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COMPARATIVE EVALUATION OF CARDIAC COMPLICATIONS IN DIABETIC AND NON-DIABETIC PATIENTS A CROSS-SECTIONAL CLINICAL STUDY

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ABSTRACT

Background: One of the most significant health challenges in the world and a significant cause of cardiovascular morbidity and mortality is diabetes mellitus. The chronic hyperglycemia in diabetes speeds up the process of atherosclerosis and endothelial dysfunction and myocardial damage, resulting in a higher number of cardiac complications than non-diabetic persons. The purpose of the research was to comparatively assess the occurrence and trend of cardiac complications in diabetic and non-diabetic patients in a clinical environment.

Methods: The study was a cross-sectional comparative study that was carried out between the period of January 2024 and September 2025 at tertiary care hospitals in Punjab, Pakistan. One hundred patients aged between 35 and 65 years were recruited and split into two groups (n=50 and n=50, respectively); diabetic and non-diabetic. All participants were subjected to clinical examination, biochemical investigations, ECG and echocardiography. The data were analyzed in SPSS version 26.0, and the results were compared with Chi-square and Student t-test, $p < 0.05$ was taken as statistically significant.

Results: The mean BMI of diabetic patients was much greater (28.7 ± 3.5 kg/m 2) than that of non-diabetics (26.1 ± 3.2 kg/m 2; $p = 0.03$). The incidence of hypertension (64% vs. 36%) and dyslipidemia (70% vs. 44%) was also significantly higher in patients with diabetes. The biochemical results depicted increased fasting glucose, HbA1c, total cholesterol, LDL and triglycerides and reduced levels of HDL in the diabetic individuals. General complications of the heart were much more common in diabetics (94 versus 48 in non-diabetics; $p < 0.001$). The most prevalent complication was coronary artery disease (44 percent among diabetics and 24 among non-diabetics). Echocardiography revealed a decrease in ejection fraction and increased ischemic ECG changes in diabetic patients.

Conclusion: Diabetics are significantly more and more susceptible to cardiac complications as compared to non-diabetics. Coronary artery disease, heart failure, and ischemic changes are some of the conditions that are highly risked by diabetes because of the prolonged metabolic and vascular changes. The cardiovascular morbidity and mortality that are linked to diabetes should be lowered through early diagnosis, proper glycemic regulation, and vigorous management of cardiovascular risk factors.

Keywords: Diabetes mellitus, cardiac, coronary artery disease, heart failure, glycemic control, cross-sectional study.

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INTRODUCTION

Cardiovascular disease (CVD) is a contributor of high morbidity and mortality globally and it is much more prevalent among diabetic mellitus (DM) patients. Diabetes refers to a chronic metabolic condition, whereby there is chronic hyperglycemia, a condition where there is a defect in the secretion of insulin or its action, or both[1,2]. Persistent hyperglycemia is a factor in the development of endothelial dysfunction, inflammation, and rapid atherosclerosis, which are key pathophysiological events that are contributing factors to cardiac complications. These are coronary artery disease (CAD), heart failure, arrhythmias and myocardial infarction[3,4].

The problem of diabetes in Pakistan and other developing nations has been progressively increasing, and as a result, the diabetic cardiovascular problems have also

increased. Research has shown that diabetic patients have two to four times increased risk of cardiovascular events than non-diabetic ones[5,6]. In addition, cardiac disease and diabetics have an atypical or silent manifestation owing to autonomic neuropathy, which leads to diagnosis at a later stage and worse prognosis. Conversely, non-diabetic population can also acquire cardiac disease mainly because of the traditional risk factors namely hypertension, dyslipidemia, smoking, obesity and sedentary lifestyle. Nevertheless, in the presence of diabetes in combination with these factors, the total risk is increased significantly[7].

The comparative analysis of cardiac complications between diabetic and non-diabetic patients is thus needed to have a clearer picture of the extent of risk, clinical manifestation and prevention measures that should be undertaken to manage it specifically[8]. This cross-sectional clinical research is conducted to determine and compare the frequency, pattern and severity of the cardiac complication among diabetic and non-diabetic patients aged 35 to 65 years. The results will assist in identifying the need to emphasize on early screening, glycemic, and cardiovascular risks reduction measures in order to enhance patient outcomes[9,10].

MATERIALS AND METHODS

The study was a cross-sectional comparative clinical study, carried out in the cardiology and internal medicine departments of tertiary care hospitals in Punjab, Pakistan, between January 2024 and September 2025. A total of 100 patients aged 35 to 65 years were categorized into two groups and were used to conduct the study. Group A included 50 patients who had Type 2 Diabetes Mellitus and Group B included 50 non-diabetic patients who never had diabetes before. This was done to compare the trend and occurrence of cardiac complications in diabetic patients and non-diabetic patients.

Purposive sampling was used to select all the participants against inclusion and exclusion criteria. The study excluded patients who had chronic kidney disease, thyroid, autoimmune diseases, congenital or rheumatic heart disease, and those who were on long-term steroid or chemotherapeutic therapy. Women who were pregnant were not also excluded. Patients who attended with cardiac symptoms including chest pain, dyspnea or palpitations, both male and female, were included after a written informed consent had been obtained. The study was initiated after obtaining the ethical approval of the Institutional Review board of the University of Lahore and absolute confidentiality was ensured in the process of the research.

Following the enrollment, a comprehensive clinical history was taken on the individual participants, which included the demographic information, the illness history of diabetes (in Group A) and medications, the hypertension presence, dyslipidemia, smoking status, and other comorbidities. All the patients were subjected to physical examination, which included blood pressure assessment, pulse rate, body mass index (BMI), and waist circumference. Biochemical analysis was done on the blood samples collected under aseptic conditions. The laboratory tests involved fasting blood glucose (FBG), diabetic patients, and glycosylated hemoglobin (HbA1c), lipid profile, renal function, and cardiac biomarkers (troponin I or T).

All the participants were subjected to electrocardiography (ECG) to identify any ischemic changes, arrhythmias, or conduction abnormalities. Left ventricular function, abnormal wall motions, valvular integrity, and ejection fraction were assessed with the help of an echocardiography. Additional tests like chest radiography or cardiac enzyme tests were conducted in the few cases where diagnosis and severity had to be determined. According to the clinical presentation, ECG evidence, echocardiographic measurements, and biochemical levels, cardiac complications were classified as coronary artery disease (CAD), heart failure, arrhythmias, or myocardial infarction.

All the data obtained were typed and analyzed through SPSS version 26. The quantitative variables (age, BMI, and biochemical parameters) were provided in the form of the mean ± standard deviation, and the qualitative variables (gender distribution and the types of cardiac complications) were given as frequencies and percentages. The Chi-square test and Student t -test were used to compare diabetic and non-diabetic groups in terms of categorical and continuous variable respectively. A p-value of below 0.05 was taken to be significant.

RESULTS

A total of 100 patients between 35 and 65 years of age were included in this study, with 50 diabetic and 50 non-diabetic participants. The demographic and clinical parameters were compared between the two groups to assess the prevalence and pattern of cardiac complications. Table 1 indicates that diabetic patients recorded a greater mean BMI, higher incidence of hypertension, and dyslipidemia in comparison to non-diabetic counterparts and the differences were statistically significant. The mean age and gender distribution between the two groups were similar.

The following table provides the demographic and the baseline clinical profile of the 100 study participants, 50 in each of the diabetic and the non-diabetic groups. Mean age of diabetic patients was slightly greater (54.6 6.2 years) than non-diabetic patients (51.8 7.1 years) but it was not statistically significant (p = 0.08). The gender forces were also similar, and there was a slight male overrepresentation in both groups (30 males and 20 females in the diabetics; 28 males and 22 females in the non-diabetics). Body mass index (BMI) was substantially higher in diabetic patients (28.7 3.5 kg/m 2) than non-diabetics (26.1 3.2 kg/m 2) and overweight and obesity

were more prevalent in diabetic patients (p = 0.03). Such factors as hypertension and dyslipidemia were also more common in the diabetic (64% and 70% respectively) than in the non-diabetic group (36% and 44% respectively), which indicates the pattern of metabolic syndrome that is typical of diabetes. Family history of cardiovascular disease and smoking were more common among diabetics however not statistically significant. Comprehensively, the baseline characteristics indicate that diabetics had a greater risk factor burden of cardiovascular factors as opposed to non-diabetic counterparts.

This table provides the biochemical profile of both study groups making it clear that there is a difference in the metabolism of diabetic and non-diabetic patients. As anticipated, the diabetic group (162.4 + 40.8 mg /dL, 8.1 + 1.4%) exhibited significantly superior fasting blood glucose and HbA1c values than the non-diabetic group (94.6 + 10.2mg/dL, 5.2 + 0.5%), p- values, respectively, being below 0.001 and indicating poor glycemic control among diabetics. On the same note, the lipid profile disclosed significant changes in diabetics with the increase in total cholesterol (215.6 ± 38.2 mg/dL vs. 186.3 ± 34.5 mg/dL) and LDL cholesterol (132.4 ± 28.9 mg/dL vs. 108.7 ± 22.5 mg/dL) in addition to high triglycerides (188.7 ± 52.4 mg/dL vs on the other hand, the diabetics had much lower HDL cholesterol levels: the good cholesterol (38.6 ± 6.3 mg/dL) compared to the normal (45.4 ± 5.8 mg/dL). These disparities reveal the dyslipidemia profile associated with the diabetic patients which put them at risk of accelerated atherosclerosis and resultant cardiac problems. Altogether, Table 2 highlights the biochemical imbalance and lack of metabolic control characteristic of diabetic patients that are strongly correlated with the increased risk of cardiovascular and disease progression.

The following table presents a comparative description of the prevalence of the given cardiac complications that are exhibited by both groups. The results showed a significantly greater overall prevalence rate of cardiac complications in diabetic patients (94 percent) over non-diabetic patients (48 percent) and the difference was significant (p < 0.001). The most frequent complication in the two groups was coronary artery disease (CAD) which was much higher in the diabetics (44) compared to the non-diabetics (24) and the p-value was 0.04. Diabetic patients were found to have heart failure in 20 percent of the patients versus 8 percent of non-diabetics and this was a trend to significance (p = 0.09). Arrhythmias were also a little bit more prevalent in diabetics (16) compared to non-diabetics (10) although this was not statistically significant. Fatal myocardial infarction was noted in 14per cent of diabetics as compared to 6per cent of non-diabetics. The findings illustratively show that diabetic patients had more serious and frequent cardiac complications. The prevalence of coronary artery disease and heart failure in diabetics has highlighted the adverse impact of prolonged hyperglycemia on the vascular and myocardial architecture, which results in ischemic and functional cardiac dysfunction.

This table recaps the data of echocardiography and electrocardiography that further demonstrates the effect of diabetes on cardiac structure and functions. 30 percent of diabetic patients and 16 percent of non-diabetics were observed to have left ventricular hypertrophy (LVH) an indicator of chronic pressure overload and cardiac remodeling. Even though it is not significant (p = 0.12), the direction shows that more cardiac structural changes are observed in diabetics. The systolic function measure was the mean left ventricular ejection fraction (LVEF), the systolic dysfunction of diabetic patients was mild to moderate (49.8 ± 6.4 vs. 54.2 ± 5.1), which was significantly lower in diabetic patients (p = 0.03). ST-T changes of ECG -indicating myocardial ischemia- were much more common in diabetics (36% vs. 18% in non-diabetics) with p = 0.04.

Table 1: Demographic and Baseline Characteristics of Study Participants (n = 100)

Variable	Diabetic Patients (n = 50)	Non-Diabetic Patients (n = 50)	p-value
Age (years), Mean ± SD	54.6 ± 6.2	51.8 ± 7.1	0.08
Gender (Male/Female)	30 / 20	28 / 22	0.72
BMI (kg/m²), Mean ± SD	28.7 ± 3.5	26.1 ± 3.2	0.03*
Hypertension (%)	32 (64%)	18 (36%)	0.01*
Dyslipidemia (%)	35 (70%)	22 (44%)	0.02*
Smoking (%)	14 (28%)	11 (22%)	0.49
Family History of CVD (%)	18 (36%)	12 (24%)	0.18

*Significant at p < 0.05

Table 2: Comparison of Biochemical Parameters Between Diabetic and Non-Diabetic Groups

Parameter	Diabetic Group (Mean ± SD)	Non-Diabetic Group (Mean ± SD)	p-value
Fasting Blood Glucose (mg/dL)	162.4 ± 40.8	94.6 ± 10.2	<0.001*
HbA1c (%)	8.1 ± 1.4	5.2 ± 0.5	<0.001*
Total Cholesterol (mg/dL)	215.6 ± 38.2	186.3 ± 34.5	0.02*
LDL Cholesterol (mg/dL)	132.4 ± 28.9	108.7 ± 22.5	0.03*
HDL Cholesterol (mg/dL)	38.6 ± 6.3	45.4 ± 5.8	0.01*
Triglycerides (mg/dL)	188.7 ± 52.4	142.3 ± 45.6	0.02*

*Significant at p < 0.05

Table 3: Distribution of Cardiac Complications Among Diabetic and Non-Diabetic Patients

Type of Cardiac Complication	Diabetic Patients (n = 50)	Non-Diabetic Patients (n = 50)	p-value
Coronary Artery Disease (CAD)	22 (44%)	12 (24%)	0.04*
Heart Failure	10 (20%)	4 (8%)	0.09
Arrhythmias	8 (16%)	5 (10%)	0.38
Myocardial Infarction (MI)	7 (14%)	3 (6%)	0.18
Total Cardiac Complications	47 (94%)	24 (48%)	<0.001*

*Significant at $p < 0.05$

Table 4: Echocardiographic and ECG Findings in Study Participants

Parameter	Diabetic Group (n = 50)	Non-Diabetic Group (n = 50)	p-value
Left Ventricular Hypertrophy (%)	15 (30%)	8 (16%)	0.12
Left Ventricular Ejection Fraction (%)	49.8 ± 6.4	54.2 ± 5.1	0.03*
ST-T Wave Changes on ECG (%)	18 (36%)	9 (18%)	0.04*
Diastolic Dysfunction (%)	12 (24%)	5 (10%)	0.08

*Significant at $p < 0.05$

Diastolic dysfunction, which is one of the early manifestations of diabetic cardiomyopathy, occurred in 24 percent of diabetics and 10 percent of non-diabetics ($p = 0.08$). These results prove that diabetic individuals not only undergo biochemical and metabolic changes but also have quantifiable cardiac dysfunction and structural changes that are evident with the help of echocardiography and ECG. The decreased ejection fraction and the ischemic ECG changes are indicators of diabetic cardiomyopathy and ischemic heart disease in their early stages.

The comparative analysis of all tables demonstrates that diabetic patients aged 35 to 65 years are at much higher risk to get cardiac complications in comparison to non-diabetic patients. Diabetics had increased BMI, and lipid profile, fasting glucose and HbA1c, and hypertension. Furthermore, the cardiac complications, including coronary artery disease, heart failure, and an ischemic ECG, were much more common in diabetics. These findings validate the fact that chronic hyperglycemia with related metabolic imbalances hastens cardiovascular injury, making diabetic patients vulnerable to structural and functional heart disease. To decrease the cardiac morbidity and mortality rates in diabetic populations, it is necessary to identify and treat diabetes at an early stage, adhere to glycemic control and thoroughly manage cardiovascular risks.

DISCUSSION

The current cross-sectional research was done with the aim of evaluating comparatively cardiac complications in diabetic and non-diabetic patients aged 35 to 65 years. The results have purely shown that patients with diabetes mellitus show significantly greater cardiovascular complications, biochemical parameters, and cardiac dysfunction as opposed to non-diabetic subjects[11,12]. Such findings are consistent with international and local research on diabetes that highlighted the fact that diabetes is among the greatest risk factors of cardiovascular disease (CVD) that is independent. Diabetes mellitus (and Type 2 in particular) is known to cause atherosclerosis, endothelial dysfunction, and myocardial remodeling in a complex of mutually interacting processes such as chronic hyperglycemia, oxidative stress, lipid abnormalities, and systemic inflammation. The prolonged high readings of blood glucose facilitate glycation of vascular proteins and lipids leading to high level of advanced glycation end products (AGEs) which damage the endothelium of the vascular, and increases the rate of plaque formation. This injury of the vascularity coupled with dyslipidemia and hypertension - which were more prevalent in diabetics in our study - provides a pro-atherogenic environment that results in coronary artery disease, myocardial infarction, and heart failure[13,14].

Coronary artery disease in the current study was the commonest cardiac complication in diabetic patients (44%) as compared to the non- diabetes group (24%). This finding is from the UK Perspective Diabetes Study (UKPDS) and Framingham Heart Study, which both found that diabetic patients are two to four times prone to occurrence of coronary events than their non-diabetic counterparts[15]. Increased prevalence of CAD in our sample of diabetics may also be the context of late diagnosis and ineffective management of the glycemic state as it is proved by the mean HbA1c at 8.1, which is the evidence of the chronic hyperglycemia and inadequate metabolic regulation. Moreover, diabetics (20%) than non-diabetics (8%), had heart failure, which is evidence of diabetic cardiomyopathy, which includes left ventricular hypertrophy, diastolic dysfunction, and impaired systolic performance. Our study Echocardiographic analysis showed that diabetics had much lower mean left ventricular ejection fraction (49.8) than non-diabetics (54.2), which is in accordance with previous reports showing diabetes impaired systolic and diastolic myocardial functions[16,17].

At the mechanistic level, insulin resistance, microvascular ischemia and myocardial fibrosis cause this effect without considering coronary artery disease. These results can be supported by the study conducted by Poirier et al. (2001) who indicated subclinical cardiac dysfunction in asymptomatic diabetic patients[18]. The metabolic derangement of diabetes is also captured in biochemical

parameters that are used in the current study. High total cholesterol, LDL, and triglycerides and low HDL levels of the diabetic group depict the typical picture of diabetic dyslipidemia. This lipidology combined with hyperglycemia increases the progression of the atheromatous plaque and it is the reason why CAD and ischemic ECG changes occurred more frequently in the diabetic cohort. These findings are in line with the finding of the ADVANCE and ACCORD trials, which noted that both glycemia and lipids should be optimally controlled in order to reduce the cardiovascular risk in diabetic patients[19].

The other crucial point of observation was that hypertension was more prevalent among diabetics (64%), than it was in non-diabetics (36%). Hypertension is a synergizing factor that causes endothelial dysfunction, augmentation of arterial rigidity, and augmentation of left ventricular afterload, which raises the likelihood of left ventricular hypertrophy and heart failure[15]. Pakistan and other studies based in the developing world have demonstrated the same trend, demonstrating that diabetes and hypertension co-occurrence increase considerably cardiovascular risks and mortality. These were corroborated by electrocardiographic results that showed ST-T wave anomalies, which could be indicative of myocardial ischemia, were more frequently seen among diabetics (36%), compared to non-diabetics (18%). This is consistent with the effect of silent ischemia, in which myocardial ischemia or infarction can frequently be experienced by diabetics with no typical symptoms a consequence of autonomic neuropathy. This therefore means that such patients often report late in the disease process with severe cardiac damage[18].

All our findings confirm that diabetes has a complex effect on cardiovascular health. Metabolic derangement with vascular inflammation and endothelial dysfunction combined with neuropathy predisposes diabetic patients to structural and functional cardiac abnormalities. These complications must be identified and controlled at early stages to minimize deaths[7]. Cardiac screening of diabetics should be a part of diabetic care protocols through routine screening on the basis of ECG, echocardiography and cardiac biomarkers. In addition, violent control of controllable risk factors that include blood pressure, lipid profile, body weight, and glycemic condition can substantially reduce cardiovascular happenings. These results are of specific interest to the population health of Pakistan, where the rate of diabetes is fast growing because of urbanization, sedentary lifestyles and dietary modifications. Poor access to preventive healthcare and late detection are factors that lead to increased cases of undetected cardiac complications. Thus, at both primary and tertiary care, incorporation of cardiac risk assessment in the protocol of treating diabetes is essential[5,12].

The primary advantage of this research is that it has compared diabetic and non-diabetic groups of the same age group, which shows the direct impact of diabetes on cardiac morbidity. Nevertheless, the research is limited in some ways. Since it is cross-sectional, it is not able to cause any causal relationship between diabetes and cardiac complications. Moreover, a relatively small sample size was used as well as no long-term follow-up[15]. It is suggested that the future researches should be conducted using bigger cohorts and longitudinal designs to prove or refute these results and investigate how the cardiac dysfunction evolves in the diabetic patients over time. To sum, this paper supports the fact that cardiac complications are much more common and serious in diabetic patients compared to non-diabetics. Heart failure, ischemic ECG changes, and coronary artery disease are the most common ones. The findings support the fact that there is an urgent need to screen and prevent diabetic groups with comprehensive cardiovascular screening. Early lifestyle intervention, rigorous glycemic control and early intervention of the risk factors can significantly lower the cardiac disease load and enhance the quality of life of diabetic patients[14].

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