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Frequency of Complete Heart Block in Patients Presenting with Acute St-Segment Elevation Myocardial Infarction (STEMI)

Shahzad Abdullah[1], Latif Ullah[1], Muhammad Alam[1], Sohail Ahmad[1]

[1]Department of Cardiology, Saidu Group of Teaching Hospital, Swat, Pakistan

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Correspondence to: Shahzad Abdullah, Department of Cardiology, Saidu Group of Teaching Hospital, Swat, Pakistan.
Emails: shahzad.abdullah90@hotmail.com

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ABSTRACT

Background: Acute ST-segment elevation myocardial infarction is one of the most serious type of heart attack where blood flow to part of heart muscle stop suddenly due to blockage of coronary artery, mostly by a clot forming on a ruptured plaque. It causes severe chest pain, sweating, and breath difficulty and need quick treatment to save life. Complete heart block is a serious complication in such patients, happen when the electrical signal from upper to lower chamber stop passing. This lead to very slow heart rate and can cause fainting or death if not managed quickly. **Objective:** To determine the frequency of complete heart block in patients presenting with Acute ST-Segment Elevation Myocardial Infarction STEMI to a tertiary care hospital. **Study Design:** Cross-sectional descriptive study. **Duration and Place of Study:** Conducted from September 2024 to March 2025 in the Department of Cardiology, Saidu Group of Teaching Hospital, Swat. **Methodology:** A total of 237 patients aged 18–70 years diagnosed with ST-segment elevation myocardial infarction were included by consecutive sampling. Diagnosis was based on chest pain, ECG changes, and raised cardiac biomarkers. Complete heart block was diagnosed when P waves and QRS complexes were independent on ECG. **Results:** Out of 237 patients, 169 (71.3%) were males. The mean age was 48.68±12.69 years. Complete heart block was found in 36 patients (15.20%). No significant association was found with age, gender, BMI, pain duration, residence, or comorbidities (p>0.05). **Conclusion:** This study has concluded that complete heart block is not rare in patients presenting with acute ST-segment elevation myocardial infarction and show serious clinical concern, mostly due to ischemic damage and treatment delay.

INTRODUCTION

ST-segment elevation myocardial infarction is one of the serious form of heart attack where the blood flow to the heart muscle stop suddenly and completely due to blockage of a coronary artery mostly by a blood clot over a ruptured atherosclerotic plaque.[1] It cause severe chest pain, sweating, and shortness of breath and often the patient present in emergency with high risk of death if not treated on time.[2] The electrocardiogram show the typical ST segment elevation which mean the heart muscle is suffering from full-thickness ischemia.[3] The main treatment in this condition is to restore the blood flow by using thrombolytic drug or by doing angioplasty to open the blocked vessel.[4] Delay in treatment increase the size of infarction and cause damage to the pumping capacity of heart.[4] The patient also need oxygen, pain relief and antiplatelet therapy to prevent further clot formation.[4] Early recognition and fast management is the key to reduce mortality and improve heart function after recovery.

Complete heart block happens when the electrical signal from the atria do not pass to the ventricles which cause a disconnection between upper and lower chamber activity of the heart.[5] It is also known as third-degree atrioventricular block.[6] The atria keep beating at their own pace from the sinus node, while the ventricles generate their own slower rhythm from escape pacemaker below the block.[6] This lead to very slow heart rate, low blood pressure, dizziness, fainting, or even cardiac arrest. On ECG it shows independent P waves and QRS complexes with no relation.[7] The condition may be temporary or permanent depend on the cause. Some cases need urgent temporary pacing while some need permanent pacemaker implantation to maintain proper heart rhythm and cardiac output.[8] It can be caused by degeneration of conduction system, medication effect, or ischemic damage to the AV node or bundle branches.

In patients with acute ST-segment elevation myocardial infarction, complete heart block is one of the dangerous complication especially when the infarction involve the inferior wall supplied by the right coronary artery which also supply the AV node.[9] The ischemia of this node lead to disturbance of conduction causing complete heart block.[9] In anterior wall infarction the cause is often extensive

necrosis of conduction tissue leading to poor prognosis.[10] The appearance of complete heart block in STEMI increase the mortality and worsen the heart function because of bradycardia and decreased cardiac output.[11] In many inferior STEMI cases the block may be transient and resolve after reperfusion therapy, while in anterior infarction it is mostly persistent and need permanent pacing.[12] Early identification and management of heart block in these patients is very important to prevent sudden cardiac death and to stabilize the hemodynamic condition during acute phase of myocardial infarction. In a study, complete heart block was observed in 19.0% patients presenting with acute STEMI.[13]

This study need to be done in Swat because many patients here come late to hospital with heart attack and sometimes they already develop heart block. There is not enough data from this area about how often complete heart block happen in STEMI patient. Hospital in Swat have limited facility for early treatment and no proper record keeping. Doing this study will help to know the real situation and improve early diagnosis and management for better outcome of heart attack patient in this region.

METHODOLOGY

This cross-sectional study was done in the Department of Cardiology at Saidu Group of Teaching Hospital, Swat from September 2024 to March 2025. Permission for the research was taken from the hospital ethical and research review board before starting data collection. All procedures were done according to hospital research policy and patient rights were respected during the study. The sample size was 237 patients which was calculated using WHO formula by keeping 95% confidence level and 5% margin of error and expecting 19% occurrence of complete heart block in patients of STEMI.[13] Non-probability consecutive sampling method was used, and every patient who met the criteria during the study period was included till the sample size completed.

The study included all patients of age 18 to 70 years of both genders who were diagnosed with ST-segment elevation myocardial infarction based on ECG showing elevation of more than 2 mm in chest leads or 1 mm in limb leads, chest pain typical of MI, and raised troponin more than 0.1 ng/dl. Patients who already had known heart block, those using beta-blockers, or those having abnormal potassium either high or low were not taken in the study. ST-segment elevation myocardial infarction was recognized when patient had severe central chest pain radiating to shoulder or jaw, not relieved by nitrates, ECG showing ST elevation as mentioned, and troponin raised above normal. Each patient was examined in detail. History was taken about chest pain, its duration, and associated symptoms. On physical examination pulse rate, rhythm, and blood pressure were checked. Precordial examination was done to assess heart sounds and any murmurs. A 12-lead ECG was done for every patient to confirm the diagnosis of STEMI and to look for heart block. ECGs were checked by a consultant cardiologist having more than five years of post-fellowship experience who did not know the patient clinical details to avoid bias. Complete heart block was considered when ECG showed no link between P wave and QRS, both atria and ventricles beating with their own rhythm (atria 60–80 bpm, ventricles 20–40 bpm), and QRS complex wider than 0.12 seconds.

All information was entered and analyzed in IBM SPSS version 25. For numerical data such as age, BMI, height, weight, and duration of chest pain, mean and standard deviation were used if the data followed normal pattern, otherwise median and interquartile range were calculated. For qualitative variables frequency and percentage were calculated. The comparison of complete heart block with other variables like age, gender, BMI, chest pain duration, and comorbidities was done by chi-square or Fisher's exact test, and p value less than 0.05 was considered significant.

RESULTS

The patient demographics was showing mean age of 48.68±12.69 years with mean height 168.84±8.28 cm and mean weight 72.10±9.14 kg, resulting in mean BMI of 25.37±3.37 kg/m^2. The mean pain duration was recorded as 12.66±6.78 hours. Regarding gender distribution, males were predominant with 169 patients (71.3%) while females comprised 68 patients (28.7%). In terms of residence, majority were from rural areas with 156 patients (65.8%) compared to urban residents who were 81 patients (34.2%). The comorbidities profile revealed that diabetes was present in 69 patients (29.1%), hypertension in 85 patients (35.9%), and 83 patients (35.0%) had no comorbidities (as shown in Table 1).

Table 1

Patient Demographics

Demographics		Mean ± SD
Age (years)		48.68±12.69
Height (cm)		168.84±8.28
Weight (kg)		72.10±9.14
BMI (kg/m^2)		25.37±3.37
Pain Duration (hours)		12.66±6.78
Gender	Male n (%)	169 (71.3%)
	Female n (%)	68 (28.7%)
Residence	Rural n (%)	156 (65.8%)
	Urban n (%)	81 (34.2%)
Comorbidities	Diabetes n (%)	69 (29.1%)
	Hypertension n (%)	85 (35.9%)
	None n (%)	83 (35.0%)

The frequency analysis demonstrated that complete heart block was present in 36 patients (15.20%) while it was absent in 201 patients (84.80%) out of total 237 patients (as shown in Table 2).

Table 2

Frequency of Complete Heart Block in Patients Presenting with Acute ST-Segment Elevation Myocardial Infarction

Complete Heart Block	Frequency	% age
Yes	36	15.20%
No	201	84.80%
Total	237	100%

The stratification analysis for association of complete heart block with various demographic and clinical factors showed that among patients aged ≤40 years, 11 patients (15.9%) had complete heart block versus 58 patients (84.1%) without it, while in age group >40 years, 25

patients (14.9%) had complete heart block compared to 143 patients (85.1%) without it, with p-value of 0.836. For gender, males showed 25 patients (14.8%) with complete heart block and 144 patients (85.2%) without it, whereas females had 11 patients (16.2%) with complete heart block and 57 patients (83.8%) without it, with p-value of 0.788. When BMI was considered, patients with BMI ≤25 kg/m^2 showed 15 patients (12.7%) with complete heart block versus 103 patients (87.3%) without it, while those with BMI >25 kg/m^2 had 21 patients (17.6%) with complete heart block and 98 patients (82.4%) without it, yielding p-value of 0.290. The pain duration stratification revealed that patients with pain duration ≤12 hours had 18 patients (16.5%) with complete heart block and 91 patients (83.5%) without it, while those with pain duration >12 hours showed 18 patients (14.1%) with complete heart block and 110 patients (85.9%) without it, with p-value of 0.600. Residential status analysis indicated that rural patients had 24 cases (15.4%) with complete heart block and 132 cases (84.6%) without it, while urban patients showed 12 cases (14.8%) with complete heart block and 69 cases (85.2%) without it, with p-value of 0.908. Finally, comorbidities analysis demonstrated that diabetic patients had 8 cases (11.6%) with complete heart block versus 61 cases (88.4%) without it, hypertensive patients had 11 cases (12.9%) with complete heart block and 74 cases (87.1%) without it, and patients with no comorbidities showed 17 cases (20.5%) with complete heart block compared to 66 cases (79.5%) without it, with p-value of 0.243. All associations were analyzed using Chi-square test and none of demographic or clinical factors showed statistically significant association with complete heart block as all p-values were greater than 0.05 (as shown in Table 3).

Table 3

Association of Complete Heart Block with Demographic and Clinical Factors

Demographic Factors		Complete Heart Block		p-value
		Yes n(%)	No n(%)	
Age (years)	≤40	11 (15.9%)	58 (84.1%)	0.836*
	>40	25 (14.9%)	143 (85.1%)	
Gender	Male	25 (14.8%)	144 (85.2%)	0.788*
	Female	11 (16.2%)	57 (83.8%)	
BMI (kg/m^2)	≤25	15 (12.7%)	103 (87.3%)	0.290*
	>25	21 (17.6%)	98 (82.4%)	
Pain Duration (hours)	≤12	18 (16.5%)	91 (83.5%)	0.600*
	>12	18 (14.1%)	110 (85.9%)	
Residence	Rural	24 (15.4%)	132 (84.6%)	0.908*
	Urban	12 (14.8%)	69 (85.2%)	
Comorbidities	Diabetes	8 (11.6%)	61 (88.4%)	0.243*
	Hypertension	11 (12.9%)	74 (87.1%)	
	None	17 (20.5%)	66 (79.5%)	

*Chi-square Test

DISCUSSION

In this study total 237 patients were observed who came with acute ST segment elevation myocardial infarction to find how many develop complete heart block. The result show that 15.2% patient had complete heart block which is quite high and show that conduction system of heart is often affected during severe infarction. The mean age of patient was near 49 years and mostly were male which is expected because male in this age group have more risk factor like smoking, stress and high cholesterol. Most of patient were from rural area where health care facility and early treatment are not easily available that may lead to delay in reaching hospital and increase heart damage. The mean BMI was 25.3 which show mild overweight condition and can make heart muscle more sensitive to ischemia. Pain duration was around 12 hours which indicate many patient reach late and that delay may increase chance of heart block due to longer ischemia time. Diabetes and hypertension were common among patient which also affect blood vessel wall and cause poor blood supply to conduction tissue, this can explain why some patient develop complete heart block. Though no significant statistical association found between these factors and heart block but medically they all have logical link due to their effect on coronary circulation and myocardial health.

The current study demonstrated complete heart block frequency of 15.20% in STEMI patients which was showing some similarity with several previous investigations but also revealed notable differences. When comparing with Dar et al. [14] who reported overall AV block frequency of 18.7% including all degrees with third-degree block being only 1.3%, our frequency of complete heart block was considerably higher, this difference might be attributed to our study focusing specifically on complete heart block rather than including all AV block grades. Similarly, Bhalli et al. [15] found complete AV block in 8.1% of cases which was notably lower than our finding, this disparity could be explained by their study including thrombolysis in 72.8% patients which might have prevented progression to complete block. However, Hayat et al. [16] reported much higher prevalence of 27.58% for complete heart block, this substantial difference might be due to their smaller sample size of 87 patients and different patient selection criteria. The findings of Ali et al.[17] showed only 5.9% CHB frequency which was markedly lower than our results, but their study specifically noted that 60% of CHB occurred in inferior MI cases, this suggests that infarction location plays crucial role which was not stratified in our analysis. Khan et al. [18] reported extremely low frequency of 3.3% in anterior wall MI patients exclusively, indicating that our mixed population of different MI locations likely contributed to our higher overall frequency.

Regarding demographic associations, our study found no significant relationship between complete heart block and age groups (p=0.836), this was partially consistent with general population characteristics but contrasted with Hussain et al. [19] who specifically noted that RBBB-related mortality was especially pronounced among younger individuals. The mean age in our study was 48.68±12.69 years which was considerably younger than Saleem et al. [20] who reported mean age of 61.00±11.75 years, this age difference might reflect different demographic patterns in our catchment area. Our gender distribution showed 71.3% males which was comparable to Dar et al. [14] with 74.7% males and Ali et al. [17] with 61.6% males, however our analysis revealed no significant gender association with CHB (p=0.788), this contrasted with Dar et al. [14] who suggested that female patients with anterior wall MI showed slightly higher risk.

The BMI analysis showed mean of 25.37±3.37 kg/m^2 with no significant association between BMI and complete heart block (p=0.290), this finding was markedly different from Hussain et al. [19] who found that mortality was strongly associated with higher BMI (p<0.001), however it should be noted that Hussain et al. were examining mortality outcomes rather than CHB frequency. Our pain duration averaged 12.66±6.78 hours with no significant relationship to CHB development (p=0.600), this was in stark contrast to Pirzada et al. [21] who found that late presentation after symptom onset significantly increased risk of high-degree AV block (p<0.001), this disparity could be explained by Pirzada et al. studying specifically inferior wall MI with right ventricular involvement where timing is more critical.

Regarding comorbidities, our study showed diabetes in 29.1%, hypertension in 35.9%, with no significant association between any comorbidity and CHB development (p=0.243), interestingly patients without comorbidities had highest CHB frequency of 20.5% compared to 11.6% in diabetics and 12.9% in hypertensives, this pattern was somewhat contradictory to Mehmood et al. [22] who found that only 3.6% hypertensive and 2.9% diabetic patients had complete heart block. When comparing with Hashim et al. [23] who reported diabetes in 38.3% and hypertension in 35%, our comorbidity profile was relatively similar. Saleem et al. [20] demonstrated that congestive heart failure occurred in 52.6% of AV block patients versus 16.1% without it, cardiogenic shock in 28.4% versus 7.8%, and mortality in 29.5% versus 4.9%, all significantly higher (p<0.05), this emphasized that development of conduction abnormalities markedly worsened prognosis.

The residential distribution showed 65.8% rural and 34.2% urban patients with no significant difference in CHB frequency (p=0.908), the lack of association might suggest that once patients reached hospital, their presentation severity was similar regardless of origin. The overall lack of significant associations in our study between CHB and any demographic or clinical factor contrasted with multiple other studies, Pirzada et al. [21] demonstrated that right ventricular infarction presence significantly increased AV block risk, Bhalli et al. [15] found that conduction defects were associated with much higher mortality and complications, and Ali et al. [17] showed that 70% of CHB patients died compared to overall mortality of 17.96%. Our study's failure to find significant associations might be due to relatively small number of CHB cases (n=36) limiting statistical power, or possibly inadequate stratification by infarct location, for instance Hayat et al. [16] reported location-specific differences, and Khan et al. [18] studied exclusively anterior MI finding only 3.3% CHB frequency.

The mortality aspects were not examined in our study which limits comprehensive comparison, however other studies consistently demonstrated that CHB presence dramatically worsened prognosis, Bhalli et al. [15] concluded that conduction abnormalities were associated with high in-hospital mortality, Ali et al. [17] found mortality rate of 4.19% directly attributable to CHB, Hussain et al. [19] reported overall mortality of 10.5%, Hashim et al. [23] found 23.3% mortality rate, and Khan et al. [18] emphasized that CHB indicated extensive myocardial injury with higher mortality risk. Mehmood et al. [22] provided important insight showing that approximately 49% of AV blocks in acute MI were reversible, indicating that pacemaker implantation should be delayed unless block persisted, this was supported by Pirzada et al. [21] who noted that temporary pacemaker was required in 75% of high-degree AV block cases. The treatment differences also likely influenced outcomes, Hashim et al. [23] noted mortality was higher in streptokinase-treated patients compared to primary PCI, and Ali et al. [17] concluded that thrombolytic therapy was helpful in reversing block in many cases.

This study has some limitations which must be kept in mind while reading the results. It was a single center study conducted in one tertiary hospital, so the findings cannot represent the whole population of the country. The sample size though statistically enough still small to cover full variation of patients with myocardial infarction from different areas and socioeconomic background. The duration of study was short and follow-up period was not included, so long term outcome could not be known. Only in-hospital data was collected which may not show later complications. The study also used non-probability sampling so some selection bias may be there. Some values like pain duration and BMI were taken from patient statement and routine record so chance of minor measurement error also possible. Despite these limitations, the study gives useful insight for local data and can be helpful for future large multicenter research.

CONCLUSION

Our study has concluded that complete heart block is not rare in patients presenting with acute ST segment elevation myocardial infarction and it show serious clinical concern. It mostly happens in patients with severe ischemia and delay in treatment. Though it was not found linked with age, gender or other factors statistically, still it reflects extensive heart damage and poor outcome.

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