

Comparative study of clinical profile and biochemical parameters of cardiac failure in type 2 diabetic vs. non-diabetic patients

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Abstract

Background: Diabetes mellitus and heart failure are common comorbidities, and their prevalence has increased significantly. Present study was aimed to compare clinical profile and biochemical parameters of cardiac failure in type 2 diabetic vs. non-diabetic patients at a tertiary hospital. **Material and Methods:** Present study was hospital based, observational, analytical study, conducted in patients of age 18-70 years, either gender, with heart failure clinically selected by using Framingham's criteria, with type 2 diabetes & other group without diabetes. **Results:** In present study, 50 patients from each group were studied. Chronic pressure overload is the second most common cause in both groups, comparatively more patients of chronic pressure overload present in non-diabetic group, difference was statistically significant (p- 0.029). Presence of rales was more in diabetic group (68 %) as compared to non-diabetic group (44 %), difference was statistically significant (p- 0.027). In present study, 37 (74%) patients from diabetic group and 21 (42%) patients from non-diabetic group were obese/over-weight, difference was statistically significant (p- 0.002). Arrhythmia, acute myocardial ischemia, mean triglyceride level, Mean cholesterol level in diabetic group was more as compared to non-diabetic group difference was statistically significant. Mean length of hospital stay in diabetic group (6.42 ± 1.939 days) more than from non-diabetic group (4.96 ± 1.261 days), difference was statistically significant ($p < 0.001$). 8 patients (16%) in diabetic group and 3 patients (6%) in non-diabetic group died & difference was not significant statistically ($p > 0.05$). **Conclusion:** Significantly higher numbers of diabetic heart failure patients were obese/overweight, had dyslipidemia and had deranged renal functions. They had a significantly higher chance of presenting with rales, arrhythmias and acute coronary ischaemia.

Keywords: type 2 diabetes mellites, heart failure, obese/overweight, dyslipidemia

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Introduction

Diabetes mellitus is metabolic cum vascular syndrome of multiple etiology characterized by chronic hyperglycemia with disturbances of carbohydrate, fat, protein metabolism resulting from defect in insulin secretion, insulin action, or both leading to changes in both small blood vessels (microangiopathy) and large blood vessels.^{1,2}

Diabetes mellitus and heart failure are common comorbidities, and their prevalence has increased significantly. Framingham study is the first study to demonstrate risk of congestive heart failure in patients with diabetes mellitus and incidence of heart failure in young diabetic male and female were 4 and 8 folds respectively.¹ The risk for development of heart failure

increases with disease severity of diabetes. 1% increase in base line level of HbA1c increased the risk of developing heart failure by 15%.²

The number of patients with diabetes has been increasing worldwide and these patients are predisposed to serious cardiovascular morbidity and mortality.³ Studies have shown that the risk of heart failure is increased two- to three fold by diabetes.^{4,5} Present study was aimed to compare clinical profile and biochemical parameters of cardiac failure in type 2 diabetic vs. non-diabetic patients at a tertiary hospital.

Material And Methods

Present study was hospital based, observational, analytical study, conducted in Department of Biochemistry, Dr. Shankarrao Chavhan Government Medical College, Vishnupuri, Nanded, India. Study duration was of 2 years (July 2013 to June 2015). Study approval was obtained from institutional ethical committee.

Inclusion criteria

- Patients of age 18-70 years, either gender, IPD (indoor patient department) patients with heart failure clinically selected by using Framingham's criteria, with type 2 diabetes, willing to participate in present study were taken as Diabetic group.
- Patients of age 18-70 years, either gender, IPD (indoor patient department) patients with heart failure clinically selected by using Framingham's criteria, without diabetes, willing to participate in present study were taken as Non-diabetic group.

Exclusion criteria

- In patients in whom written consent can not be obtained & relatives unwilling to give consent
- Heart failure with type 1 and types of DM (diabetes mellitus) other than type 2.

Study was explained to patients in local language & written consent was taken for participation & study. Consecutive type of non-probability sampling was used for selection of study subjects.

All patients underwent demographic data collection, complete history taking, clinical examination. Assessment for Framingham's major criteria (Rale, Paroxysmal nocturnal dyspnea, Raised jugular venous pressure, cardiomegaly, Hepatojugular reflux, significant weight loss) & minor criteria (Edema, Nocturnal cough, Dyspnea on exertion, Pleural effusion, Tachycardia & Hepatomegaly) were done in all patients. Various laboratory & radiological tests such as CBC, Serum electrolytes, serum urea, serum creatinine, Lipid profile (serum triglyceride level, serum cholesterol level), blood sugar levels (random, overnight & fasting), HbA1c, Urine (routine & microscopy). Xray chest (PA view), Ultrasonography abdomen, ECG, 2D Echocardiography (assessment of systolic dysfunction & Diastolic Dysfunction).

Parameters such as prognosis of heart failure, morbidity of patients, effect of diabetic state on heart failure, association of risk factors (hypertension, sedentary life style, Obesity/Overweight, smoking), assessment for presence of precipitating factor (Uncontrolled hypertension, arrhythmia, infection, non-compliant with diet, non-compliant with therapy, acute myocardial ischemia, anemia, dyslipidemia), causes of heart failure, (ischemic heart disease-evidences of coronary artery disease, myocardial infarction, myocardial ischemia) were studied.

All the collected data was entered in Microsoft excel sheet and then transferred to SPSS software ver. 17 for analysis. Appropriate statistical tests (t-tests/chi-square test) were applied based on type & distribution of data. -value < 0.05 was taken as level of significance.

Results

In present study, 50 patients from each group were studied. Mean age of patients from diabetic group was 57.98 ± 7.636 as compared to non-diabetic group was 59.68 ± 7.705 , difference was not significant statistically ($p= 0.271$). Number of males in the two groups was equal. Number of females in the two groups was equal. Number of patients with first time admission–16 diabetic,12 nondiabetic. Number of patients with recurrent admission–34 diabetic,38 nondiabetic, difference was not significant statistically ($p= 0.504$).

Table 1: General characteristics

	Diabetic group	Nondiabetic group	P value
Age groups (in years)			
≤40	1	1	
41–50	9	4	
51-60	19	20	
61-70	20	23	
>70	1	2	
Mean age (mean±SD)	57.98 ± 7.636	59.68 ± 7.705	0.271
Gender			
Male	26	26	
Female	24	24	
Type Of Admission			0.504
First Time Admission	16	12	
Recurrent Admission	34	38	

Ischemic heart disease dominates as a cause in two groups. Chronic pressure overload is the second most common cause in both groups, comparatively more patients of chronic pressure overload present in non–diabetic group, difference was statistically significant ($p= 0.029$).

Table 2: Distribution of Cases According to Causes of Heart Failure in Two Groups

Indicator	Diabetic Group	Nondiabetic Group	P value
IHD	32	24	0.1586
Chronic Pressure Overload	6	16	0.02981*
RVHD	4	3	1
Dilated Cardiomyopathy	3	3	1
Chronic Cor Pulmonale	3	4	1

On assessment for Framingham’s major criteria (Rale, Paroxysmal nocturnal dyspnea, Raised jugular venous pressure, cardiomegaly, Hepatojugular reflux, significant weight loss), presence of rales was more in diabetic group (68 %) as compared to non-diabetic group (44 %), difference was statistically significant ($p= 0.027$). Rest all criteria were comparable in both groups &, difference was not significant statistically ($p > 0.05$).

Table 3: Comparison of Features from Framingham’s Major Criteria

Major Criteria	Diabetic Group	Nondiabetic Group	P value
PND	16	15	1.0
Jugular Venous Pressure	15	16	1.0
Rales	34	22	0.027*
Cardiomegaly	12	16	0.504
Hepatojugular Reflux	4	3	1.0
Weight Loss	6	4	0.739

On assessment for Framingham’s minor criteria (Edema, Nocturnal cough, Dyspnea on

exertion, Pleural effusion, Tachycardia & Hepatomegaly), all criteria were comparable in both groups & difference was not significant statistically ($p > 0.05$).

Table 4: Comparison of Features from Framingham's Minor Criteria

Minor Criteria	Diabetic Group	Nondiabetic Group	P value
Edema	29	27	0.840
Nocturnal Cough	32	28	0.540
Dyspnea On Exertion	37	31	0.285
Pleural Effusion	3	1	0.617
Tachycardia	35	34	1.0
Hepatomegaly	6	6	1.0

In present study, 37 (74%) patients from diabetic group and 21 (42%) patients from non-diabetic group were obese/over-weight, difference was statistically significant ($p = 0.002$). While other risk factors were comparable in both groups & difference was not significant statistically ($p > 0.05$).

Table 5: Comparison of Risk Factors

Risk factors	Diabetic Group	Nondiabetic Group	P value
Obesity/overweight BMI>25	37	21	0.002*
Cigarette smoking	8	10	0.794
Hypertension	16	22	0.303
Sedentary life	31	28	0.684

16 patients (32%) in diabetic group and 6 patients (12%) in non-diabetic group presented with arrhythmia, difference was statistically significant ($p = 0.029$). 15 patients (30%) in diabetic group and 6 patients (12%) in non-diabetic group presented with features of acute myocardial ischemia, difference was statistically significant ($p = 0.049$). While other factors associated with acute decompensation of heart failure such as uncontrolled hypertension, evidences of infection, history of non-compliance to advised diet, history of non-compliance to & anemia were comparable in both groups & , difference was not significant statistically ($p > 0.05$).

Table 6: Comparison of factors associated with acute decompensation of heart failure

Acute Decompensating	Diabetic Group	Nondiabetic Group	Chi Square Df=1/ Fisher Exact Test	P value
Uncontrolled HTN	8	14	1.457	0.227
Arrhythmia	16	6	4.72	0.029*
Infection	19	14	0.724	0.395
Non Compliant With Diet	20	22	0.041	0.839
Non Compliant With Therapy	12	11	0.0	1.0
Acute Myocardial Ischemia	15	6	3.858	0.049*
Anemia	23	19	0.369	0.543

Mean triglyceride level in diabetic group (212.20 ± 44.091) was more as compared to non-diabetic group (193 ± 44.733), difference was statistically significant ($p = 0.033$). Mean cholesterol level in diabetic group (211.80 ± 44.935) was more as compared to non-diabetic group (189 ± 42.197), difference was statistically significant ($p = 0.01$).

Table 7: Comparison of lipid profile

Lipid profile	Diabetic group	Nondiabetic group	Unpaired t	P value	Significance
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Triglyceride Level (mg/dl)	212.20 ± 44.091	193.00 ± 44.733	2.162	0.033	Yes
Cholesterol Level (mg/dl)	211.80 ± 44.935	189.00 ± 42.197	2.165	0.010	Yes

On 2D Echo, affected systolic function such as ejection fraction (<20 %, 20-35 % & 35-45 %) were comparable in both groups & difference was not significant statistically ($p > 0.05$). On 2D Echo, pure Diastolic Dysfunction, was comparable in both groups & difference was not significant statistically ($p > 0.05$). 21 patients (42%) in diabetic group and 9 patients (18%) in non-diabetic group presented with evidences Diastolic Dysfunction along with affected (reduced) ejection fraction, difference was statistically significant ($p = 0.01$). 38 patients (76%) in diabetic group and 23 patients (46%) in non-diabetic group presented with evidence of affected systolic function on 2D Echo, difference was statistically significant ($p = 0.01$).

Table 8: Comparison of 2D Echo Findings

2 D Echo findings	Diabetic Group	Nondiabetic Group	P value
Ef < 20 %	6	3	0.485
Ef 20- 35	13	18	0.387
Ef >35 to 45%	14	15	1.0
Total affected systolic function	33	36	0.665
Pure Diastolic Dysfunction	17	14	0.665
Diastolic Dysfunction with decreased EF	21	9	0.016*
Total affected diastolic function	38	23	0.0041*

Mean length of hospital stay in diabetic group (6.42 ± 1.939 days) more than from non-diabetic group (4.96 ± 1.261 days), difference was statistically significant ($p < 0.001$). 8 patients (16%) in diabetic group and 3 patients (6%) in non-diabetic group died & difference was not significant statistically ($p > 0.05$).

Table 9: Other characteristics

Characteristics	Diabetic Group	Nondiabetic Group	P value
Hospital Stay (days)	6.42 ± 1.939	4.96 ± 1.261	<0.001
Death	8	3	0.201

Mean serum potassium level & mean serum sodium level were comparable in both groups & difference was not significant statistically ($p > 0.05$). Mean serum urea level in diabetic group (55.9 ± 37.724 mg/dl) more than from non-diabetic group (35.14 ± 19.499 mg/dl), difference was statistically significant ($p = 0.001$). Mean serum creatinine level in diabetic group (1.74 ± 1.562 mg/dl) more than from non-diabetic group (1.1 ± 1.298 mg/dl), difference was statistically significant ($p = 0.028$).

Table 10: Laboratory tests

Laboratory tests	Diabetic group	Nondiabetic group	P value
Serum Potassium level {mEq/l}	4.50 ± 0.491	4.48 ± 0.515	0.968
Serum sodium level {mEq/l}	136.36 ± 6.04	136.14 ± 5.15	0.845
Serum Urea Level (mg/dl)	55.9 ± 37.724	35.14 ± 19.499	0.001
Serum Creatinine Levels (mg/dl)	1.74 ± 1.562	1.10 ± 1.298	0.028

Discussion

Heart failure in type 2 diabetes and heart failure in non-diabetics cannot be differentiated clinically depending on signs and symptoms. Signs and symptoms in Framingham's major and minor criteria are seen comparably in both the groups. There was no significant difference in prevalence of PND, nocturnal cough, dyspnea on exertion, raised JVP, hepatojugular reflux, response to diuretics, edema, cardiomegaly, pleural effusion, tachycardia, or hepatomegaly and in serum electrolytes in diabetic versus non diabetic heart failure patients. Only the sign rate was seen significantly higher in diabetic group of patients. Also the comorbidities like chronic renal insufficiency usually complicate inpatients from diabetic group making them more susceptible for extreme exercise intolerance. And pulmonary edema gets precipitated in these patients, producing rales.

58.9% patients with edema & 77.1 % patients with dyspnea on exertion were seen in registration of IMPACTHF trial.⁶ 55% patient with nocturnal cough were seen in registration of Symptom Presentation Acute Heart Failure.⁷ In two different studies by Kannel WB et al.,⁸ and Chae CU et al.,⁹ it was seen that obesity/overweight was a risk factor for congestive heart failure. Similar findings were noted in present study.

In a study by Martens F.M. et al.,¹⁰ the role of PPARs has been studied. It was found that the cardiovascular risk factors like dyslipidemia, hypertension and obesity/overweight are part of the insulin resistance syndrome and are regulated by nuclear peroxisome proliferator-activated receptors(PPARs). This may be the reason for higher level of obesity/over-weight in patients from diabetic group. In the Framingham cohort, it was seen that diabetic men and women had higher blood pressures and were more obese/overweight than non-diabetics.¹

In a study by Satish Kenchaiah et al.,¹¹ it was seen that there was an increase in the risk of heart failure with increments in body-mass index. As compared to subjects with a normal body-mass index obese/over-weight subjects had a doubling of the risk of heart failure. Thus, there exist a relation between diabetes- obesity and obesity – heart failure.

There was a significantly higher number of obese/ overweight patients in the diabetic group as compared to non diabetic group in our study, thus our study findings were similar to above mentioned studies

Martens F.M. et al.,¹⁰ found that the cardiovascular risk factors like dyslipidemia, hypertension and obesity/overweight are part of the insulin resistance syndrome and are regulated by nuclear peroxisome proliferator-activated receptors(PPARs). This may be the reason for higher levels of triglycerides and cholesterol in patients from the diabetic group.

In a study by Jeffrey R.E. et al.,¹² the state of hyperglycemia in type 2 diabetes acts as predisposition for development of arrhythmia. Thus, prevalence of arrhythmia was significantly higher in the diabetic group as compared to the non diabetic group with heart failure in our study, which was a finding similar to the above study.

In a study done by Danaei G et al.,³ it was seen that diabetes was the most prevalent risk factor for cardiovascular events. Patient with diabetes mellitus have increased risk for cardiovascular disease. Acute phase hyperglycaemia and diabetes are both associated with adverse outcomes in acute myocardial infarction, with higher reported incidences of congestive heart failure, cardiogenic shock and death.

In a study by Thom N. Haase et al.,¹³ it was seen that, insulin resistance, changes in endothelial function, dyslipidaemia, diabetes were powerful risk factor for development of postinfarction heart failure. Our study showed acute myocardial ischemia prevalence was significantly higher in the diabetic group as compared to the non diabetic group with heart failure; outlining the fact that acute myocardial ischemia is a precipitating event for heart failure.

Mean serum potassium level in diabetic group was 4.5 ± 0.491 mEq/l, while in non-diabetic group was 4.48 ± 0.515 mEq/l, difference was not significant statistically (p-0.968). In a

study by Tavazzi L et al.,¹⁴ It was seen that mean serum potassium level in heart failure patients was 4.3 to 4.6 mEq/l. Thus, our study results about serum potassium level are similar to the above study.

Mean urea level in diabetic group was 55.900 ± 37.724 and mean urea level in non-diabetic group was 35.14 ± 19.499 . P value by unpaired t test was 0.001 which was significant statistically. Comorbidities like chronic renal insufficiency usually complicate patients from diabetic group making them more susceptible for deranged renal function producing higher serum urea and creatinine level.

In a study done by Havranek Ep et al.,¹⁵ state of heart failure itself results in slight derangement of serum urea and creatinine level, added to this in diabetic group of patients comorbidities like chronic renal insufficiency add its effect to increase the serum urea and creatinine level more than that in non-diabetic patients. Similar findings were noted in present study.

8 patients (16%) in diabetic group and 3 patients (6%) in nondiabetic group died (P value 0.201). Thus, there was no significant difference in the number of deaths in the two groups. In a study by Y. Y. Allen et al.,¹⁶ there was a role of diabetic state in mortality of patients of heart failure, confirming diabetic state as a predictor of mortality in acute heart failure. Our study showed no significant difference in mortality in the two groups.

Mean length of hospital stay in diabetic group (6.42 ± 1.939 days) more than from non-diabetic group (4.96 ± 1.261 days), difference was statistically significant (p-0.001). In a study by Gebreegziabher, Y. et al.,¹⁷ it was seen that there was a relation between admission hyperglycemia and length of hospital stay in patients with diabetes and heart failure. Presence of diabetes and hyperglycemia with poor glycaemic control in patients with acute heart failure were associated with prolonged hospital stay. Thus the findings from our study were similar to the above studies.

Conclusion

There was no significant difference in prevalence of PND, nocturnal cough, dyspnea on exertion, raised JVP, hepatojugular reflux, response to diuretics, edema, cardiomegaly, pleural effusion, tachycardia, or hepatomegaly and in serum electrolytes in diabetic versus non-diabetic heart failure patients. Significantly higher numbers of diabetic heart failure patients were obese/overweight, had dyslipidemia and had deranged renal functions. They had a significantly higher chance of presenting with rales, arrhythmias and acute coronary ischaemia.

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