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Impact of Primary Percutaneous Coronary Intervention on AV Blocks with Acute ST-Elevation Myocardial Infarction

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ABSTRACT

Objective: To determine the impact of Primary Percutaneous Coronary Intervention on Atrioventricular Blocks with Acute ST-Elevation Myocardial Infarction.

Study Design: Analytical Cross-sectional study.

Place and Duration of Study: Armed Forces Institute of Cardiology/National Institute of Heart Disease, Rawalpindi Pakistan, from Apr, 2023 to Sep, 2023.

Methodology: A total of one hundred and fifty patients diagnosed with acute ST-Elevation Myocardial Infarction (STEMI) who presented with AVB symptoms were enrolled in the study. Non-probability Consecutive Sampling technique was used. Data was collected prospectively using a questionnaire, and Daily Electrocardiography (ECG) monitoring was performed. PPCI was performed to restore blood flow in affected coronary artery. Chi-square and t-test were used to analyze the data. *p*-value<0.05 was taken as significant.

Results: Out of 150 participants, mean age of participants was 58.37±7.90 years, 116(77.3%) were males and 34(22.7%) were females. The research findings unveiled a significant occurrence of concurrent health conditions, such as diabetes mellitus and dyslipidemia in patients with AVB (p<0.05). Regarding types of AVB, 1st-degree AVB was observed in 23(15.3%) patients, Mobitz-I in 9(6.0%), Mobitz-II in 3(2.0%), and 3rd-degree AVB in 1(0.7%) of the cases. AVB were resolved in 72(47.6%) patients. There was statistically significant AVB resolution in all the patients except 6(7.7%) 1st degree block patients (p<0.001).

Conclusion: Utilization of invasive treatment strategy yielded a favorable outcome, leading to the resolution of AVB in 48% of cases and the infrequent need for pacemaker insertion.

Keywords: Acute Myocardial Infarction, Atrioventricular Block, Coronary Artery Disease, Echocardiography, Primary Percutaneous Coronary Intervention.

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INTRODUCTION

Coronary Artery Disease (CAD) remains a third leading cause of mortality worldwide, accounting for a staggering number of deaths annually.[1] In particular, CAD-related deaths have a significant impact on low- and middle-income countries, contributing to a significant 7 million deaths worldwide.[2] Myocardial Infarction (MI), a severe complication of CAD, poses a substantial burden on healthcare systems and populations globally. Interestingly, the Asian population exhibits a heightened susceptibility to MI, with studies revealing that MI rates among South Asians in the United Kingdom are 50% higher compared to white individuals.[3]

Pakistan, as a developing South Asian country with a population exceeding 231.4 million, faces significant challenges in managing CAD and its complications.[4] The majority of Pakistan's population resides in rural areas, bearing the brunt of the burden imposed by heart diseases.[5] Historical research literature has identified multiple risk factors associated with the onset of CAD, including obesity, hypertension, smoking, diabetes mellitus, and hypercholesterolemia. Alarming statistics indicate that over 30% of the Pakistani population aged 45 years and above is affected by MI.[6]

Among the various complications of MI, inferior infarcts have been recognized as particularly detrimental to patient outcomes. Such infarcts can result in reduced blood supply to the Atrioventricular (AV) node, often leading to the development of a third-degree AV block. In most cases, this block is temporary and typically resolves within a two-week period. Preceding the third-degree AV block, hemiblocks may manifest, and several mechanisms have been proposed to explain these occurrences.[7] One mechanism involves compromised blood supply to the AV node due to the nodal branch originating from the right coronary

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artery. Consequently, malfunctioning myocardial circuits can lead to variable blocks. Another potential mechanism implicates the Bezold-Jarisch reflex, which induces heightened vagal tone. While AV blocks are relatively common, and third-degree AV blocks are relatively rare, with an estimated incidence of 0.02-0.04% in the general population.[8]

In patients presenting with acute ST-Elevation Myocardial Infarction (STEMI), Primary Percutaneous Coronary Intervention (PPCI) has emerged as a life-saving procedure, reducing Major Adverse Cardiovascular Events (MACE) when compared to medical treatment alone. The introduction of PPCI has played a pivotal role in reducing the alarming incidence of third-degree AV blocks associated with acute Myocardial Infarction.[8] Furthermore, in cases where the block persists after PPCI, treatment options such as pacemakers can be employed to address the condition.[9,10]

Understanding the impact of PPCI on AV blocks in the setting of acute ST-Elevation Myocardial Infarction is crucial for optimizing patient outcomes and refining treatment strategies. In this article, we aimed to explore the existing body of evidence regarding the influence of PPCI on AV block development, with a particular focus on its efficacy in mitigating the occurrence of third-degree AV blocks. By evaluating the available data, we seek to provide valuable insights that can guide clinicians in their decision-making processes and ultimately enhance the management of patients with acute Myocardial Infarction. However, certain gaps persist in this research such as; limited focus on AV block grading, underlying mechanisms, risk stratification and patient profiling, long-term follow-up and prognosis, comparative analysis of reperfusion strategies, and interventional strategies.

By thoroughly examining the impact of PPCI on AV block occurrence, we aspire to contribute to the existing knowledge base and provide healthcare professionals with evidence-based guidance for delivering optimal care to patients presenting with acute STEMI. Thereby, the study was focused to determine the impact of Primary Percutaneous Coronary Intervention on Atrioventricular Blocks with Acute ST-Elevation Myocardial Infarction.

METHODOLOGY

This was an Analytical Cross-sectional study conducted at Armed Forces Institute of Cardiology/ National Institute of Heart Diseases, Rawalpindi, Pakistan, during six months (April 2023 to Sept 2023). Data was collected prospectively through non-probability consecutive sampling technique after granted approval from Institutional Ethical Review Board (IERB) with reference to letter no. (9/2/R&D/2023/257).

Sample size of 119 was calculated by using WHO sample size calculator (confidence level=95%, margin of error=5%), with reference to the prevalence 8.4% of AVB in acute STEMI.[19] However, we gathered data from 150 patients.

Inclusion Criteria: Patients with AV blocks following acute STEMI who underwent primary PCI irrespective of gender and age were study participants.

Exclusion criteria: Patients with unstable angina, anterior wall MI, lateral wall MI, and NSTEMI were excluded from the study.

Data was collected using a predesigned questionnaire, which included relevant variables and information required for the study. Daily Electrocardiography (ECG) monitoring was done to assess changes in cardiac electrical activity. ECG analysis focused on identifying inferior STEMI characterized by ST-elevation in leads II, III, and aVF. Patients displaying these ECG patterns were included in the study. All eligible patients underwent PPCI within 90 minutes of their arrival at the hospital. This procedure aimed to restore blood flow in the affected coronary artery and minimize the extent of myocardial damage.

The collected data was analyzed using the Statistical Package for Social Sciences (SPSS) version 26:00. Categorical data was presented as frequencies and percentages. Continuous data was presented as mean and standard deviation to summarize the numerical variables of study. Chi-square test and t-test were used to find association and mean differences respectively. *p*-value ≤0.05 was considered as statistically significant.

RESULTS

Mean age of participants was 58.37±7.90 years. The majority of the participants were males 116(77.3%), while females constituted 34(22.7%) of the study population. Diabetics were 90(60.0%), and hypertensive were 94(62.7%) participants. Chronic Kidney Disease was present in 25(16.7%) patients, smoking in 55(36.7%), and dyslipidemia in 89(59.3%) patients. In terms of treatment outcomes, AVB resolved in 72(47.6%) cases, indicating a favorable response to non-invasive interventions. Pacemaker insertion was

required in 6(4.0%) patients. The mortality rate among AVB patients was 12(8.0%) (Table-I).

Table-I: Baseline Characteristics and Outcomes of the Study Participants (n=150)

Variables			Frequency(%)
Gender		Male	116(77.3%)
		Female	34(22.7%)
Age (years) (Mean±SD)			58.37±7.90
Comorbids		Diabetes Mellitus	90(60.0%)
		Hypertension	94(62.7%)
		Chronic Kidney Disease	25(16.7%)
		Smoking	55(36.7%)
		Dyslipidemia	89(59.3%)
Outcomes	AVB	AVB Resolved	72(47.6%)
		PPM inserted	6(4.0%)
	AVB Types	1st Degree	23(15.3%)
		Mobitz-I	9(6.0%)
		Mobitz-II	3(2.0%)
		3rd Degree	1(0.7%)
	Mortality		12(8.0%)

AVB=Atrioventricular Blocks; PPM=Permanent Pacemaker

Regarding AVB types, 1st-degree AVB was observed in 23(15.3%) of the patients, Mobitz-I in 9(6.0%), Mobitz-II in 3(2.0%), and 3rd-degree AVB in 1(0.7%) of the cases (Figure).

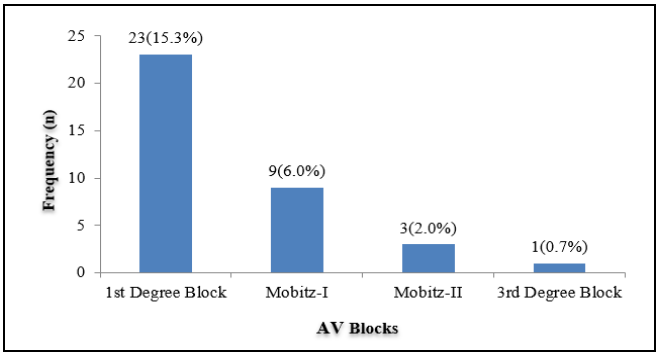

Figure: Frequency Distribution of AV Blocks in Study Participants (n=150)

The statistical analysis revealed a significant association of AVB resolution with age, diabetes mellitus and dyslipidemia (p<0.05). AVB resolution occurred in 72(47.6%) patients. There was statistically significant association between AVB resolution and type of AV Blocks in all the patients except 6(7.7%) 1st degree block patients (p<0.001) (Table-II).

DISCUSSION

The findings from this study provided valuable insights into the comorbidities, treatment outcomes, and mortality rates in patients with Atrioventricular Block (AVB). The prevalence of comorbidities, such as diabetes mellitus, hypertension, chronic kidney disease, smoking, and dyslipidemia, highlighted the significance of managing these conditions in AVB patients. Additionally, the resolution of AVB in nearly half of the cases and the low frequency of pacemaker insertion indicated the efficacy of non-invasive treatment approaches. However, it is important to interpret these results in the context of existing literature and to consider the limitations of the study.

Table-II: Association of patients' baseline characteristics with Resolution of AVB (n=150)

Characteristics			Resolution of AVB Frequency(%)		*p*-value
			No(n=78)	Yes(n=72)	
Gender	Male		59(75.6%)	57(79.2%)	0.74
	Female		19(24.4%)	15(20.8%)	
Age (years) (Mean±SD)			55.35±8.14	61.63±6.20	<0.001
Comorbids	Diabetes Mellitus		30(38.5%)	60(83.3%)	<0.001
	Hypertension		45(57.7%)	49(68.1%)	0.25
	Chronic Kidney Disease		9(11.5%)	16(22.2%)	0.12
	Smoking		23(29.5%)	32(44.4%)	0.08
	Dyslipidemia		39(50.0%)	50(69.4%)	0.02
Outcomes	PPM inserted		-	6(8.3%)	0.02
	AV Blocks	Brady blocks	72(92.3%)	42(58.3%)	<0.001
		1st Degree	6(7.7%)	17(23.6%)	
		Mobitz-I	-	9(12.5%)	
		Mobitz-II	-	3(4.2%)	
		3rd Degree	-	1(1.4%)	
	Mortality		2(2.6%)	10(13.9%)	0.02

AVB=Atrioventricular Blocks; PPM=Permanent Pacemaker

Comparing the prevalence of comorbidities in this study with previous research, we observed consistency in the association of diabetes mellitus with AVB resolution.[11,12] The high prevalence of diabetes mellitus 60(83.3%) and hypertension 49 (68.1%) supports the notion that these conditions contribute to the development and progression of AVB. Dyslipidemia and smoking, known risk factors for cardiovascular disease, were also common comorbidities in AVB patients, aligning with the literature in a study done by Moroz *et al.*, and Tselios *et al*.[13,14]

The successful resolution of AVB in 47.6% of the cases indicated the effectiveness of treatment interventions employed in this study. Non-invasive approaches, such as medication management and lifestyle modifications, might have contributed to the positive outcomes.

The low frequency of pacemaker insertion 6(4.04%) suggested that this treatment was effective in

the majority of cases which is comparable with a previous study.[15,16] The mortality rate of 8% among AVB patients in this study was notable, indicating that AVB carries a certain risk of adverse outcomes. This finding is inconsistent with the mortality rate of another study undertaken in Pakistan, where the sample size matches with our study. Their results showed that 5 patients from their sample size of 150 patients died, while in our study the mortality occurred in 10 patients. The higher mortality in this study might be due to comorbid diseases that is one of the reasons a more thorough study is required to be undertaken to deeply understand the relationship.[9]

The distribution of AVB types observed in this study aligned with the expected proportions reported in the literature. The prevalence of 1st degree AVB (23.6%) suggests that mild conduction abnormalities are relatively common in AVB patients, while higher-grade AVBs, such as Mobitz-I (12.5%), Mobitz-II (4.2%), and 3rd degree (1.4%), are less frequent.[10,17] These findings emphasized the need for careful monitoring and risk stratification in AVB patients, as higher-grade AVBs can have significant clinical implications.

This study provided valuable insights into the comorbidities, treatment outcomes, and mortality rates among AVB patients. The high prevalence of diabetes mellitus, hypertension, chronic kidney disease, dyslipidemia, and smoking highlighted the importance of managing these comorbidities in AVB patients. The successful resolution of AVB in nearly half of the cases and the low frequency of pacemaker insertion suggested the efficacy of treatment approaches.

LIMITATIONS OF STUDY

It is important to acknowledge the limitations of this study, which may affect the generalizability and interpretation of the results. The sample size and characteristics of the study population make it challenging to assess the representativeness of the findings. Additional clinical parameters and long-term follow-up data would have enhanced the study's robustness and provided a more comprehensive understanding of AVB in this population. However, further research is needed to explore the factors contributing to mortality in AVB patients and identify strategies to mitigate this risk effectively.

CONCLUSION

Utilization of invasive treatment strategy yielded a favorable outcome, leading to the resolution of AVB in 48% of cases and the infrequent need for pacemaker insertion.

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Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript:

ZA, SKS & ZAK: Study design, Drafting the manuscript, Data interpretation, Critical review, Approval of the final version to be published.

IA & MK: Data acquisition, Data Analysis, Approval of the final version to be published.

MNK & FKT: Critical review, Study concept, Drafting the manuscript, Approval of the final version to be published.

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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