, symptom duration >12 hours, reduced ejection fraction, multivessel disease, and thrombolysis versus PCI, were not significantly associated with HAVB after adjustment (Table 4).

Table 4: Logistic Regression Analysis for Predictors of High-Degree AV Block (HAVB)

Variables	Univariate Analysis OR (95% CI)	p-value	Multivariate Analysis OR (95% CI)	p-value
Age >60 Years	5.2 (1.4–19.8)	0.015*	4.8 (1.2–19.4)	0.027*
Female Gender	1.4 (0.3–6.2)	0.619	1.2 (0.2–6.8)	0.812
BMI >30 kg/m²	1.2 (0.2–6.4)	0.826	—	—
Diabetes Mellitus	4.3 (1.0–18.6)	0.046*	3.9 (1.1–14.2)	0.038*
Hypertension	2.9 (0.6–14.2)	0.183	2.1 (0.4–11.8)	0.364
Smoking	0.7 (0.1–3.6)	0.654	—	—
Family History of CVD	2.6 (0.6–11.2)	0.208	1.8 (0.3–9.4)	0.521
Symptom Duration >12 h	1.8 (0.4–8.1)	0.432	—	—
Ef <40%	2.3 (0.5–10.4)	0.276	1.9 (0.4–9.2)	0.421
Multivessel Disease	1.8 (0.4–8.1)	0.432	—	—
Thrombolysis vs PCI	0.5 (0.1–4.2)	0.548	—	—

Note: Variables showing p < 0.20 in univariate analysis and those with established clinical relevance were entered into multivariate regression. The final model was derived using backward elimination. *p < 0.05 statistically significant

Multivariate logistic regression identified age, presence of high-degree AV block, cardiogenic shock, and peak troponin levels as independent predictors of in-hospital mortality. Other variables, including DM, EF <35%, female gender, multivessel disease, and TIMI flow <3, were not significantly associated with mortality after adjustment (Table 5).

Table 5: Logistic Regression Analysis for Predicting in-Hospital Mortality

Variables	Univariate Analysis OR (95% CI)	p-value	Multivariate Analysis OR (95% CI)	p-value
Age (Years)	1.15 (1.04–1.28)	0.008*	1.12 (1.02–1.23)	0.019*
HAVB Present	9.07 (1.37–60.1)	0.022*	9.3 (1.4–62.1)	0.021*
Cardiogenic Shock	10.7 (1.78–64.2)	0.010*	12.5 (2.1–74.8)	0.006*
Diabetes Mellitus	2.41 (0.40–14.5)	0.340	—	—
EF <35%	4.58 (0.76–27.6)	0.097	3.2 (0.5–20.4)	0.221
Female Gender	3.06 (0.51–18.4)	0.227	—	—
Multivessel Disease	2.03 (0.34–12.2)	0.441	—	—
TIMI Flow <3	3.98 (0.66–24.0)	0.133	—	—

Peak Troponin	1.03 (1.01–1.06)	0.012*	1.02 (1.00–1.05)	0.048*

*Statistically significant at p<0.05

DISCUSSION

HAVB was identified as a clinically important complication associated with AWMI, adverse hemodynamic status, increased healthcare resource utilization, and significantly higher in-hospital mortality. In the present study, the incidence of HAVB was 9%, placing it in the upper range compared with reports from larger registries, where incidence rates among patients with acute myocardial infarction range from 1.5% to 8.6% [7, 11]. This higher incidence may be attributed to the study's greater focus on anterior infarctions, delayed presentation, and a higher prevalence of comorbid conditions, particularly DM. Consistent with prior studies, complete heart block accounted for a substantial proportion of HAVB cases and has been reported in up to 15.8% of anterior STEMI, where it is associated with worse outcomes compared with non-anterior infarctions [12]. In our study, high-degree AV block, including Mobitz II and complete heart block, was associated with early presentation, hemodynamic instability, and increased need for supportive interventions. Most events occurred within the first six hours, supporting the concept that AV block in anterior myocardial infarction reflects extensive septal ischemia involving the cardiac conduction system [13]. In our study, age >60 years and DM emerged as independent predictors of HAVB, consistent with prior evidence identifying advanced age as a major risk factor [7]. Unlike previous studies that have linked male sex and right coronary artery involvement with HAVB, all patients in our study had left anterior descending artery occlusion due to the anterior infarct distribution, likely explaining the lack of association with RCA involvement. The association with diabetes remains variable across studies; however, our findings suggest increased susceptibility of the diabetic myocardium to ischemia-related conduction disturbances [14]. Patients with HAVB experienced significantly worse clinical outcomes, including prolonged hospitalization, higher rates of cardiogenic shock, increased need for mechanical ventilation, and greater dependence on temporary and permanent pacing, in line with earlier reports [5, 15]. In-hospital mortality was markedly higher in the HAVB group and comparable to rates reported in other populations (15–28.6%) [7, 16]. Although literature indicates that HAVB loses independent prognostic significance after adjustment for confounders [7, 16], multivariate analysis identified HAVB as an independent predictor of in-hospital mortality, alongside age, cardiogenic shock, and peak troponin levels. This finding likely reflects the predominance of extensive LAD-territory infarction in our

cohort, underscoring the prognostic importance of HAVB in anterior myocardial infarction. Even though the vast majority of HAVB patients in our research received timely PCI, post-operative TIMI-3 flow was less often observed in this group of patients, indicating a higher level of myocardial damage or microvascular blockage. This is also in line with other studies, which have shown that HAVB is linked with poor post-procedural perfusion and worse TIMI flow grades [17]. The increased incidence of pacemaker implantation in our cohort is also in agreement with the global statistics, where HAVB occurring in hospitalization would be an indicator of decreased chances of spontaneous recovery and the necessity of permanent pacing [18]. Despite the pathophysiological differences between TAVI-related HAVB and ischemic HAVB, there are some similarities between them in terms of hemodynamic compromise, the necessity of pacing, and a long hospital stay. The relevance of conduction disturbances as indicators of cardiac instability in various patient settings is highlighted by these similarities [19, 20].

The limitation of the study is that it is a single-center, retrospective study and not a large-scale one; therefore, its findings might be limited in their generalizability. Emphasis on a particular group of patients (AWMI with LAD involvement) precludes the presence of other types of infarcts and can potentially cause selection bias. Long-term outcomes and the finer timing of the conduction recovery data were also not available. These predictors and outcomes should be confirmed by prospective, multicenter, larger, and more diverse cohort studies. The study ought to examine the prognosis of survivors of HAVB in the long run and the best time to install permanent pacemakers. Additional investigation of the pathophysiological connection of diabetes, micro-vascular dysfunction, and conduction impairments is also justified.

CONCLUSIONS

This study illustrates that HAVB is an important complication of AWMI and is associated with cardiogenic shock, increased intensive care requirement, long hospitalization, and increased in-hospital mortality. HAVB was significantly predicted by older age and DM. Most of the cases occurred early during the first six hours, which underscores the importance of early diagnosis and constant supervision.

Authors' Contribution

Conceptualization: MM
Methodology: MM, MFAK
Formal analysis: MM, MF
Writing and Drafting: KK, MM, JK, MWH
Review and Editing: KK, MM, JK, MFAK, MF, MWH

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

All the authors declare no conflict of interest.

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