Journal of Cardiovascular Disease Research

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 6, 2024

Original Research Article

COMPARATIVE CLINICAL STUDY OF PATIENTS OF HEART FAILURE IN TYPE 2 DAIBATES MELLITUS VERSES HEART FAILURE IN NON DIABETIC PATIENTS

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Abstract

Introduction: Type 2 diabetes mellitus (T2DM) significantly increases the risk of cardiovascular events and heart failure (HF). T2DM patients face higher HF incidence and worse prognosis due to direct and indirect factors such as atherosclerosis, hypertension, and dyslipidemia. This relationship is compounded by conditions like inflammation and kidney dysfunction, necessitating comprehensive cardiovascular risk management in diabetic individuals.

Aims and Objective: To compare the clinical parameters of heart failure in diabetic and non-diabetic patients.

Method: This retrospective observational study at Smt. Kashibai Navale Hospital in Pune included 150 heart failure patients, divided into diabetic and non-diabetic groups. Conducted from May 2022 to April 2024, it analyzed demographics, clinical variables, and cardiac function. Significant differences in ECHO parameters and NYHA classifications highlighted diabetes's impact on heart failure. Data were statistically analyzed using SPSS 27 software.

Results: The study reveals no significant baseline differences between males and females across both groups, with p-values between 0.069 and 0.0812. Diabetic individuals had higher systolic ($p = 0.065$) and diastolic blood pressure ($p = 0.085$), mean FBG ($p = 0.0879$), and glycated hemoglobin ($p = 0.033$). ECHO parameters indicated significant differences in the E/e' Ratio ($p = 0.0398$) and RV FAC ($p = 0.033$). The NYHA Classification showed significant differences in Class I ($p = 0.049$), III ($p = 0.043$), and IV ($p = 0.0498$), indicating more severe heart failure among diabetic patients.

Conclusion: The study has concluded that the diabetic patients exhibit significantly poorer cardiovascular health and more severe heart failure symptoms compared to their non-diabetic

Keywords: heart failure, diabetes, non-diabetes, NYHA classification.

INTRODUCTION

Diabetes mellitus (DM) is a firmly proven factor that increases the risk of various cardiovascular (CV) events, such as problems affecting both large and small blood vessels and is also linked to other risk factors like dyslipidemia, hypertension, and obesity [1]. The current progress in diabetic therapy underscores the necessity for a deeper understanding of the complex relationship between Heart Failure (HF) and type 2 diabetes (T2DM). Individuals with T2DM experience a greater occurrence of HF and a more unfavorable prognosis compared to individuals without diabetes. T2DM is linked to the development of

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 6, 2024

HF both directly and indirectly, due to the presence of associated cardiovascular risk factors and illnesses [1,2].
T2DM itself can hasten the development of coronary and systemic atherosclerosis, changes in blood vessels, malfunction of the autonomic nervous system, and the accumulation of collagen in the extracellular matrix. This association may complicate the risk assessment, and it is uncertain to what extent the unfavorable result is linked to the elevated risk load or directly related to glycemic dysfunction[3]. Additionally, T2DM is linked to a lipid profile that promotes the development of atherosclerosis, high blood pressure, chronic low-level inflammation, kidney dysfunction, and the accumulation of AGEs stand for advanced glycation end products. Every single one of these factors contribute to an increased risk of cardiovascular disease (CV) [3, 4].

Diabetes is linked to several forms of heart failure. The prevalence up to 40–60% in individuals with left ventricular diastolic dysfunction with the exception of coronary artery disease. Around 40 percent of those who have been given a preserved ejection fraction heart failure (HFpEF) also have diabetes, indicating a strong connection between diabetes and the underlying mechanisms of HFpEF[5, 6]].

Over the last two decades, there was a steady rise in the prevalence of type 2 diabetes in patients with HF, specifically in individuals aged 70 years or older, with the prevalence rising from 12% to 22%. A recent An observational research revealed that HF affected 12% of diabetes individuals who were hospitalized to the hospital. Additionally, it was shown that diabetic patients Has an annual elevated risk of without HF 3.3% for getting the disease [7, 10].

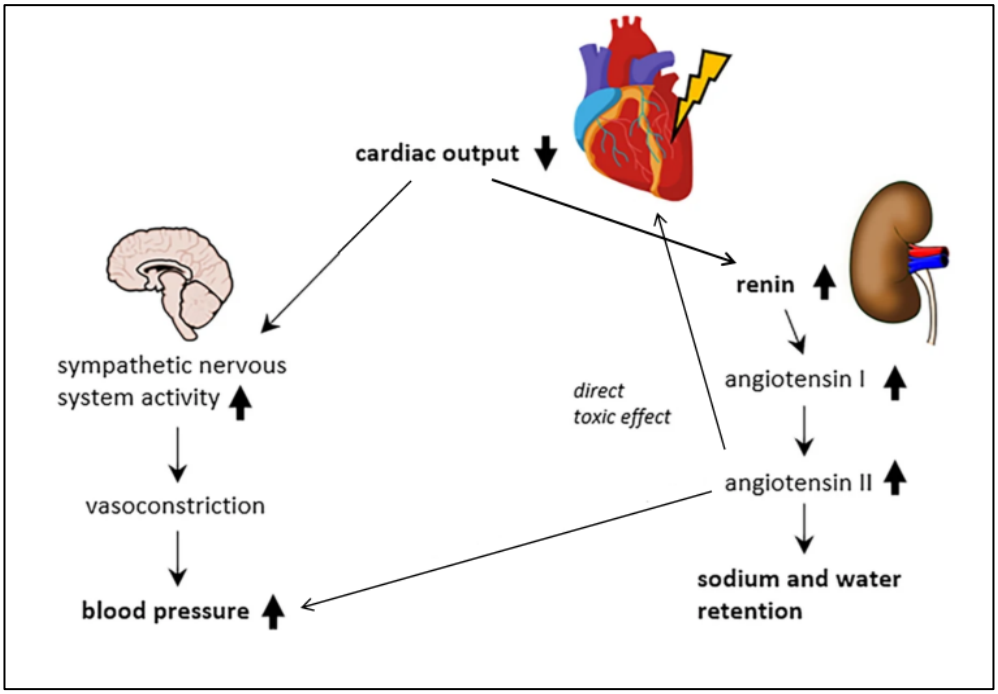

Figure 1: The pathophysiology of heart failure linkage to diabetes

The higher occurrence of T2DM insulin resistance is mostly to blame for heart failure (HF) patients' conditions, regardless of fasting glucose levels is not abnormally high. The

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increased likelihood of developing T2DM with a recent onset in those suffering heart failure (HF) may also be attributed to the excessive functioning of the RAAS (renin-angiotensin-aldosterone). increased angiotensin II levels (AT2) may specifically contribute to the constriction of blood vessels in skeletal muscles, leading to a decrease in the transport of glucose and a decrease in insulin sensitivity[8]. In addition Reduced activity in the natriuretic peptides (NPs) system may also be linked to an altered glucose metabolism in addition to the hyperactivity of the sympathetic nervous system or the renin-angiotensin-aldosterone system (RAAS). By promoting the excretion of sodium and potassium, natriuretic peptides (NPs) counteract the effects of the sympathetic nervous system (SNA) and the renin-angiotensin-aldosterone system (RAAS) water, exerting an inhibitory influence on fibrosis in the heart, inducing the widening of blood vessels, and suppressing the RAAS [9, 10]. Figure 1 shows the detailed flowchart of the pathophysiology.

Method

Study Design

This is a retrospective observational study involving patients with heart failure as confirmed by ECHO characteristics and NYHA classification. The patients were then divided into 2 groups, namely, Diabetic group and Non-diabetic group. Patients with confirmed type 2 diabetes were considered in Diabetic group while those without diabetes, were considered in Non-diabetic group. The study was conducted at Smt. Kashibai Navale Hospital in Pune. The data was obtained from May 2022 to April 2024, which allowed comprehensive data gathering over two years to ensure robust and reliable findings.The study collected demographic, clinical, and diagnostic variables among diabetic and non-diabetic patient groups and compared these characteristics and health outcomes. This looks like an observational kind of study designed to be cross-sectional or cohort to find differences in cardiac function and health status between two groups—diabetic and non-diabetic.

Data collected included demographic and baseline characteristics, age, sex distribution, systolic blood pressure, diastolic blood pressure, mean fasting blood glucose levels, HbA1c percentage, and serum potassium levels. The mean age in the diabetic group was 49.15 years, and in the non-diabetic it was 51.25 years. There was an identical sex distribution in both groups, likewise with the baseline characteristics. Well-picked systolic and diastolic blood pressure readings, along with mean FBG levels, were good indicators of the patient's cardiovascular and metabolic health. The diabetic group showed significantly high glycated hemoglobin percentages in the blood, representing chronic hyperglycemia. Likewise, blood serum potassium levels were taken to observe the electrolyte balance within the groups. Different measures of cardiac function were taken as part of the ECHO parameters.

These were the Left Ventricular Ejection Fraction (LVEF), distinguishing whether it was heart failure with reduced ejection fraction (HFrEF) or heart failure with preserved ejection fraction (HFpEF). The study also measured the Left Ventricular End-Diastolic Diameter (LVEDD), diastolic function by both E/A and E/e' ratios, proper ventricular function via Right Ventricular Fractional Area Change (FAC), pulmonary artery function via Pulmonary Artery Systolic Pressure (PASP), and the severity of mitral regurgitation. The study also evaluated the functional status by determining the classification in the New York

ISSN: 0975-3583, 0976-2833 VOL 15, ISSUE 6, 2024

Heart Association (NYHA) functional classes. The classification represents the severity of clinical symptoms in patients. The differences in distribution across NYHA classes between diabetic and non-diabetic groups were statistically significant.
The objective was to compare the clinical characteristics and outcomes of heart failure in patients with Type 2 Diabetes Mellitus (T2DM) versus those without diabetes.

Sample Size

The study included a total of 150 patients, divided into two groups: those with Type 2 Diabetes Mellitus (diabetic group) and those without diabetes (non-diabetic group). Each group was carefully selected to ensure a representative sample of the hospital's heart failure patient population.

Inclusion Criteria

Patients were eligible for inclusion in the study if they met the following criteria:

- Age between 18 and 89 years: Ensuring an adult population while avoiding pediatric and very elderly patients who may have different heart failure characteristics.
- Diagnosed with heart failure, confirmed by at least one of the following:
  - 24-hour echocardiogram (ECHO): Providing detailed imaging of heart function and structure. Here we have considered the following parameters— left ventricular ejection fraction , left ventricular end diastolic diameter, right ventricular function and pulmonary artery function which should be 35mmHg for both diabetic and non-diabetic patients. There are both mild & severe parameters for mitral regurgitation for both type.
  - New York Heart Association (NYHA) classification: Offering a functional assessment of heart failure severity based on symptoms and physical activity limitations by differentiating the patients into 4 respective classes.

Exclusion Criteria

Patients were excluded from the study if they met any of the following criteria:

- Age below 18 years: Excluding pediatric patients to focus on adult heart failure characteristics.
- Diagnosis of Type I Diabetes Mellitus (DM): As Type 1 diabetes has different pathophysiological mechanisms and clinical management compared to Type 2 diabetes, these patients were excluded to maintain homogeneity in the diabetic group.

Here we can observe variation in heart failure patients by comparing the following parameter between diabetic patients and non diabetic patients.

Statistical Analysis

The statistical analysis involved several key steps to ensure a comprehensive evaluation of the data. Descriptive statistics were first used to summarize the baseline characteristics of the diabetic and non-diabetic groups, including mean and standard deviation for continuous variables, and frequencies and percentages for categorical variables. Comparative analysis between the two groups was conducted using the chi-square test for categorical variables and the independent t-test for continuous variables to determine any significant differences.

For outcome analysis, the primary endpoints included measurements from the echocardiograms (ECHO) and the NYHA classification. Logistic regression models were employed to adjust for potential confounders and assess the impact of diabetes status on heart

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failure outcomes. All statistical tests were two-tailed, and a p-value of less than 0.05 was considered statistically significant. Statistical analysis was performed using SPSS 27 software. The level of significance was considered to be P<0.05.

Result

Table 1 shows the average age of the diabetic group is 49.15 ± 10.77 years, compared to 51.25 ± 7.98 years in the non-diabetic group, with a p-value of 0.065 indicating no significant age difference between the groups. The study also found that males and females in both groups have similar baseline characteristics, with p-values ranging from 0.069 to 0.0812, suggesting no statistically significant difference. Systolic blood pressure averages at 155.34 ± 14.66 mmHg for the diabetic group and 142.5 ± 10.66 mmHg for the non-diabetic group (p = 0.065), while diastolic blood pressure is 9.23 ± 11.12 mmHg for diabetics and 95.66 ± 55 mmHg for non-diabetics (p = 0.085). Mean Fasting Blood Glucose (FBG) is markedly higher in the diabetic group (132.45 ± 4) compared to the non-diabetic group (92.65 ± 5), although the p-value of 0.0879 indicates marginal significance. Glycated hemoglobin (HbA1c) is significantly higher in the diabetic group at 7.8 ± 0.4%, compared to 5.2 ± 0.6% in the non-diabetic group (p = 0.033). Serum potassium levels are 4.4 ± 0.33 mEq/L for diabetics and 4.1 ± 0.23 mEq/L for non-diabetics, with a p-value of 0.067.

Table 1: Demographic and baseline characteristics of the patients of each group

Parameters	**Diabetic group (n=75)**	**Non-diabetic group (n=75)**	**P-value**
Age	49.15±10.77	51.25±7.98	0.065
Sex	55.23±12.33	43.12±16.66	0.069
Males	75.77±16.66	65.56±14.55	0.076
Females	40.44±12.65	57.55±13.55	0.0812
Systolic blood pressure, mmHg	155.34±14.66	142.5±10.66	0.065
Diastolic blood presure ,mmHg	9.23±11.12	95.66±55	0.085
Mean FBG	132.45±4	92.65±5	0.0879
Glycohaemoglobin %	7.8±0.4	5.2±0.6	0.033
Serum potassium , mEq/L	4.4±0.33	4.1±0.23	0.067

In Table 2, which outlines the findings of ECHO parameters for diabetic and non-diabetic groups, several key observations emerge, particularly regarding p-values. For Left Ventricular Ejection Fraction (LVEF), the p-values for both Heart Failure with reduced Ejection Fraction (HFrEF) and Heart Failure with preserved Ejection Fraction (HFpEF) are 0.087 and 0.066, respectively, indicating no statistically significant difference between the diabetic and non-diabetic groups in these measures. The Left Ventricular End-Diastolic Diameter (LVEDD) also shows a p-value of 0.078, suggesting a marginal difference between the groups.

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When examining diastolic function, the E/A Ratio yields a p-value of 0.056, nearing significance, while the E/e' Ratio has a p-value of 0.0398, indicating a significant difference, with diabetic patients showing higher ratios. Regarding right ventricular function, the RV Fractional Area Change (FAC) has a p-value of 0.033, showing a significant difference with lower values in the diabetic group. Pulmonary Artery Systolic Pressure (PASP) has a p-value of 0.098, suggesting no significant difference between the groups. In terms of mitral regurgitation, mild cases have a p-value of 0.032 and severe cases have a p-value of 0.041, both indicating significant differences, with diabetic patients having higher incidences of severe mitral regurgitation.

Table 2: Findings of Cardiovascular parameters as found in ECHOfor patients of each group

Parameter	**Diabetic group (n=75)**	**Non-diabetic group (n=75)**	**P-value**
Left Ventricular Ejection Fraction (LVEF)			
HFrEF	45.34%± 4.56%	39.66% ± 5.78%	0.087
HFpEF	55.62±3.67%	54.67±3.77%	0.066
Left Ventricular End-Diastolic Diameter (LVEDD) [mm]	56.67±0.5	55.78±0.3	0.078
Diastolic Function			
E/A Ratio	2.65±0.33	2.09±0.08	0.056
E/e' Ratio	18.77±2.89	13.65±1.2	0.0398
Right Ventricular Function			
RV Fractional Area Change (FAC)	32.87±1.89%	38.65±1.76%	0.033
Pulmonary Artery Function			
Pulmonary Artery Systolic Pressure (PASP) [mmHg]	35.76±1.78	34.78±1.23	0.098
Mitral Regurgitation			
Mild	32 (42.67%)	45 (60%)	0.032
Severe	43 (57.34%)	30 (40%)	0.041

In Table 3, which presents the NYHA Classification for each group, notable differences are observed in the distribution of heart failure classes between diabetic and non-diabetic patients. For Class I, the p-value is 0.049, indicating a significant difference with fewer diabetic patients in this class. Class II has a p-value of 0.0567, which is not statistically significant. Class III shows a p-value of 0.043, indicating a significant difference with a

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higher proportion of diabetic patients. Lastly, Class IV has a p-value of 0.0498, also indicating a significant difference, with this class being present only in the diabetic group.

Table 3: Findings of NYHA Classification for each group

Parameter	Diabetic group (n=75)	Non-diabetic group (n=75)	P-value
Class I	7 (9.33%)	21 (28%)	0.049
Class II	29 (38.67%)	32 (42.67%)	0.0567
Class III	37 (49.33%)	22 (29.33%)	0.043
Class IV	2 (2.67%)	0	0.0498

Discussion

Although diabetes is a separate risk factor of heart failure (HF); nonetheless, not all diabetic people develop HF. Thus, the goal of this research was to investigate the clinical features of DM patients who have HF and those who do not, as well as individuals without DM who have HF and those who do not. The researchers determined that the DM-HF group exhibited significant differences compared to the other groups in terms of age, length of diabetes, HbA1c level, HFpEF, coronary artery disease (CAD), & prevalence of hypertension [10].

An epidemiological review was conducted to describe the link between heart failure (HF) and diabetes type 2 mellitus (T2DM), including probable causative factors. The evidence obtained from observational, experimental, and randomized control studies unequivocally establish the robust correlation between HF and T2DM. Individuals with a T2DM diagnosis have a higher likelihood of developing HF and experiencing HF-related incidents. However, people with heart failure have a higher likelihood of developing new-onset type 2 diabetes mellitus. T2DM in HF and HF in T2DM are connected to a more unfavorable outcome [12].

An article includes a concise summary of the key elements of diagnosis and screening, as well as a review of the current data regarding the treatment of reducing blood sugar with heart failure in diabetics. People who have been diagnosed with diabetes demonstrate a heightened susceptibility to developing heart failure, and the coexistence of these conditions significantly influences the outlook for these individuals. Therefore, it is crucial to identify heart failure in diabetics and to determine whether diabetes is present in any patient with heart failure [13].

A comparative investigation was conducted to examine the risk factor profile, clinical, and angiographic aspects of individuals with coronary artery disease, distinguishing between those with diabetes and those without. Patients with both diabetes and coronary artery disease (CAD) were more prone to experiencing severe and widespread involvement of their coronary arteries. A considerable proportion of individuals with diabetes experienced asymptomatic ischemia, despite having a normal electrocardiogram (ECG) and two-dimensional echocardiogram (2D echo). This highlights the importance of conducting thorough cardiac assessments at an early stage. The combination of hypertension, dyslipidemia, female gender, and uncontrolled and long-standing diabetes led to a more severe type of coronary artery disease (CAD) and resulted in unfavorable treatment outcomes, specifically the need for coronary artery bypass surgery (CABG) [14].

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An examination of information from 58 patients with diabetes and 58 patients without diabetes, all of whom had Diabetic individuals exhibited a much greater incidence of large stenoses within the intermediate portions of the coronary arteries, according to arteriography proof of coronary artery disease. However, there were There were no discernible changes in either the proximal nor distal portions. As a result, the diabetic individuals did indeed have more advanced heart disease. But the group of people with diabetes did not show a higher prevalence of disease in the distal segments, as indicated by the quantity of large or tiny lesions. The individuals with diabetes showed a notably higher occurrence symptoms of left ventricular dysfunction and anomalies in electrocardiographic intraventricular conduction. Diabetic individuals exhibiting myocardial decompensation did not significantly differ in terms of the severity of heart disease from those without such symptoms. This suggests that variables other than the severity of coronary artery disease may be responsible for the increased incidence of myocardial dysfunction among diabetic individuals[15].

Conclusion

The main conclusion between the diabetic and non-diabetic groups is that diabetic patients exhibit significantly poorer cardiovascular health and more severe heart failure symptoms compared to their non-diabetic counterparts. Although both groups are demographically similar in terms of age and sex distribution, diabetics have significantly higher glycated hemoglobin (HbA1c) levels, indicating worse long-term glucose control. Cardiovascular assessments reveal that diabetic patients have significantly impaired diastolic function, as evidenced by higher E/e' Ratios and reduced Right Ventricular Fractional Area Change (FAC).In conclusion, the comparative analysis of diabetic and non-diabetic groups reveals several key insights into their demographic, baseline, cardiovascular, and heart failure characteristics. The average age and sex distribution between the two groups showed no significant difference, underscoring the demographic similarity. Although systolic and diastolic blood pressure readings were higher in the diabetic group, these differences were not statistically significant. Fasting Blood Glucose (FBG) levels were markedly elevated in diabetics, albeit with marginal significance, while glycated hemoglobin (HbA1c) levels were significantly higher in diabetics, confirming poorer long-term glucose control. Serum potassium levels did not differ significantly between the groups.

Echocardiographic (ECHO) parameters highlighted significant cardiovascular distinctions. While Left Ventricular Ejection Fraction (LVEF) in both HFrEF and HFpEF categories and Left Ventricular End-Diastolic Diameter (LVEDD) showed no significant differences, the E/e' Ratio was significantly higher in diabetics, indicating impaired diastolic function. Right Ventricular Fractional Area Change (FAC) and the severity of mitral regurgitation were significantly worse in the diabetic group, reflecting compromised cardiac performance. Although Pulmonary Artery Systolic Pressure (PASP) did not differ significantly, the E/A Ratio approached statistical significance, suggesting subtle diastolic dysfunction in diabetics.

The New York Heart Association (NYHA) classification further delineated disparities in heart failure severity. Diabetic patients were significantly less likely to be in Class I and more likely to be in Classes III and IV, indicating more severe heart failure. Class II differences were not statistically significant, yet the overall trend highlights a greater burden of heart failure among diabetics. These findings collectively underscore the heightened

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cardiovascular risks and complications associated with diabetes, emphasizing the need for vigilant cardiovascular monitoring and management in diabetic patients.

References

1. Morrish JN, Wang S-L, Stevens KL, Fuller HJ, Keen H (2001) Mortality and causes of death in the WHO multinational study of vascular disease in diabetes. Diabetologia 44:S14–S21. 10.1007/pl00002934
2. Garcia MJ, McNamara PM, Gordon T, Kannel WB. Morbidity and mortality in diabetics in the Framingham population. *Sixteen year follow-up study Diabetes.* 1974;23:105–111. doi: 10.2337/diab.23.2.105.
3. Nichols GA, Gullion CM, Koro CE, Ephross SA, Brown JB (2004) The incidence of congestive heart failure in type 2 diabetes: an update. Diabetes Care 27:1879–1884. 10.2337/diacare.27.8.1879
4. McMurray JJ, Gerstein HC, Holman RR, Pfeffer MA. Heart failure: a cardiovascular outcome in diabetes that can no longer be ignored. *Lancet Diabetes Endocrinol.* 2014;2:843–851. doi: 10.1016/S2213-8587(14)70031-2.
5. Fitchett DH, Udell JA, Inzucchi SE (2017) Heart failure outcomes in clinical trials of glucose-lowering agents in patients with diabetes. Eur J Heart Fail 19:43–53. 10.1002/ejhf.633
6. Fitchett D, Butler J, van de Borne P et al (2018) Effects of empagliflozin on risk for cardiovascular death and heart failure hospitalization across the spectrum of heart failure risk in the EMPA-REG Outcome trial. Eur Heart J 39:363–370. 10.1093/eurheartj/ehx511
7. Bertoni AG, Hundley WG, Massing MW, Bonds DE, Burke GL, Goff DC Jr (2004) Heart failure prevalence, incidence, and mortality in the elderly with diabetes. Diabetes Care 27:699–703. 10.2337/diacare.27.3.699
8. Duckworth W, Abraira C, Moritz T et al (2009) Glucose control and vascular complications in veterans with type 2 diabetes. N Engl J Med 360:129–39. 10.1056/NEJMoa0808431
9. Levelt E, Gulsin G, Neubauer S, McCann GP (2018) Mechanisms in endocrinology: Diabetic cardiomyopathy: pathophysiology and potential metabolic interventions state of the art review. Eur J Endocrinol 178:R127-R139. 10.1530/EJE-17-0724
10. Nichols GA, Gullion CM, Koro CE, Ephross SA, Brown JB (2004) The incidence of congestive heart failure in type 2 diabetes: an update. Diabetes Care 27:1879–1884. 10.2337/diacare.27.8.1879
11. Devarajan, A., Karuppiah, K., Venkatasalam, R., Avasarala, S., Subramanian, S., Immaneni, S., & Viswanathan, V. (2021). Heart failure in people with type 2 diabetes vs. those without diabetes: A retrospective observational study from South India. *Diabetes & Metabolic Syndrome*, *15*(1), 39–43. https://doi.org/10.1016/j.dsx.2020.11.022
12. Palazzuoli, A., & Iacoviello, M. (2022). Diabetes leading to heart failure and heart failure leading to diabetes: epidemiological and clinical evidence. *Heart Failure Reviews*. https://doi.org/10.1007/s10741-022-10238-6
13. Schütt, K. (2023). Rethinking the Impact and Management of Diabetes in Heart Failure Patients. *Current Heart Failure Reports*. https://doi.org/10.1007/s11897-023-00633-x
14. Sareddy, P., Pandya, H. B., Sumple, R. S., & Lakhani, J. D. (2021). Diabetic CAD versus non diabetic CAD: a comparative study of clinical features, risk factors and angiographic profile. *International Journal of Advances in Medicine*, *8*(7), 927–933. https://doi.org/10.18203/2349-3933.ijam20212403
15. Wilson, C. S., Gau, G. T., Fulton, R. E., & Davis, G. D. (1983). Coronary artery disease

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in diabetic and nondiabetic patients: A clinical and angiographic comparison. *Clinical Cardiology*, *6*(9), 440–446. https://doi.org/10.1002/clc.4960060905