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A cross-sectional study of prevalence of heart failure in diabetic patients in a Tertiary Care Centre of West Bengal

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ABSTRACT

Background: Heart failure (HF) and type 2 diabetes mellitus (DM) are closely related. Diabetic patients have an increased risk of developing HF and those with HF are at higher risk of developing diabetes. **Aims and Objectives:** To estimate the prevalence of type 2 DM in patients with HF. **Materials and Methods:** This analytical observational type of epidemiological study with case control design was conducted from July 2022 to June 2023 at the inpatient department, Department of General Medicine and Endocrinology of RG Kar Medical College, Kolkata, West Bengal, India. Ninety-two study subjects by purposive sampling method were taken as per inclusion and exclusion criteria. Data were collected based on history, clinical examination, relevant investigations, and review of records. **Results:** Study reveals patients who were not under treatment with Dipeptidyl peptidase 4 inhibitors and glucagon-like peptide-1 agonists showed statistically significant occurrence of HF. **Conclusion:** Regarding choice of antidiabetic agents these two molecules may have impact on outcome of patient with type 2 diabetes.

Key words: Prevalence; Heart failure; Diabetes mellitus; Cardiovascular disease; Glycemic control

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INTRODUCTION

Diabetes leading to heart failure (HF) and HF leading to diabetes.[1] Uncontrolled diabetes leads to hyperglycemia and subsequently leads to serious damage to many of the body's systems, especially the nerves and blood vessels.[2]

Diabetes mellitus (DM) is a metabolic disorder with multiple etiology and is one of the leading causes of morbidity and mortality worldwide.[3-5] The prevalence of DM is increasing at an alarming rate and is predicted to occur in approximately 5% of the global population by 2025.[6,7] Data from a 20-year follow- up of the Framingham study showed diabetes were an independent risk factor for the development of HF.[8] Over the past two decades the prevalence of diabetes has sharply increased from 3.5% in the 1990s to >9% in 2012.[9] DM also affects the cardiac muscle, causing both systolic and diastolic HF. The etiology of this excess cardiovascular morbidity and mortality is not completely clear. Evidence suggests that not only hyperglycemia, contributes to myocardial damage after ischemic events but also pre-diabetes and the presence of the metabolic syndrome in normoglycemic patients, increase the risk of most types of cardiovascular disease.[9]

HF is a clinical syndrome caused by functional and structural defects in myocardium resulting in impairment of ventricular filling or the ejection of blood and characterized by symptoms of dyspnea, fatigue, exercise intolerance, and fluid retention. It develops because of

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reduced systolic and/or diastolic cardiac function, and causes are heterogeneous.[10]

HF is growing to a modern epidemic and despite advances in therapy, it still carries a worst prognosis and a significant socioeconomic burden.[11]

The Framingham Heart Study suggests that DM increases the risk of HF up to 2-fold in men and 5-fold in women compared with age-matched controls,[8,12] highlighting a sex discrepancy that is incompletely understood. The increased incidence of HF in diabetic patients persists after adjusting other risk factors such as age, hypertension, dyslipidemia, and coronary artery disease. Thus, the term diabetic cardiomyopathy was initially used to describe ventricular dysfunction in the absence of hypertension and coronary artery disease in diabetic patients.[13]

The relationship between tight glycemic control and cardiovascular endpoints has been addressed by many landmark clinical trials.

The ADVANCE trial (Action in Diabetes and Vascular Disease: PreterAx and DiamicroN Controlled Evaluation) showed that intensive glucose control, which lowered Hemoglobin A1C to 6.5% in type 2 diabetics, showed no evidence of a reduction in macrovascular events with no increase in mortality.[14]

There is a dearth of knowledge over the prevalence of HF among patients with DM among Indian population. This study aims not only to provide the correlation between type II DM and HF but also to provide information regarding the prevalence of HF in patients under treatment with variety of oral hypoglycemic drugs and insulin and finally outcome of those patients.

Aims and objectives

To estimate the prevalence of Type 2 diabetes mellitus in patients with heart failure.

MATERIALS AND METHODS

A descriptive analytical cross-sectional study was conducted among 92 patients by interviewing and doing relevant investigation over a time period of 1 year in the department of medicine and endocrinology from July 2022 to June 2023.The study was pre-approved by the institutional ethical committee.

Inclusion criteria

The inclusion criteria for the study were patients aged above 18 years admitted with complications related to DM.

Exclusion criterion

- Patients who did not give consent
- Those with features of chronic liver disease
- Patients with chronic kidney disease
- Severely anemic patients.

Operational definitions and terms followed in the study

In this study to diagnose diabetes, the following criteria have been used.

Framingham criteria for congestive HF (CHF)[15]

Diagnosis of CHF requires the presence of at least 2 major criteria or 1 major criterion in conjunction with 2 minor criteria.

Major criteria

- Paroxysmal nocturnal dyspnea
- Neck vein distention
- Rales
- Radiographic cardiomegaly (increasing heart size on chest radiography)
- Acute pulmonary edema
- S3 gallop
- Increased central venous pressure (>16 cm H_2O at right atrium)
- Hepatojugular reflux
- Weight loss >4.5 kg in 5 days in response to treatment.

Minor criteria

- Bilateral ankle edema
- Nocturnal cough
- Dyspnea on ordinary exertion
- Hepatomegaly
- Pleural effusion
- Decrease in vital capacity by one third from maximum recorded
- Tachycardia (heart rate>120 beats/min).

Type 2 diabetes ADA diagnostic criteria[16]

- A fasting plasma glucose level of 126 mg/dL (7.0 mmoL/L) or higher, or
- A 2-h plasma glucose level of 200 mg/dL (11.1 mmoL/L) or higher during a 75-g oral glucose tolerance test, or
- A random plasma glucose of 200 mg/dL (11.1 mmoL/L) or higher in a patient with classic symptoms of hyperglycemia or hyperglycemic crisis.

Data analysis

Collected data of 92 study subjects were checked for consistency and completeness. Data were entered into Microsoft Excel data sheet for analysis. Data were analyzed by IBM Statistical Package for Social Sciences version 28.0.1 (2021). Data were organized and presented

applying the principles of descriptive statistics in the form of frequency and percentage and also in tables and diagrams. Diagrams were done by Microsoft Excel software. Chi-square test was applied as test of significance for categorical variables and significance level was set at P<0.05.

RESULTS

There was no statistically significant difference in age groups and gender between cases and controls, which means there was proper age matching between these two groups. Table 1 shows that the proportion of HF was much higher (71.2%) among subjects who were not under treatment with Dipeptidyl peptidase (DPP4) inhibitors. This finding was statistically significant (P<0.05).

Table 2 shows that the proportion of HF was much higher (64.0%) among subjects who were not under treatment with glucagon-like peptide-1 (GLP1) receptor agonists. This finding was statistically significant (P<0.05).

DISCUSSION

This study reveals that the prevalence of HF among diabetic patients was 60.9%. Nichols et al.,[17] in their study observed that, CHF was prevalent in 11.8% of the diabetic patients. There might be following reasons behind such high proportion of HFs in the current study - only patients with severe complications admitted to hospital, most of them had long standing DM, delay in seeking care, poorly controlled diabetes and irregular health check-up.

Table 1: Distribution of the study subjects according to treatment with DPP4 inhibitors and status of heart failure (n=92)

Treatment with DPP4 inhibitors	Heart failure		Total (%)
	Absent (%)	Present (%)	
Absent	19	47	66
	28.8	71.2	100.0
Present	17	9	26
	65.4	34.6	100.0
Total	36 (39.1)	56 (60.9)	92 (100)

Statistical test: Chi-square value=10.488, df=1, P=0.001, DPP: Dipeptidyl peptidase4

Table 2: Distribution of the study subjects according to treatment with GLP1 receptor agonist and status of heart failure (n=92)

Treatment with GLP1 receptor agonists	Heart failure		Total (%)
	Absent (%)	Present (%)	
Absent	31	55	86
	36.0	64.0	100.0%
Present	5	1	6
	83.3	16.7	100.0
Total	36 (39.1)	56 (60.9)	92 (100)

Statistical test: Chi-square value=5.265, df=1, P=0.022

Reduced ejection fraction was observed among 12% of study subjects and 37% had mid-range of ejection fraction with a majority with preserved ejection fraction (51.1%). 8.9% of study subjects belonged to NYHA class IV, and 73.2% of subjects were in NYHA class II. In this study, 17.4% of study subjects developed ST/T changes in anterior leads, 15.2% of subjects developed left axis deviation/left ventricular hypertrophy, and 20.7% of subjects developed ST/T changes in anterolateral and inferior leads.

Most of the study participants belong to the age group between 40 and 60 years (46.7%), followed by age group above 60 years (34.8%). Proportion of male subjects was higher (58.7%) in the present study. Most of the study subjects were prehypertensive (39.1%), followed by 29.3% hypertensive subjects and rest 31.5% were normotensive. Dyspnea on exertion was present among 67.4% study subjects, paroxysmal nocturnal dyspnea was present among 37% study subjects and nocturnal cough was present among 60.9% study subjects. Tachycardia was found among 25% study subjects and ankle oedema was noticed among 45.7% study subjects. Engorged neck veins were present among 23.9% study subjects and hepatojugular reflux was seen among 29.3% study subjects.

Rales were present among 39.1% of study subjects, and S3 gallop was heard among 18.5% of study subjects. Hepatomegaly was present among 38% of study subjects, and cardiomegaly was seen among 38% of study subjects. Pleural effusion was seen among 14.1% of study subjects, and acute pulmonary edema was noticed among 14.1% of study subjects. Serum creatinine level was elevated among 64.1% study subjects.

For treatment of diabetes majority (83.7%) study subjects were under treatment with metformin, 39.1% study subjects under treatment with insulin. 71.7% study subjects had undergone treatment with DPP4 inhibitors, 27.2% study subjects were under treatment with sodium-glucose linked transporter 2 (SGLT2) inhibitor, 19.6% study subjects were under treatment with thiazolidinediones. 52.2% study subjects were under treatment with sulphonylurea and only 6.5% study subjects were under treatment with GLP1 receptor agonist. There was statistically insignificant higher proportion of HF among subjects <40 years of age (70.6%), among female subjects (68.4%). Furthermore, a statistically significant increased proportion of HF was observed among subjects who were not under treatment with DPP4 inhibitors (71.2%) and GLP1 receptor agonists

(64%) but under treatment of insulin (83.3%). Recently concluded LEADER trial revealed both cardiovascular mortality and all cause death reduction in patients treated with GLP1 receptor agonist. Sodium and water retention due to insulin, as well as hypoglycemia induced adrenergic activation, hypokalemia, and arrhythmia precipitate HF. Recent evidence suggests that insulin can inhibit cardiac contractility by inducing Gi-biased beta2 adrenergic signaling in heart. But statistically insignificant increased proportion of HF was noted among subjects who were not under treatment with thiazolidinediones (66.7%), sulphonylureas (70.5%), SGLT2 inhibitor (64.2%). In addition, there was statistically significant higher proportion of HF among subjects with stage II hypertension, mid-range to reduced ejection fraction, and subjects with cardiomegaly and having ascites and pleural effusion but having normal creatinine level. HF with mid-range ejection fraction is hypothesised to be subset of HF with preserved ejection fraction that acquires coronary arterial disease and transitioning to HF with reduced ejection fraction. Statistically significant higher proportion of death was noted among subjects who developed HF (17.9%) than the other group (only 2.8%).

Limitations of the study

This study was cross-sectional based on a single hospital, large-scale multicenter study needs to be done in this area to ascertain the findings, though it is observed in several regions of the globe.

CONCLUSION

Reduction of complications of diabetes patients can be done by early detection of diabetes among these patients, timely and appropriate management of HF, and preventing further progression toward complications. Early detection and treatment of diabetes should be done for favorable outcome.

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Authors' Contribution:
PC- Concept and design of the study, manuscript preparation, data collection, statistically analyzed and interpreted; **IM**- Concept and design of the study, critical revision of the manuscript; **PKK**- Manuscript preparation, statistically analyzed and interpreted; **AR**- Concept and design of the study, manuscript preparation, statistically analyzed and interpreted, critical revision of the manuscript.

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