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ORIGINAL ARTICLE

Prevalence, Risk Factors, and Clinical Outcomes of Cardiac Complications in Patients with Type 2 Diabetes Mellitus. A Clinic-Based Observational Study

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ABSTRACT

Background: The risk of cardiovascular complications is significantly increased in Type 2 Diabetes Mellitus (T2DM) and is still the major cause of morbidity and mortality in the diabetic population. There are limited outpatient-based data in Pakistan to quantify this burden and to identify associated risk factors in a routine clinical setting. The study was to find out the prevalence, risk factors, and clinical outcomes of cardiac complications in T2DM patients attending tertiary care hospitals.

Methods: It was a cross-sectional observational study done at Mayo Hospital Lahore and Abwa Medical College Faisalabad from May 2022 to May 2023. A total of n=120 patients 35 years and older with confirmed T2DM were recruited. Lab tests, clinical histories, and cardiovascular assessments, including electrocardiography and echocardiography, were done. Cardiac complications considered were: ischemic heart disease, left ventricular hypertrophy, congestive heart failure, and diabetic cardiomyopathy. SPSS v26.0 was used to analyze the data with statistical significance at $p < 0.05$.

Results: In 64 patients (53.3%), cardiac complications were found. The most common was LVH (23.3%), followed by IHD (20.8%), CHF (7.5%), and diabetic cardiomyopathy (1.7%). Duration of diabetes >10 years ($p = 0.003$), hypertension ($p = 0.001$), poor glycemic control (HbA1c >8%) ($p = 0.004$), and dyslipidemia ($p = 0.009$) were associated with significance. During the study period, two patients (1.7%) died of cardiac events.

Conclusion: T2DM patients are commonly affected by cardiac complications. Cardiovascular screening is recommended as routine in those with poor metabolic control and comorbidities to prevent adverse outcomes. Outpatient care of the diabetic should prioritize integrated cardiac assessment.

Keywords: Type 2 Diabetes Mellitus, cardiac complications, hypertension, glycemic control, Pakistan.

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is becoming a major global public health problem, with more than 537 million adults in the world, and the projection rises to 783 million by 2045. It is particularly cause for worry because the disease is becoming increasingly prevalent, and because of its chronic complications, especially those affecting the cardiovascular system[1]. Cardiovascular diseases (CVDs) are the main cause of morbidity and mortality in diabetic patients and represent more than 70% of the deaths in them. T2DM and cardiac dysfunction have a complex and multifactorial pathophysiological interplay, which includes chronic hyperglycemia, insulin resistance, oxidative stress, endothelial dysfunction, inflammation, dyslipidemia, and advanced glycation end products, all of which contribute to both macrovascular and microvascular damage[2].

T2DM is considered an equivalent of coronary artery disease (CAD) in clinical practice, and diabetes is regarded as a condition of high risk for cardiovascular events, including ischemic heart disease (IHD), congestive heart failure (CHF), cardiomyopathy, and arrhythmias. Diabetic cardiomyopathy, a distinct myocardial disease that does not involve hypertension or coronary artery disease, has emerged as an important factor in the development of heart failure in diabetic patients[3]. A burden to the cardiovascular system is generally compounded by other modifiable risk factors such as hypertension, dyslipidemia, obesity, and smoking that are commonly present in the diabetic patient. In addition, long-term poor glycemic control results in subclinical cardiac abnormalities that are usually undetected until late stages[4].

In Pakistan, the problem is much more serious in developing countries where resources of health resources are limited and noncommunicable diseases are increasing rapidly. National surveys from the past several years show these recent prevalence rates for diabetes of more than 17% in adults, many of whom remain undiagnosed or inadequately managed[5]. In addition, cardiology screening in diabetic care is, for the most part, carried out on an ad hoc basis, and therefore, the risk of late presentation of cardiac complications is further exacerbated by the fact that it is not done on a routine basis. Such complications could be identified early, and the associated risk factors could help anticipate timely interventions to prevent irreversible cardiovascular damage[6].

Although the association of T2DM with cardiovascular disease is well established, there is little local data regarding the prevalence of different cardiac complications in diabetic patients and specific risk factors and clinical outcomes for different cardiac complications[7]. The literature available is either hospital-based or fails to capture the range of cardiac dysfunction in the outpatient diabetic population. The knowledge gap revealed by this highlights that a comprehensive clinic-based study to investigate the incidence of cardiovascular complications in T2DM patients, as well as demographic, clinical, and biochemistry predictors of such outcomes, is required[8].

Thus, the present work was aimed to assess the prevalence, risk factors, and clinical outcomes of cardiac complications in Type 2 Diabetes Mellitus patients attending a tertiary care outpatient clinic. The study can help in clinical decision-making, risk stratification, and policy development for the integration of cardiovascular risk assessment into routine diabetic care, especially in resource-constrained settings such as Pakistan[9].

MATERIALS AND METHODS

A cross-sectional observational study was done at 2 major tertiary care hospitals in Punjab, Pakistan, i.e., Mayo Hospital, Lahore, and Abwa Medical College, Faisalabad. The study was undertaken for one year (May 2022 to May 2023) with adult patients having a confirmed diagnosis of Type 2 diabetes Mellitus (T2DM). Both institutions are high-volume outpatient departments with a diversity of clinical presentations and complications associated with diabetes, making them good sites to capture.

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The study protocol was reviewed and approved by the Institutional Review Boards , respectively. The study was strictly performed according to ethical principles outlined in the Declaration of Helsinki. Before the inclusion of all participants, they were informed about the study objectives and provided written consent. With all phases of data collection and analysis, patient privacy and data confidentiality were preserved.

A total of 120 adult outpatients aged 35 years and above with T2DM for at least one year according to the criteria of the American Diabetes Association (ADA) were included in the study. From the diabetic outpatient clinics of both hospitals, patients were recruited by a non-probability consecutive sampling technique. Adult patients with a confirmed history of T2DM were included, and those with Type 1 diabetes, pregnant or lactating women, patients with congenital heart disease, chronic kidney disease (stage 4 or 5), current malignancies, or acute infectious/inflammatory disorders that could influence cardiac evaluation were excluded.

The patients underwent a structured clinical assessment including a complete medical history and physical examination. The clinical data collected included duration of diabetes, presence of comorbidities (hypertension and dyslipidemia), smoking status, physical activity level, and family history of cardiovascular disease. Height and weight were recorded, as well as Body Mass Index (BMI). Seated and rested for at least 5 minutes before the readings, blood pressure was measured twice with a mercury sphygmomanometer. For analysis, the two readings were averaged together.

Glycemic control and cardiovascular risk were assessed in all participants by a panel of laboratory investigations. Fasting blood glucose, glycated hemoglobin (HbA1c), and a complete lipid profile (low density lipoprotein (LDL), high density lipoprotein (HDL), total cholesterol, and triglycerides) were included in these tests. Serum creatinine levels were also performed to exclude significant renal impairment. Hemoglobin A1c>8% was defined as poor glycemic control. LDL >130 mg/dL or HDL <40 mg/dL in men and <50 mg/dL in women was considered dyslipidemia. Patients with a systolic blood pressure of ≥140 mmHg, a diastolic blood pressure of ≥90 mmHg, or who are on antihypertensive therapy were diagnosed as having hypertension.

Each patient was subjected to a standard 12-lead ECG to look for ischemic changes, arrhythmias, or signs of previous infarction to determine the prevalence and type of cardiac complications. Furthermore, transthoracic echocardiography was performed in both centres according to a consistent protocol by a certified cardiologist. In the echocardiographic assessment, the left ventricular hypertrophy (LVH), regional wall motion abnormalities, systolic and diastolic dysfunction, valvular pathology, and overall ejection fraction were sought to be detected. A chest X-ray was done in selected patients, especially in those suspected to have heart failure, to evaluate pulmonary congestion and cardiomegaly. Based on clinical and diagnostic findings, the cardiac complications were categorized as ischemic heart disease (IHD), left ventricular hypertrophy, congestive heart failure (CHF), and diabetic cardiomyopathy.

The aim of the study was to estimate the prevalence of cardiac complications in patients with T2DM. Secondary objectives were to identify risk factors, including poor glycemic control, hypertension, duration of diabetes, dyslipidemia, and smoking, as well as to assess clinical outcomes, including recent hospitalization for cardiac events or cardiovascular-related mortality during the study period.

The entered data were analyzed using SPSS version 26.0. Means with standard deviations or frequencies and percentages were used to report continuous and categorical variables, respectively. The Chi-square test or Fisher's exact test was used to test the association between categorical variables (presence or absence of cardiac complications; risk factors of hypertension or dyslipidemia). The independent samples t-test was used to compare the continuous variables (e.g., age, BMI, HbA1c). All inferential analyses were considered statistically significant if the p-value was less than 0.05.

RESULTS

In the final analysis, 120 patients with confirmed Type 2 Diabetes Mellitus were included. The study population was 56.8 ± 9.3 years old (range 35–78 years). Sixty-six (55%) of the participants were females, while 54 (45%) were males. The mean time of diabetes was 9.4 ± 4.8 years, and 63 (52.5%) had diabetes for more than 10 years. The Body Mass Index (BMI) mean was 27.6 ± 3.9 kg/m², and 71 (59.2%) patients were overweight or obese. Of the 85 patients (70.8%) had poor control on HbA1c > 8%. It was observed that 78 patients (65%) had hypertension, and 69 (57.5%) had dyslipidemia. A history of smoking (current or past) was reported by 38 (31.7%) patients. These baseline demographics and clinical characteristics are summarized in Table 1.

Table 1: Baseline Characteristics of Study Population (n = 120)

Variable	Frequency (%) / Mean ± SD
Age (years)	56.8 ± 9.3
Gender (Male/Female)	54 (45%) / 66 (55%)
Duration of Diabetes (>10 yrs)	63 (52.5%)
BMI (kg/m²)	27.6 ± 3.9
HbA1c > 8%	85 (70.8%)
Hypertension	78 (65%)
Dyslipidemia	69 (57.5%)
Smoking History	38 (31.7%)
Family History of CAD	44 (36.7%)

The prevalence among the study population was 53.3%, and cardiac complications were found in 64 (24.2%). The most commonly observed complications were LVH (left ventricular hypertrophy) in 28 patients (23.3%) and ischemic heart disease (IHD) in 25 patients (20.8%). CHF was found in 9 patients (7.5 %) and diabetic cardiomyopathy without ischemia in 2 patients (1.7%).

Analysis on cross tabulation and statistical analysis revealed that some factors were statistically associated with the presence of cardiac complications. Duration of diabetes more than 10 years ($p = 0.003$), hypertension ($p = 0.001$), poor glycemic control with HbA1c more than 8% ($p = 0.004$), and dyslipidemia ($p = 0.009$) were included. There was a suggestion of a contributory role ($p = 0.06$) with smoking history approaching significance. Table 2 shows these associations.

Table 2: Association of Risk Factors with Cardiac Complications

Risk Factor	With Cardiac Complications (n = 64)	Without Cardiac Complications (n = 56)	p-value
Age > 55 years	42 (65.6%)	28 (50%)	0.08
Duration of Diabetes >10 years	44 (68.8%)	19 (33.9%)	0.003**
HbA1c > 8%	51 (79.7%)	34 (60.7%)	0.004**
Hypertension	52 (81.3%)	26 (46.4%)	0.001**
Dyslipidemia	44 (68.8%)	25 (44.6%)	0.009**
Smoking History	26 (40.6%)	12 (21.4%)	0.06

Note: $p < 0.05$ is considered statistically significant (**).

Also, 14 patients (11.7%) had hospitalization within the past 6 months with cardiac-related illness, all of whom had confirmed cardiac complications. During the study period, two patients (1.7%) died from cardiac events; both had uncontrolled diabetes, long-standing hypertension, and ischemic heart disease. These outcomes emphasize that unrecognized or poorly managed cardiac disease is a serious problem in diabetics.

In summary, this clinic-based study found that more than half of the diabetic patients had structural or functional abnormalities of the heart, and that there were significant associations with classical modifiable risk factors, including prolonged duration of disease, uncontrolled blood glucose, hypertension, and dyslipidemia. These findings highlight the importance of active cardiovascular screening in the diabetic population.

DISCUSSION

This study presents an overview of the burden of cardiac complications among patients with Type 2 Diabetes Mellitus (T2DM) attending outpatient departments of two major tertiary care hospitals of Pakistan, Mayo Hospital Lahore and Abwa Medical College Faisalabad [10]. Notably, cardiac complications were found to be highly prevalent at 53.3% in this population, which further underscores the importance of diabetes and its impact on cardiovascular health in regular clinical practice. Left ventricular hypertrophy (23.3%), ischemic heart disease (20.8%), congestive heart failure (7.5%), and diabetic cardiomyopathy (1.7%) were the most common cardiac complications. This is consistent with global data and points to the cardiovascular system as a major target of chronic diabetic damage[11].

Our cohort was significantly associated with several important risk factors for the development of cardiac complications. Diabetic vasculopathy and myocardial remodeling are known to occur progressively over time, and the duration of diabetes of >10 years was strongly associated with cardiovascular manifestations ($p = 0.003$) [12]. In addition, poor glycemic control, defined as HbA1c > 8%, served as another significant determinant ($p = 0.004$), indicating that even long-standing hyperglycemia contributes to atherosclerosis, endothelial dysfunction, and myocardial stiffness. Previous pathophysiological studies have shown that advanced glycation end products and oxidative stress affect cardiac structure and function in diabetics, and these mechanisms are supported[13, 14].

More than 80% of the patients with cardiac complications had hypertension, and this association was statistically significant ($p = 0.001$). This is clinically relevant because hypertension is known to enhance left ventricular hypertrophy and diastolic dysfunction in diabetic patients [15]. This is consistent with the concept of diabetic dyslipidemia (high triglycerides, low HDL, small dense LDL particles) contributing to plaque formation and coronary artery disease, and does show a significant relationship ($p = 0.009$) with dyslipidemia. While smoking did not reach statistical significance ($p = 0.06$), it cannot be ruled out in patients with multiple coexisting risk factors [16].

These results underscore the propensity of diabetic patients, with especially poor metabolic control and longer disease duration, to develop both structural and functional cardiac abnormalities, even in the setting of outpatient care, for a large number of these subclinical complications[17]. Therefore, to avoid this, it is necessary to incorporate routine cardiovascular screening into diabetic care protocols with ECG and echocardiography, and more particularly for patients with hypertension and dyslipidemia[18].

These are important findings given the situation of Pakistan, where the health system has challenges in managing the dual burden of communicable and noncommunicable diseases. With the lack of standardized screening and limited access to specialized care in peripheral and rural areas, diabetic patients are at a greater risk of delayed diagnosis and poor cardiovascular outcomes. This study identifies the key risk factors and magnitude of cardiac complications in a clinical setting to provide evidence for early, proactive, and targeted intervention strategies[19].

However, some limits must be admitted. The study is a cross-sectional one, so temporal causality between risk factors and cardiac outcomes cannot be taken as proven. The sample size, although adequate for observational inference, limits generalizability to the wider diabetic population[20]. Furthermore, because of logistical and financial constraints, subclinical atherosclerotic burden, cardiac biomarkers, and advanced imaging modalities such as coronary angiography or cardiac MRI were not assessed. This work should be extended to longitudinal designs with larger sample sizes and the use of more advanced diagnostic modalities to validate and expand these findings[21].

CONCLUSION

Patients with Type 2 Diabetes Mellitus have a high prevalence of cardiac complications, involving more than half with some structural or functional cardiac abnormality. The main risk factors are long duration of diabetes, lack of good glycemic control, coexistent hypertension, and dyslipidemia. Furthermore, these studies highlight the importance of integrated cardiovascular risk assessment and management within routine diabetic care. Prevention of adverse cardiac outcomes in this high-risk population requires early detection by echocardiography and ECG, and aggressive control of modifiable risk factors. Significant morbidity and mortality can be avoided through the strengthening of outpatient-based cardiac screening protocols for diabetics in Pakistan.

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