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ORIGINAL RESEARCH

To investigate the relationship between diastolic blood pressure at admission and subsequent cardiovascular mortality in patients with acute coronary syndrome

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ABSTRACT

Background: Among the non-communicable illnesses in the world ,Coronary artery disease (CAD) is one of the most common and it remains a major cause of morbidity and mortality, with acute coronary syndromes (ACS) being the most severe. Acute coronary syndrome (ACS) is defined by an abrupt reduction in the flow of blood to the heart. It is frequently brought on by non-atherosclerotic or thromboembolic coronary etiologies, leading to ST segment elevation myocardial infarction (STEMI), nonSTEMI (NSTEMI), and unstable angina (UA). An estimated 7 million individuals globally receive an ACS diagnosis each year. **Objective:** To investigate the relationship between diastolic blood pressure at admission and subsequent cardiovascular mortality in patients with acute coronary syndrome. **Materials and methods:** This prospective cohort study was conducted in the Medicine Department ,Guru Nanak Dev Hospital, Amritsar. A total of 50 patients of Acute Coronary Syndrome were enrolled in this study.Their Diastolic Blood Pressure (DBP) was measured at the time of admission and were followed up for subsequent one month cardiovascular mortality. **Results**: Our study observed that lower DBP at admission is associated with a higher risk of mortality, suggesting that patients presenting with lower DBP require more immediate and intensive care.The mean DBP for those who experienced mortality was 55 mmHg, with a standard deviation of 19.30. In contrast, the mean DBP for survivors was significantly higher at 78.29 mmHg, with a standard deviation of 18.30. The p-value for this difference is <0.0001, indicating a highly significant statistical difference between the two groups. The Pearson's correlation coefficient (R) is -0.6237, showing a moderate negative correlation between DBP at admission and mortality. This signifies that as DBP at admission increases, the likelihood of mortality decreases, and vice versa**. Conclusion:** In conclusion, this study provides a comprehensive analysis of the clinical characteristics, treatment modalities, and outcomes of a sample of 50 patients diagnosed with myocardial infarction, with a predominance of STEMI cases. Significant differences in diastolic blood pressure (DBP) at admission between survivors and non-survivors were observed, with lower DBP associated with higher mortality, underscoring the importance of early and accurate blood pressure management in these patients.

INTRODUCTION

Among the non-communicable illnesses in the world ,Coronary artery disease (CAD) is one of the most common and it remains a major cause of morbidity and mortality, with acute coronary syndromes (ACS) being the most severe. Acute coronary syndrome (ACS) is defined by an abrupt reduction in the flow of blood to the heart. It is frequently brought on by non-atherosclerotic or thromboembolic coronary etiologies, leading to ST segment elevation myocardial infarction (STEMI), nonSTEMI (NSTEMI), and unstable angina (UA)[1]. An estimated 7 million individuals globally receive an ACS diagnosis each year[2].

Epidemiological data reveals that more than 7,80,000 people experience ACS every year in the United States out of which 70% of them have NSTEMI[3,4]. In high-income countries, there is decline in mortality rates in patients with AMI since the 1970s[5,6]. However, 80% of the world's CHD deaths occurred in low and middle-income countries (LMIC), especially in South Asia[7]. In India about 40% of the deaths in urban areas and 30% in rural areas are due to CHD[8]. In recent years, improving prognosis, lowering

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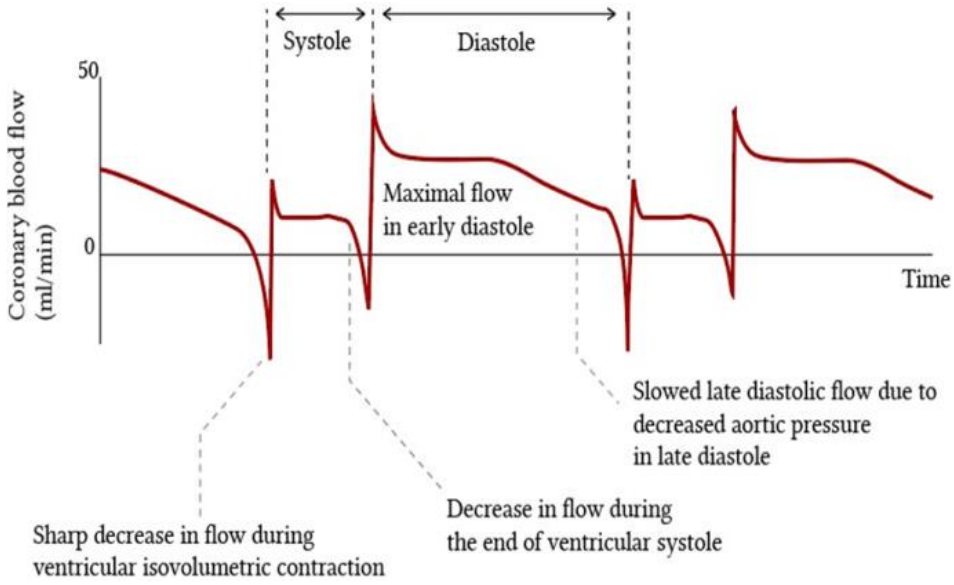
mortality, and encouraging early treatment have been crucial components of ACS treatment.

ACUTE CORONARY SYNDROME AND DIASTOLIC BLOOD PRESSURE(DBP)

DBP is related to coronary collateral circulation, a physiological adaptation of significant physiological importance that may impact the course of cardiovascular illnesses. The formation of tiny blood vessels (collaterals) that spontaneously link various coronary arteries or branches over time is referred to as coronary collateral circulation. These collaterals function as substitute blood vessels. They may become more apparent when there is prolonged ischemia or reduced blood flow. In CAD patients, well-developed coronary collateral arteries reduce myocardial infarcts and increase survival[9] .

Elevated tangential fluid strain at the surface of the artery endothelium is the main biomechanical component that causes the coronary collateral circulation (CCC). The coronary circulation is different in that the most of coronary blood flow occurs during diastole. Therefore, DBP on the tangential fluid shear strain upon the arterial endothelial surface during diastole may have an effect on the formation of the CCC. A well-developed CCC[10] is favorably correlated with high DBP. In general, a higher DBP guarantees a pressure gradient that is enough for efficient blood flow via the collateral vessels as well as the primary coronary arteries.

Myocardial ischemia risk is increased by diastolic hypotension[11]. Low DBP may lower blood flow across collaterals by impairing coronary perfusion pressure. Insufficient DBP may make it more difficult for collateral vessels to sufficiently make up for decreased blood flow through blocked or constricted coronary arteries in individuals with persistent ischemia or CAD. This can raise the risk of myocardial infarction, worsen myocardial ischemia, and cause symptoms like angina.



Numerous studies[12] have shown the J-curve phenomenon, in which because the coronary arteries are primarily perfused during diastole, DBP is inversely correlated with the risk of CAD and adverse outcomes. A significant pathophysiologic explanation has been suggested to account for the J-curve phenomenon: too aggressive antihypertensive medication may cause too-low DBP, which in turn may cause the coronary vasculature to hypoperfuse, which in turn may cause coronary events.We hypothesize that DBP might affect the outcome of patients with CAD by influencing the formation of a CCC, given the strong protective impact of CCC in CAD patients and the J-curve connection. However, an excessive decrease or rise in DBP might result in inadequately formed CCC, which would in turn result in adverse outcomes.[13]

Therefore, this present study was aimed to investigate the relationship between admission DBP and subsequent cardiovascular mortality in patients with ACS.

MATERIALS AND METHODS

Patients admitted with a confirmed case of Acute Coronary Syndrome participated in this prospective observational cohort study, conducted in the Medicine Department ,Guru Nanak Dev Hospital, Amritsar. We used the standard diagnostic criteria as defined by the European Society of Cardiology / American College of Cardiology / American Heart Association / World Heart Federation, in 2021 to diagnose acute coronary syndrome. Patients were defined as having a high DBP if they had a DBP $\geq$ 90 mmHg. The DBP was measured during admission. Blood pressure was measured with a standard mercury

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sphygmomanometer with a suitable sized cuff applied to the upper nondominant arm at heart level. Blood pressure was measured thrice, at intervals of least 2 minutes, and the measurements were averaged.
OUTCOME:

a) Investigating the relation betweenDBP at admission and subsequent cardiovascular mortality in patients with ACS.
b) All-cause mortality: in hospital and one month of hospital admission. Patients were asked to come for follow-up at these intervals. If patients did not come they were followed up telephonically.
c) Deaths were classified as coronary if this was determined by the physician at that admission. For those followed up via telephone, a simple verbal autopsy was used. Those with sudden death were classified as cardiac while those with prolonged illness such as fever, cough with sputum, or other illness were classified as non-cardiac.

INCLUSION CRITERIA

- Age >/= 18 years
- Those who gave consent for the study.
- Resident of North India, preferably within 30km radius of Amritsar
- Patients living outside 30km radius of Amritsar of North India, willing to come for follow up.

EXCLUSION CRITERIA

Severe AR (Aortic Regurgitation).

- Patent Ductus Arteriosus (PDA).
- AV (Arterio Venous) fistula.
- Severe anemia (Hemoglobin[HB] <7gm/dl).
- Ductus Arteriosus (PDA).

STATISTICAL ANALYSIS

At the end of the study, the data was collected and analyzed using appropriate statistical methods. The statistical software SPSS was used for statistical analysis. The mean±standard deviation will be calculated. Pair-wise comparison betweensurvivor and expired group was performed for all parameters using Student's unpaired t-test. The values of P <0.05 was considered as significant. The qualitative variables was compared using the chi-square test.

RESULTS

TABLE 1: DISTRIBUTION OF AGE IN STUDY POPULATION

AGE	Frequency	Percent
≤60	25	50.0
>60	25	50.0
Total	50	100.0
MEAN AGE	61.32±10.741	

Table: 1 shows the total participants in the study are 50, with 25 individuals each in ≤60 years and >60 years age category. The mean age of the study sample was 61.32 years ±10.741 years.

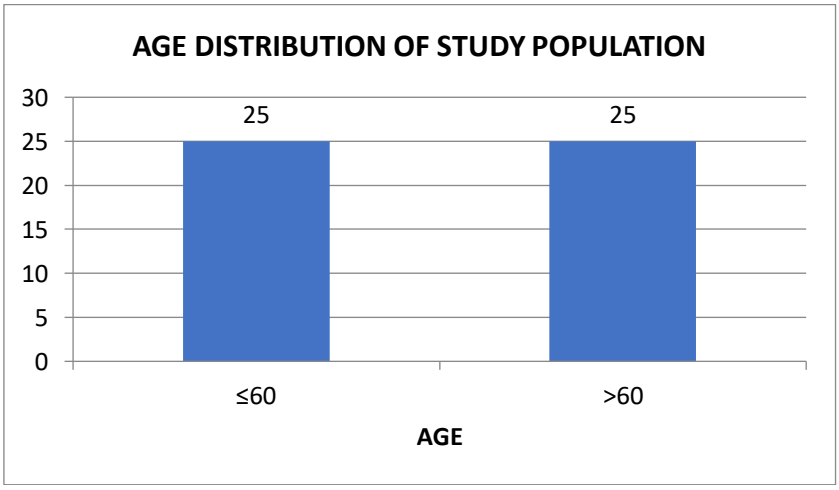

TABLE 2: GENDER DISTRIBUTION

Gender	Frequency	Percent
FEMALE	18	36.0
MALE	32	64.0
Total	50	100.0

Table 2 shows male predominance in the study. Out of the total 50 participants, 18 are female, making up 36% of the sample, while 32 were male, constituting the remaining 64%.

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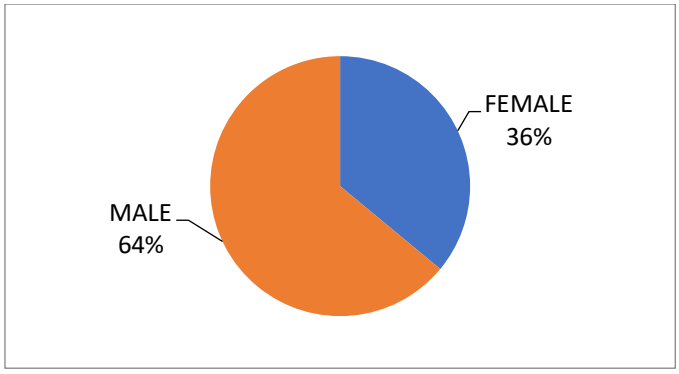
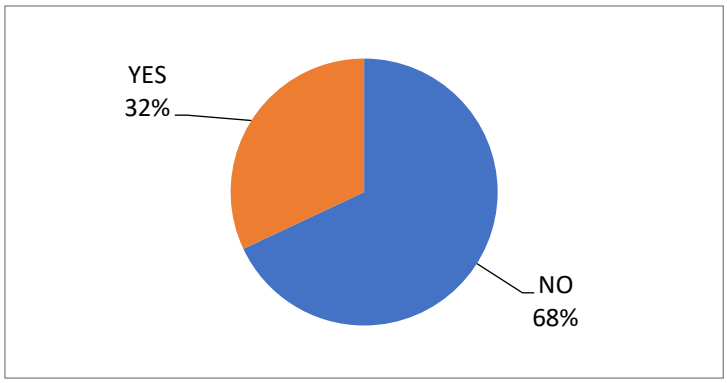


TABLE 3: DISTRIBUTION OF PATIENTS DEPENDING ON MORTALITY

Mortality	Frequency	Percent
NO	34	68.0
YES	16	32.0
Total	50	100.0

Table 3 shows that out of 50 individuals, 34 (68%) survived, while 16 (32%) had expired.



CORRELATIONS

TABLE 4: AGE WITH MORTALITY

			Mortality		Total	P VALUE
			NO	YES		
Age grp	<=60	Count	17	8	25	1.00
		% within Age grp	68.0%	32.0%	100.0%	
	>60	Count	17	8	25	
		% within Age grp	68.0%	32.0%	100.0%	
Total		Count	34	16	50	
		% within Age grp	68.0%	32.0%	100.0%	

Table 4 shows that both age groups contained 25 participants each. In both age groups, 17 individuals (68%) did not experience mortality, while 8 individuals (32%) did. This resulted in a mortality rate of 32% for each age group. The total sample of 50 individuals showed that 34 participants (68%) survived, while 16 participants (32%) had expired.

TABLE 5: AWMI WITH MORTALITY

			Mortality		Total	P VALUE
			NO	YES		
AWMI	ABSENT	Count	19	3	22	0.014*
		%	86.4%	13.6%	100.0%	
	PRESENT	Count	15	13	28	
		%	53.6%	46.4%	100.0%	
Total		Count	34	16	50	
		%	68.0%	32.0%	100.0%	

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Table 5 shows that among the 22 individuals without AWMI, 19 (86.4%) survived, while 3 (13.6%) experienced mortality. This resulted in a relatively low mortality rate of 13.6% for those without AWMI.
In contrast, among the 28 individuals with AWMI, 15 (53.6%) survived, and 13 (46.4%) experienced mortality, resulting in a much higher mortality rate of 46.4%.

Overall, in the entire sample of 50 individuals, 34 (68.0%) survived, while 16 (32.0%) experienced mortality.
The p-value for this comparison was 0.014, indicating a statistically significant difference in mortality rates between individuals with and without AWMI.

TABLE 6: NSTEMI WITH MORTALITY

			Mortality		Total	P VALUE
			NO	YES		
NSTEMI	ABSENT	Count	21	16	37	0.004*
		%	56.8%	43.2%	100.0%	
	PRESENT	Count	13	0	13	
		%	100.0%	.0%	100.0%	
Total		Count	34	16	50	
		%	68.0%	32.0%	100.0%	

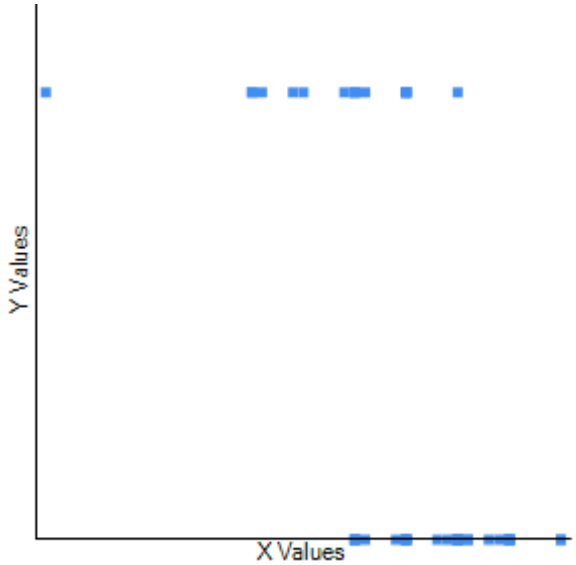
Table 6 shows that among the 37 individuals without NSTEMI, 21 (56.8%) survived, while 16 (43.2%) experienced mortality. This resulted in a mortality rate of 43.2% for those without NSTEMI.
In contrast, all 13 individuals with NSTEMI survived, resulting in a 0% mortality rate for this group.

Overall, in the entire sample of 50 individuals, 34 (68.0%) survived, while 16 (32.0%) experienced mortality.
The p-value for this comparison was 0.004, indicating a statistically significant difference in mortality rates between individuals with and without NSTEMI.

TABLE 7: CORRELATION DBP AT ADMISSION WITH MORTALITY

MORTALITY	MEAN DBP	P VALUE	PEARSONS CORRELATION (R)
YES	55±19.30	<0.0001*	-0.6237
NO	78.29±18.30		

This is a moderate negative correlation, which means there is a tendency for high X variable scores to go with low Y variable scores (and vice versa). (X axis: DBP; Y axis : Mortality)



x axis: DBP; Y axis : Mortality

The table 7 presents the correlation between Diastolic Blood Pressure (DBP) at admission and mortality, highlighting a significant relationship between these variables.

The mean DBP for patients who experienced mortality was 55 ±19.30 mmHg. In contrast, the mean DBP for survivors was significantly higher at 78.29± 18.30 mmHg. The p-value for this difference is

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<0.0001, indicating a highly significant statistical difference between the two groups.
The Pearson's correlation coefficient (R) is -0.6237, showing a moderate negative correlation between DBP at admission and mortality.

DISCUSSION

The present study was conducted in the Medicine Department of Guru Nanak Dev Hospital, Government Medical College, Amritsar, after approval by the Institutional Ethical Committee. Recruitment of participants took place over one and a half years, from December 2022 to June 2023. Our study aimed to investigate the relationship between diastolic blood pressure at admission and subsequent cardiovascular mortality in patients with acute coronary syndrome. This prospective observational cohort study focused on patients admitted with confirmed Acute Coronary Syndrome. The observations of the study are discussed as follows:
The sample group comprised an equal distribution of age categories, with 50% of individuals being 60 years old or younger and the other 50% older than 60 years. The average age of the participants was 61.32 years, with a standard deviation of 10.741 years, reflecting a diverse age range.In terms of gender, the group exhibited a notable imbalance, with 64% (32 individuals) being male and only 36% (18 individuals) being female. This significant gender disparity indicates a higher representation of males compared to females in the sample.Similar to our study Mohanan et al[14]also had study population with mean age of 60.4years and male preponderance with 77.4% patients being male.
Specifically, our analysis revealed that the presence of Anterior Wall Myocardial Infarction (AWMI) significantly increased mortality risk, with a mortality rate of 46.4% in those with AWMI compared to 13.6% in those without ($p = 0.014$). Similar to our study Haim M et al[15] also showed that patients with AWMI had increased in hospital mortality and one year cardiac events when compared with inferior and lateral wall MI.
Conversely, all individuals with NSTEMI survived, resulting in a 0% mortality rate for this group, compared to a 43.2% mortality rate in those without NSTEMI ($p = 0.004$). This suggests that the presence of NSTEMI was associated with a significantly lower risk of mortality, highlighting a clear impact on survival outcomes. Similar to our study Marceau et al[16]also showedat 30 days, STEMI was associated with a higher mortality compared to NSTEMI.

DBP AND MORTALITY

Our study presents the correlation between Diastolic Blood Pressure (DBP) at admission and mortality, highlighting a significant relationship between these variables. The mean DBP for patients who experienced mortality was 55 mmHg, with a standard deviation of 19.30. In contrast, the mean DBP for survivors was significantly higher at 78.29 mmHg, with a standard deviation of 18.30. The p-value for this difference is <0.0001, indicating a highly significant statistical difference between the two groups. The Pearson's correlation coefficient (R) is -0.6237, showing a moderate negative correlation between DBP at admission and mortality. This signifies that as DBP at admission increases, the likelihood of mortality decreases, and vice versa. Graphically, this would be represented by a downward-sloping trend when plotting DBP on the x-axis and mortality on the y-axis.
The significant negative correlation between DBP at admission and mortality underscores the importance of DBP as a prognostic indicator in clinical settings. Lower DBP at admission is associated with a higher risk of mortality, suggesting that patients presenting with lower DBP require more immediate and intensive care. This relationship is likely due to the fact that lower DBP can indicate poorer cardiac function and reduced perfusion pressure, which can lead to inadequate tissue perfusion and increased risk of adverse outcomes.
The highly significant p-value (<0.0001) confirms that this finding is not due to random chance and highlights the reliability of DBP as a predictor of mortality. Clinically, these results suggest that monitoring and managing DBP in patients at admission could be critical in improving patient outcomes. Interventions aimed at stabilizing and optimizing DBP could potentially reduce mortality rates in patients presenting with low DBP.
These findings are supported by Jiang C et al.[17], who observed a non-linear relationship between DBP at admission and cardiovascular and all-cause mortality during hospitalization and over the follow-up period. Their analysis revealed that patients in the middle DBP quartiles (Q2 and Q3) had a lower risk of 2-year cardiovascular death compared to those in the highest quartile (Q4). Interestingly, patients in the lowest quartile (Q1) had a similar risk to those in Q4, indicating a J-curve relationship with the nadir at 73–80 mm Hg. Additionally, Josephine Warren et al[18] found that patients with DBP <50 mmHg were older and had higher rates of diabetes, renal impairment, prior myocardial infarction, left ventricular dysfunction, peripheral and cerebrovascular disease (all P<0.001). These patients also had higher 30-day and long-term mortality. DBP <50 mmHg was observed to be an independent predictor of long-term mortality.

CONCLUSION

In conclusion, this study provides a comprehensive analysis of the clinical characteristics, treatment modalities, and outcomes of a sample of 50 patients diagnosed with myocardial infarction, with a predominance of STEMI cases. The mean age of participants was 61.32 years, with a higher prevalence of male patients.

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Significant differences in diastolic blood pressure (DBP) at admission between survivors and non-survivors were observed, with lower DBP associated with higher mortality, underscoring the importance of early and accurate blood pressure management in these patients. Despite the lack of significant gender-based differences in mortality rates, the overall mortality rate was 32%, highlighting the critical need for timely and effective medical interventions.

Thus in conclusion, our findings suggest that low DBP might be used as an early indicator and independent prognostic factor in patients with ACS.

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