

IMPACT OF HIGH HEART RATE AT ADMISSION ON IN-HOSPITAL MORTALITY AFTER PCI FOR ACUTE STEMI

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ABSTRACT:

INTRODUCTION:

ST-segment elevation myocardial infarction, the severe form of coronary artery disease, carries high morbidity and mortality. Primary percutaneous coronary intervention is the preferred treatment for better survival. Recent research suggests a high heart rate upon admission predicts in-hospital mortality with PCI in STEMI patients. However, limited evidence and lack of local data prompted this study.

AIMS & OBJECTIVE:

To assess mortality in STEMI patients having high heart rate at presentation.

MATERIAL & METHODS:

Research at the Department of Cardiology, Punjab Institute of Cardiology, Lahore from 03/12/2019 to 02/06/2020 involved 196 patients (aged 30-60) undergoing percutaneous coronary intervention for acute STEMI. Heart rate upon admission ≥ 80 bpm considered high. In-hospital mortality (death within 48 hours of admission) was compared between patients with and without high heart rate. Written consent was obtained from each patient.

RESULTS:

The mean age of patients was 53.4 ± 6.9 years, with a male predominance at a ratio of 2.1:1. Out of the patients, 78.1% were obese, and 52.6% were smokers. High heart rate (≥ 80 bpm) was seen in 53.6% patients, and 9.7% with STEMI undergoing PCI had in-hospital mortality. In-hospital mortality was significantly higher in STEMI patients with high heart rate (15.2% vs. 3.3%; $p=0.005$).

CONCLUSION:

In this study, many acute STEMI patients had high heart rates at admission, leading to increased in-hospital mortality rates. High heart rate on admission is a bad prognostic sign. Regular monitoring of heart rate in STEMI cases is advised to improve outcomes, especially for high-risk patients.

KEY WORDS:

ST Elevation Myocardial Infarction, Percutaneous Coronary Intervention, In-Hospital Mortality, Heart Rate.

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INTRODUCTION

Elevated resting HR is linked to increased total and cardiovascular mortality risk, irrespective of demographic factors or medical conditions.¹⁻² Bordejevic et al. found that in-hospital mortality was 15% for patients with high heart rates upon admission after PCI for acute STEMI. Among the 294 patients, 143 (48.6%) had a heart rate > 80 bpm at admission.³

No previous studies in Pakistan have addressed the impact of high heart rate in patients. More research is required to understand its significance in predicting poor outcomes post-myocardial infarction. I am investigating in-hospital mortality rates in acute STEMI patients with high admission heart rates after PCI. Successful completion of this study will set the foundation for future local research on this topic.

MATERIAL AND METHODS:

A research study was conducted at the Department of Cardiology, Punjab Institute of Cardiology, Lahore from 03/12/2019 to 02/06/2020. A total of 196 eligible patients were included after approval from the ethical committee and research department of CPSP. Informed consent was obtained from each patient, ensuring confidentiality and their safety in participating in the study. The criteria for inclusion were as follows: Individuals aged between 30 and 60 years, both male and female participants, diagnosis of acute STEMI and subjects undergoing percutaneous coronary intervention (PCI).

Exclusion parameters included: history of heart failure documented in medical records, renal impairment characterized by serum creatinine levels exceeding 200 $\mu\text{mol/l}$ as determined by laboratory analysis, history of anemia defined by hemoglobin levels falling below 10 g/dl according to laboratory evaluation and blood sugar readings surpassing 200 mg/dl as indicated by laboratory testing.

Sample size of 196 cases was calculated with 95% confidence level, 7% margin of

error and taking expected frequency of high heart rate to be 48.6% in patients undergoing PCI for STEMI.³ Demographic data including age, gender, weight, and heart rate was collected. Patients were categorized based on high heart rate. They were monitored for 48 hours, and in-hospital mortality data was recorded.

High heart rate was defined as patient's heart rate ≥ 80 bpm on admission. STEMI was defined as patients with ST-segment elevation ACS presenting with chest pain, ST-segment elevation at the J point in 2 or more consecutive leads on ECG and cardiac troponin T values ≥ 0.01 ng/ml. In-hospital mortality was defined as patient's death within 48 hours of admission.

All the data that was gathered was analyzed using the Statistical Product and Service Solutions version 25. For age, BMI and number of beats per minute on admission measurement scale, mean and standard deviations were used. Continuous variables such as age, length of stay and systolic blood pressure on admission were represented as Mean and standard deviation while nominal variables which include gender, smoking history more than five packs per year, high heart rate on admission and in-hospital mortality were represented using frequency and percentage. Statistical analysis was done using chi-square where mortality frequency of patients with high in-hospital heart rate was compared with those patients who did not have such high heart rate on admission. These include age, gender, BMI, and smoking which were further used to proportionate cell data in order to account for effect modifiers. After post-stratification, Chi-square test was used which gave a p-value of less than or equals to 0.05.

RESULTS:

The patients' age varied from 30 years to 60 years with the mean age of 53.4 ± 6.9 years. The patients were 133 males, 67.9% and 63 females, 32.1% with a male to female ratio of 2. 1:1. Patients' BMI

Table-1: Baseline characteristics of study population.

Characteristics	Participants (n=196)
Age (years)	53.4±6.9
• ≤50 years	61 (31.1%)
• >50 years	135 (68.9%)
Gender	
• Male	133 (67.9%)
• Female	63 (32.1%)
BMI (kg/m ²)	29.7±3.2
• Obese	153 (78.1%)
• Non-Obese	43 (21.9%)
Smoker	
• Yes	103 (52.6%)
• No	93 (47.4%)
Heart Rate upon Admission (bpm)	81.4±11.6

Table-2: Frequency of High Heart Rate in STEMI Patients undergoing PCI.

High Heart Rate	Frequency (n)	Percent (%)
Yes	105	53.6
No	91	46.4
Total	196	100.0

Table-3: Frequency of High Heart Rate across Various Subgroups of STEMI Patients undergoing PCI.

Subgroups	N	High Heart Rate n (%)	P-value
Age (years)			
• ≤50 years	61	33 (54.1%)	0.921
• >50 years	135	72 (53.3%)	
Gender			
• Male	133	71 (53.4%)	0.939
• Female	63	34 (54.0%)	
BMI (Kg/m ²)			
• Obese	153	83 (54.2%)	0.720
• Non-Obese	43	22 (51.2%)	
Smoker			
• Yes	103	55 (53.4%)	0.959
• No	93	50 (53.8%)	

Table-4: Frequency of In-Hospital Mortality in STEMI Patients undergoing PCI.

In-Hospital Mortality	Frequency (n)	Percent (%)
Yes	19	9.7
No	177	90.3
Total	196	100.0

Table-5: Frequency of In-Hospital Mortality across Various Subgroups of STEMI Patients undergoing PCI.

Subgroups	N	In-Hospital Mortality n (%)	P-value
Age (years)			
• ≤50 years	61	6 (9.8%)	0.964
• >50 years	135	13 (9.6%)	
Gender			
• Male	133	12 (9.0%)	0.644
• Female	63	7 (11.1%)	
BMI (Kg/m²)			
• Obese	153	17 (11.1%)	0.206
• Non-Obese	43	2 (4.7%)	
Smoker			
• Yes	103	11 (10.7%)	0.624
• No	93	8 (8.6%)	

Table-6: Comparison of Frequency of In-Hospital Mortality in STEMI Patients with versus without High Heart Rate upon Admission.

In-Hospital Mortality	High Heart Rate Upon Admission		P-value
	Yes n=105	No n=91	
Yes	16 (15.2%)	3 (3.3%)	0.005*
No	89 (84.8%)	88 (96.7%)	
Total	105 (100.0%)	91 (100.0%)	

varied from 21.4 kg/m² to 34.7 kg/m² with average of 29 kg/m². Patients 153(78.1%) were obese and 103(52.6%) patients were smoker. The admission heart rate was from 60 to 100 bpm with the average of 81.4±11.6 bpm.(Table-1)

However heart rate of greater than or equal to 80bpm was present in 105(53.6%) patients with STEMI undergoing PCI. (Table-2) Using a statistic T-test, the relation between frequency of high heart rate and age, gender, BMI, and smoking status was not significant (p-value of 0.921, 0.939,

0.720 and 0.959 respectively). (Table-3)

Thus, in- hospital mortality rate amongst 19 patients with STEMI treated by PCI was 9.7%. The frequency of in-hospital mortality of patients in the study did not vary significantly by age, gender, BMI or smoking status as indicated by the following p-values; Age, p-value 0.964, Gender, p-value 0.644, BMI, p-value 0.206 and smoking, p-value 0.624. (Table-4)

As such, it was also observed that 15% of the STEMI patients with high heart rate on admission had in hospital mortality contrary

Table-7: Comparison of Frequency of In-Hospital Mortality in STEMI Patients with versus without High Heart Rate upon Admission across Gender Groups.

Gender	In-Hospital Mortality		High Heart Rate		Total	P-value
			Yes (n=105)	No (n=91)		
Male (n=133)	Yes		10	2	12	0.029*
			14.1%	3.2%	9.0%	
	No		61	60	121	
			85.9%	96.8%	91.0%	
	Total			71	62	
			100.0%	100.0%	100.0%	
Female (n=63)	Yes		6	1	7	0.074
			17.6%	3.4%	11.1%	
	No		28	28	56	
			82.4%	96.6%	88.9%	
	Total			34	29	
			100.0%	100.0%	100.0%	

Table-8: Comparison of Frequency of In-Hospital Mortality in STEMI Patients with versus without High Heart Rate upon Admission across Age Groups.

Age	In-Hospital Mortality		High Heart Rate		Total	P-value
			Yes (n=105)	No (n=91)		
≤50 years (n=61)	Yes		5	1	6	0.130
			15.2%	3.6%	9.8%	
	No		28	27	55	
			84.8%	96.4%	90.2%	
	Total			33	28	
			100.0%	100.0%	100.0%	
>50 years (n=135)	Yes		11	2	13	0.017*
			15.3%	3.2%	9.6%	
	No		61	61	122	
			84.7%	96.8%	90.4%	
	Total			72	63	
			100.0%	100.0%	100.0%	

to 3.3% of the patients without high heart rate. (Table-5,6) Comparable difference in the frequency of in-hospital mortality was seen among STEMI patients with high heart rate on admission by different age group,

gender, BMI and smokers compared to other STEMI patients with normal heart rate on admission. (Table 7-10) There is significant p value in male patients age more than 50 obese patients and smoker and non smoker both.

Table-9: Comparison of Frequency of In-Hospital Mortality in STEMI Patients with versus without High Heart Rate upon Admission across BMI Groups.

BMI	In-Hospital Mortality		High Heart Rate		Total	P-value
			Yes (n=105)	No (n=91)		
Obese (n=153)	Yes		14	3	17	0.014*
			16.9%	4.3%	11.1%	
	No		69	67	136	
			83.1%	95.7%	88.9%	
Total			83	70	153	
			100.0%	100.0%	100.0%	
Non-Obese (n=43)	Yes		2	0	2	0.157
			9.1%	.0%	4.7%	
	No		20	21	41	
			90.9%	100.0%	95.3%	
Total			22	21	43	
			100.0%	100.0%	100.0%	

Table-10: Comparison of Frequency of In-Hospital Mortality in STEMI Patients with versus without High Heart Rate upon Admission across Smoking Status.

Smoking	In-Hospital Mortality		High Heart Rate		Total	P-value
			Yes (n=105)	No (n=91)		
Yes (n=103)	Yes		9	2	11	0.046*
			16.4%	4.2%	10.7%	
	No		46	46	92	
			83.6%	95.8%	89.3%	
Total			55	48	103	
			100.0%	100.0%	100.0%	
No (n=93)	Yes		7	1	8	0.045*
			14.0%	2.3%	8.6%	
	No		43	42	85	
			86.0%	97.7%	91.4%	
Total			50	43	93	
			100.0%	100.0%	100.0%	

DISCUSSION:

Acute coronary syndrome (ACS) encompasses a range of conditions from unstable angina to non-ST segment elevated MI (NSTEMI) and ST segment elevated MI (STEMI). STEMI is the most severe form associated with high morbidity and mortality. Primary PCI is now the preferred treatment for STEMI patients.⁴⁻⁸

Our understanding of factors affecting PCI outcomes led to the creation of new

techniques and technology, enhancing patient results. Stent advancements notably cut procedural issues and repeat revascularizations. Improvements in drug treatments impacted ischemic complications and bleeding rates. Trials and registries continue to provide a plethora of valuable data guiding PCI guideline development.⁵⁻⁸

Several large studies found links between patient characteristics during PCI and in-

hospital outcomes. High heart rate on admission was identified as a predictor of in-hospital mortality post-PCI for STEMI patients.¹⁻³ Limited evidence and a lack of local published material prompted the present study. It aimed to assess how often patients admitted to the hospital with acute STEMI had a high heart rate upon admission and to compare in-hospital mortality rates between patients with and without high heart rates undergoing percutaneous coronary intervention for acute STEMI.

In this study, patients' mean age was 53.4 ± 6.9 years. Saleem et al. found a comparable mean age of 52.93 ± 13.30 years at Hayatabad Medical Complex. Jafary et al. also reported a similar mean age of 52 ± 10.8 years in acute STEMI patients across Pakistan. Adam et al. reported a mean age of 57.9 ± 12.7 years in ACS patients in Sindh.⁹⁻¹¹

Singh et al. reported an average age of 58.0 ± 13.6 years for ACS patients in India, while Das et al. found it to be 56.6 ± 10.3 years in Bangladesh, and Roe et al. noted a similar mean age of 55.6 ± 13.8 years among American patients. Thabet et al. reported a comparable mean age of 58.9 ± 11.3 in Egyptian patients, and Al-Rasadi et al. observed it to be 56 ± 12 years in Oman.¹²⁻¹⁶ In STEMI patients, a male predominance was observed with a ratio of 2.1:1, as reported in studies by Lashari et al. at PAF Hospital Mushaf Sargodha and Shaikh et al. at Tabba Heart Institute, Karachi, who found a similar male to female ratio of 2.1:1 and 2.2:1, respectively.¹⁷⁻¹⁸

Adam et al. reported a male-to-female ratio of 1.9:1 in Sindh. This trend of male predominance is consistent with findings from local studies by Salahuddin et al. (2.1:1) and Arshad et al. (4.1:1) among STEMI patients.^{11,19-20} Singh et al. found a male predominance among these patients in India (2:1). A similar pattern was reported by Hagstrom et al. in Sweden (2.2:1), González-Pacheco et al. in America (2.2:1), and Al-Rasadi et al. in Oman (2.4:1).^{12,16,21-22}

Our study found that 78.1% of patients were obese and 52.6% were smokers. These

findings align with Saleem et al.'s study at Hayatabad Medical Complex, Peshawar, which reported similar rates of smoking (57.8%) and obesity (72.2%). Iqbal et al. also observed comparable smoking rates (52.5%) but lower obesity rates (32.5%) among STEMI patients at Divisional Headquarter Hospital, Faisalabad.^{9,23}

The study found that over half (53.6%) of STEMI patients had high heart rate (≥ 80 bpm.), with 9.7% experiencing in-hospital mortality. Mortality was significantly more common in those with high heart rate at admission (15.2% vs. 3.3%; $p=0.005$). Wang et al. reported similar findings in Chinese STEMI patients, with 53.5% having high heart rate and 2.3% experiencing in-hospital mortality. They also noted a significant difference in mortality rates between patients with and without high heart rate at admission (3.5% vs. 2.4%; $p<0.001$).²⁴

In a UK study, Balasubramaniam et al. found high heart rate in-hospital mortality rates were 56.1% and 10.3%. They noted a difference in mortality between patients with and without high heart rate at admission (12.7% vs. 7.0%; $p\text{-value}=0.005$).²⁵ An Australian study by O'Brien et al. found that 47.8% of STEMI patients had a high heart rate, with an in-hospital mortality rate of 11.3%. They also noted a significant difference in mortality between those with high heart rates upon admission (7.7%) compared to those without (3.4%) in line with the current study results.²⁶

Our observation aligns with Zheng et al., showing high heart rate in 40.8% and in-hospital mortality in 5.1% of STEMI patients undergoing PCI in China. They noted a significantly higher mortality rate in patients with high heart rate upon admission compared to those without (7.0% vs. 3.8%; $p=0.023$).²⁷ Noman et al. found high heart rate incidence and in-hospital mortality rates to be 56.1% and 3.8% in British STEMI patients. Patients with high heart rate on admission had significantly higher in-hospital mortality compared to those without (4.9% vs. 2.4%; $p<0.05$).²⁸

The study is the first in the local population, adding evidence to international research. A significant number of acute STEMI patients

had high heart rates, correlating with higher in-hospital mortality. Larger sample size (196 cases) and data stratification were strengths. However, limitations include not considering various factors such as time to intervention, diabetic/hypertensive status, and prior cardiac history. In-hospital mortality was the only outcome measure, excluding other important aspects like bleeding and stent issues. Future research is needed to comprehensively assess

the role of high heart rate in STEMI risk stratification.

CONCLUSION:

In this study, a notable number of acute STEMI patients with high heart rates at admission undergoing percutaneous coronary intervention had significantly increased in-hospital mortality rates. Routine heart rate monitoring in STEMI patients could enhance outcomes, particularly by identifying high-risk patients early for more effective management.

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