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PREVALENCE OF UNCONTROLLED DIABETES AND ITS ASSOCIATION WITH LEFT VENTRICULAR DYSFUNCTION IN MYOCARDIAL INFARCTION (MI) PATIENTS

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Abstract

OBJECTIVE: *To evaluate the frequency of uncontrolled diabetes in individuals diagnosed with myocardial infarction (MI) at a tertiary healthcare center in Karachi, Pakistan, and to compare the incidence of left ventricular (LV) dysfunction between MI patients with uncontrolled and controlled diabetes.*

METHODOLOGY: *A cross-sectional study was carried out at the Adult Cardiology Department of the National Institute of Cardiovascular Diseases (NICVD), Karachi. The study included 155 myocardial infarction patients, aged 18 to 65 years, of either gender. Blood samples were collected for HbA1c testing, and individuals with values greater than 7% were classified as having uncontrolled diabetes. Echocardiography was carried out to evaluate left ventricular performance, with an ejection fraction below 50% indicating dysfunction. The data were analyzed using SPSS version 26, and a 5% level of significance was applied.*

RESULTS: *A cohort of 155 individuals diagnosed with myocardial infarction was analyzed (mean age 58.66 ± 9.45 years; 73.5% male). The prevalence of uncontrolled diabetes was noted in 76.8% of the cases examined. The average HbA1c level was markedly elevated within this cohort (9.35 ± 1.79% vs. 6.18 ± 0.52%, $p < 0.001$). No statistically significant variations were identified in LVEF ($p = 0.418$) or in the rates of LV dysfunction ($p = 0.604$) across the specified groups.*

CONCLUSION: *This study found a high prevalence of poorly managed diabetes among the population experiencing myocardial infarction (MI). While LV dysfunction was noted more commonly in poorly-controlled diabetic patients, this association did not reach statistical significance. These findings reinforce the need for routine glycemic monitoring in individuals with MI, while also emphasizing the need for further study to evaluate the impact of poorly controlled glycemia on the heart.*

INTRODUCTION

Diabetes mellitus (DM) has currently become a tremendous issue in public health globally with nearly 451 million individuals in the world being afflicted with it [1]. The number is projected to jump to 693 million by 2045. Alarmingly, approximately half of individuals with DM are not aware of their condition, which leads to serious health complications as a result of delayed care [2]. The prevalence is higher in low-middle income countries (LMICs) compared to high-income countries. South Asian countries Pakistan bears high burden of diabetes with nearly 33 million persons affected [2, 3]. Diabetes, especially uncontrolled diabetes, is a serious problem in Pakistan, where the healthcare sector may poorly cope with chronic disease [4].

The most prevalent complication of diabetes is the increasing prevalence of potentially deadly CV diseases [5]. The myocardial infarction (MI) is developed when the circulation of the blood to the heart is blocked, usually by a clot in a coronary artery, and leads to ischemia and damage to tissue [6]. The LV, which is the heart's primary pumping chamber, is frequently involved in patients with MI, and depressed function after the occurrence of MI results in what is known as left ventricular (LV) dysfunction [7].

In diabetic patients, LV dysfunction after MI is a frequent and lethal complication [4,8,9]. In patients with diabetes, inadequate glycemic control is considerably associated with poor outcomes following acute MI [6, 10]. In a study, diabetic individuals, who had uncontrolled diabetes, had 13 times the odds of a cardiovascular event, compared with non-diabetic subjects (OR=13.57, 95% CI=7, 26, p=0.001 [11]. Diabetes mellitus was present in 19.4% MI patients in Pakistan [12].

Though diabetes and cardiovascular diseases are highly prevalent in Pakistan, there is paucity of data regarding the prevalence of uncontrolled diabetes in patients with MI in Karachi and its association with LV dysfunction. The present study is designed to explore this issue and to evaluate the prevalence of uncontrolled diabetes in MI patients and the association between uncontrolled diabetes and LV dysfunction in the local population.

Insight into the effect of uncontrolled diabetes on LV function in MI patients of Karachi would be beneficial for clinicians to devise targeted management strategy. This study aims to increase awareness about optimal diabetes care to improve cardiac outcomes and emphasise the significance of glycemic control in the prevention and management of CVCs in Pakistan.

METHODOLOGY

This cross-sectional study was carried out in the Adult Cardiology Department at the National Institute of Cardiovascular Diseases (NICVD), Karachi, Pakistan. A non-probability consecutive sampling technique was employed, involving 155 patients aged 18 to 65 years, of both sexes, all diagnosed with myocardial infarction (MI).

The diagnosis of MI was based on the presence of at least two criteria, including: ischemic symptoms, new ST-segment changes, left bundle branch block, pathological Q waves on ECG, wall motion abnormalities, or intracoronary thrombus observed via angiography or autopsy.

Patients with pre-existing LV dysfunction or end-stage renal disease (ESRD) were excluded to minimize confounding. Clinical and demographic data were recorded using a structured form.

Venous blood samples were collected from all participants and analyzed for HbA1c levels in the hospital laboratory. Individuals with HbA1c ≥ 7% were classified as having uncontrolled diabetes.

All were evaluated by echocardiography to measure LV function. LV failure was defined as an EF < 50%. Echocardiographic findings were read by skilled technicians and recorded as appropriate.

All the subjects underwent echocardiography to evaluate LV function. Dysfunction of the LV was categorized by an EF of <50%.

The data were processed using SPSS version 26. Continuous data were reported as mean ± standard deviation, while categorical data were summarized using frequencies and percentages. The Chi-square test was used to examine the association between LV dysfunction and uncontrolled diabetes. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

A total of 155 individuals participated in the study, with an average age of 58.66 ± 9.45 years. The mean duration of diabetes among participants was 8.35 ±

7.36 years, and the average HbA1c level recorded was 8.62 ± 2.08%. The mean left ventricular ejection fraction (LVEF) was 40.00 ± 10.05%, while the mean serum creatinine concentration was 1.05 ± 0.46 mg/dL. Most participants were male (73.5%), and females represented 26.5% of the cohort. Regarding occupation, 49.0% of them were employed and 51.0% unemployed. A majority of them were of the middle socioeconomic class (68.4%), followed by the upper class (18.7%) and lower class (12.9%). With regard to lifestyle, 23.9% were smokers and 2.6% drunk alcohol. All subjects had Type 2 diabetes. Regarding diabetes control, 75.5% were being treated with oral hypoglycemic drugs, 16.1% with insulin, 7.1% with diet and 1.3% with other methods. Hypertension and dyslipidemia were identified in 63.9 and 23.9% of participants, respectively. Family history of CAD was seen in 12.3% and of MI in 27.7%. Single-, double-, triple-vessel, and left main coronary artery disease were detected in 28.4%, 22.6%, 39.4%, and 9.7% of the cases, respectively. In terms of treatment strategies, 69.0% of patients underwent PCI and 20.6% received CABG, with 10.4% managed with medical therapy alone as presented in Table I.

Comparison of clinical characteristics between uncontrolled (n=119) and controlled (n=36) diabetes patients revealed that the mean HbA1c in the uncontrolled group (9.35 ± 1.79%) was significantly higher than in the controlled group (6.18 ± 0.52%); the p-value was 0.0001 and the 95% confidence interval was -3.776 to -2.575. Age, duration of diabetes, LVEF, and serum creatinine were not significantly different between the two groups. There was no significant difference in sex, smoking status, and alcohol use between groups. Likewise, diabetic treatment modality (insulin, oral hypoglycemic agents, dietary restriction etc.) was not significantly associated with the glycemic control status.

There were slightly more patients with hypertension and dyslipidemia in the uncontrolled group, but the differences were not significant. Although a numerically higher percentage of previous myocardial infarction patients were included in the controlled diabetes group (38.9% vs. 24.4%), this was also not significant statistically (p =0.088). There was no significant difference in vessel involvement pattern (single, double, triple, and left main coronary artery disease) between the two groups. Interve ntion strategies (PCI, CABG and medical management) in both groups was more toward PCI with higher percentage in the controlled group (80.6% vs. 65.5%) but this difference was not statistically significant. Finally, no significant difference was observed in the incidence of associated LV dysfunction between the two groups (76.5% and 72.2% among uncontrolled and controlled, respectively, p = 0.604). In general, except HbA1c, none of the patient features was found to have a statistically significant relationship with poorly controlled diabetes in this study as presented in Table II.

DISCUSSION

The present study found that 76.5% of uncontrolled diabetes patients had left ventricular dysfunction (LVD), as opposed to 72.2% of controlled diabetes patients, but the difference was not statistically significant (p = 0.604). Thus, although the trend is consistent with previous literature reporting adverse cardiac outcomes during periods of poor glycemic control, we are unable to conclude that uncontrolled diabetes is a statistically significant predictor of LVD in this cohort. These results are consistent with earlier reported studies, although differences in prevalence of uncontrolled diabetes were found between populations and the context of study. For instance, Fayed et al. [11], in their sub-cohort analysis of the Heart Health Promotion (HHP) study, found a substantially lower prevalence of uncontrolled diabetes (11.8%), possibly due to disparities in healthcare delivery and accessibility, patient's knowledge, or regional health policy.

A more relevant work of Awana et al. [13] carried out in Lahore, Pakistan where the frequency of uncontrolled diabetes was 69.33% which is quite close to our findings. They have also documented a significantly increased prevalence of LVD among uncontrolled diabetics (83.65%) when compared to well controlled ones (60.87%) with a p value of 0.05. These findings also reaffirm the deleterious effect of unsatisfactory glycemic control on the heart and the critical need for tight metabolic control in diabetic subjects.

From a pathophysiological point of view several mechanisms could explain the relationship between diabetes and left ventricular Dysfunction. Liu et al.

[14] studied that diabetes mellitus could aggravate post-myocardial infarction heart failure by epigenetic modulation, including decreased methylation of the sarcolipin promoter. This molecular mechanism is involved in altered calcium homeostasis in cardiomyocytes and results in a myocardial dysfunction. Furthermore, Aldujeli et al. [15] investigated the contribution of coronary microvascular dysfunction on functional left ventricular remodeling and diastolic function. Their findings lend support to the theory that microvascular dysfunction—an end organ complication of chronic diabetes—is a key culprit in the decline of left ventricular function, both structural and functional.

Apart from structural and microvascular alterations, metabolic derangements of diabetes may have a direct role in the aetiopathogenesis of heart failure. Chen et al. [16] demonstrated that serum iron can serve as a prognostic marker for HF in patients with acute ST-segment elevation myocardial infarction (STEMI), meaning that even small metabolic perturbations may be able to affect diabetic patients' cardiovascular prognosis. Hyponatremia has also been reported to be a potential predictor of adverse cardiovascular events. Cordova Sanchez et al. [17] found a markedly relationship between hyponatremia and poor clinical outcomes in patients presenting with acute MI, which might be even more apparent in the subpopulation of diabetic, assigned to deviating fluid and electrolyte balance.

Long-term glycemic control as judged from levels of HbA1c' is an important determinant for cardiovascular risk. Azhar et al. [18] revealed that higher HbA1c levels were a risk of increased risk for myocardial infarction in diabetic patients in hospital-based diabetes study in Peshawar. This phenomenon even reinforces the case that hyperglycemia, chronic in its nature, acts not only as a biomarker, but also as a modifiable risk factor to produce early cardiac adverse events early including LVD onset and progression. Our report, in concordance with regional and international reports, shows the increased burden of left ventricular dysfunction in patients with uncontrolled DM. Evidence from diverse studies underscore the multifaceted aspects of cardiac dysfunction in diabetes, including epigenetic modulation, microvascular disturbance, metabolic disruption, and suboptimal long-term glucose control.

Our findings suggest an urgent call for proactive strategies for management in order to enhance glycemic control for the purpose of reducing cardiovascular complications among diabetic populations. This study gives us an important insight into the role of poorly controlled diabetes and left ventricular failure in MI. However, as with all research it has some constraints and limitations that need to be addressed. The main limitation is regarding the cross-sectional observational design, that does not allow us to establish causal relation between uncontrolled diabetes and LV disfunction. Since the data were collected at one time point, we cannot know the time course of events or progression of cardiac dysfunction with respect to the control of glucose levels. In addition, the study was performed at a single tertiary care center—NICVD, Karachi, which might reduce the generalization of the findings to the general population, especially to those residing in rural areas or other parts of the country.

There are other limitations of note, one being the non-probability consecutive sampling. While easy to perform in a clinical setting, this approach could introduce selection bias and might not be representative of the overall population of MI patients. Furthermore, other creeping confounders such as duration of diabetes, adherence to medications, lifestyle factors and comorbid conditions such as hypertension or dyslipidemia were not exhaustively questioned, all of which could also impact glycemic control and cardiac outcomes.

However, there are several strengths to this study despite these limitations. It applied specific definitions to diagnose MI and LV dysfunction, which would improve the credibility and reproducibility of the results. The objective designed proforma for data collection and laboratory-based measurement of HbA1c provide an objective measure of glycemic control. In addition, trained personnel provided echocardiographic examinations, thereby allowing for correct LV function evaluation.

We can draw some implications and limitations from the findings of this study. Further research should adopt a multicenter, prospective cohort design to facilitate the generalization and causal inference. If other variables such as duration of diabetes, medication history and other cardiovascular risk factors etc. could be included, we could obtain a

comprehensive knowledge of both groups. Last but not least, the incorporation of follow-up data might provide new insights into long-term effects of glycemic control on cardiac outcomes and assist in advancing clinical management approaches and patient care.

CONCLUSION

A cohort of 155 individuals diagnosed with myocardial infarction was analyzed (mean age 58.66 ± 9.45 years; 73.5% male). The prevalence of uncontrolled diabetes was noted in 76.8% of the cases examined. The average HbA1c level was markedly elevated within this cohort (9.35 ± 1.79% vs. 6.18 ± 0.52%, $p < 0.001$). No statistically significant variations were identified in LVEF (p=0.418) or in the rates of LV dysfunction (p=0.604) across the specified groups.

Table I: Baseline Demographic and Clinical Profile of Study Participants (n=155)		
(Mean ± SD)		
Age in years = 58.66 ± 9.45		
Duration of Diabetes in years = 8.35 ± 7.36		
HbA1c in % = 8.62 ± 2.08		
LVEF in % = 40.00 ± 10.05		
Serum Creatinine Level in mg/dl = 1.05 ± 0.46		
	Frequency (%)	
Gender	Male	114 (73.5)
	Female	41 (26.5)
Employment Status	Employed	76 (49.0)
	Unemployed	79 (51.0)
Socioeconomic Status	<30000	20 (12.9)
	30000-100000	106 (68.4)
	>100000	29 (18.7)
Smoking Status	Smoker	37 (23.9)
	Non-Smoker	118 (76.1)
Alcohol	Yes	4 (2.6)
	No	151 (97.4)
Type of Diabetes Mellitus	Type I	0 (0.0)
	Type II	155 (100.0)
Current Diabetes Treatment	Insulin	25 (16.1)
	Oral Hypoglycemia Agents	117 (75.5)
	Dietary Control Only	11 (7.1)
	Other	2 (1.3)
Hypertension	Hypertensive	99 (63.9)
	Non-Hypertensive	56 (36.1)
Dyslipidemia	Yes	37 (23.9)
	No	118 (76.1)
Family History of CAD	Yes	19 (12.3)
	No	136 (87.7)
Previous MI	Yes	43 (27.7)
	No	112 (72.3)

Vessel Involvement	Single	44 (28.4)
	Double	35 (22.6)
	Triple	61 (39.4)
	Left Main Coronary Artery	15 (9.7)
Interventions	PCI	107 (69.0)
	CABG	32 (20.6)
	Medical Management Only	16 (10.4)

Table II: Association of Clinical & Demographic Characteristics Between Patients With and Without Uncontrolled Diabetes, Including LV Dysfunction

Clinical and Demographic Parameters		Uncontrolled Diabetes		95% C. I	P-Value
		Yes (n=119)	No (n=36)		
Age in years		58.53 ± 9.81	59.08 ± 8.24	-3.017-----4.108	0.763
Duration of Diabetes in years		8.75 ± 7.66	7.02 ± 6.20	-4.487-----1.039	0.220
HbA1c in %		9.35 ± 1.79	6.18 ± 0.52	-3.776----- -2.575	0.0001*
LVEF in %		40.36 ± 9.95	38.80 ± 10.43	-5.338-----2.226	0.418
Serum Creatinine Level in mg/dl		1.01 ± 0.40	1.17 ± 0.61	-0.015-----0.331	0.075
Gender	Male	86 (72.3)	28 (77.8)	0.556-----3.245	0.511
	Female	33 (27.7)	8 (22.2)		
Smoking Status	Smoker	28 (23.5)	9 (25.0)	0.456-----2.573	0.856
	Non-Smoker	91 (76.5)	27 (75.0)		
Alcohol	Yes	4 (3.4)	0 (0.0)	N/A	0.265
	No	115 (96.6)	36 (100.0)		
Current Diabetes Treatment	Insulin	21 (17.6)	4 (11.1)	0.325-----1.319	0.644
	OHA	89 (74.8)	28 (77.8)		
	DCO	8 (6.7)	3 (8.3)		
	Other	1 (0.8)	1 (2.8)		
Hypertension	Hypertensive	77 (64.7)	22 (61.1)	0.398-----1.848	0.694
	Non-Hypertensive	42 (35.3)	14 (38.9)		
Dyslipidemia	Yes	31 (26.1)	6 (16.7)	0.216-----1.494	0.247
	No	88 (73.9)	30 (83.3)		
Previous MI	Yes	29 (24.4)	14 (38.9)	0.896-----4.352	0.088
	No	90 (75.6)	22 (61.1)		
Vessel Involvement	Single	34 (28.6)	10 (27.8)	0.587-----1.256	0.440
	Double	28 (23.5)	7 (19.4)		
	Triple	48 (40.3)	13 (36.1)		

	LMCA	9 (7.6)	6 (16.7)		
Interventions	PCI	78 (65.5)	29 (80.6)	0.893–––3.408	0.226
	CABG	27 (22.7)	5 (13.9)		
	Medical Management	14 (11.8)	2 (5.6)		
LV Dysfunction	Yes	91 (76.5)	26 (72.2)	0.538–––2.905	0.604
	No	28 (23.5)	10 (27.8)		

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