

A STUDY ON LIPID PROFILE AND CARDIOVASCULAR MANIFESTATION IN TYPE-2 DIABETES MELLITUS PATIENTS

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Received : 08/04/2023
Received in revised form : 28/05/2023
Accepted : 10/06/2023

Keywords:
PPBG, HBA1C, ECG, EPSS.

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DOI: 10.47009/jamp.2023.5.3.481

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5 (3); 2451-2461



Abstract

Background: The goal of this research was to compare the lipid profiles of individuals with type 2 diabetes and those without the disease by estimating the prevalence of cardiovascular disease in type-2 diabetes without primary cardiometabolic disease and by correlating cardiac dysfunction with the status of glycemic control and lipid profile. **Materials and Methods:** The study was performed in type-2 diabetes mellitus patients with reference to lipid profile and cardiovascular abnormalities in Darbhanga Medical College and Hospital, Laheriasarai, between January 2021 to June 2022 in the Department of Medicine. Patients who are largely asymptomatic or minimally symptomatic were selected for this study. Also, efforts were made to rule out other co-morbid disorders like dyslipidemia, hypertension, and obesity. Patients were subjected to history taking and thorough physical, clinical, and assessment of left ventricular function using non-invasive assessment by using echo Doppler machine. Variables related to case group i.e. type 2 diabetes of <10 yrs. and >10 yrs. duration, type 2 diabetes with HBA1C <10 & >10 were compared statistically. **Results:** The FBG and PPBG have substantially higher values in the population group with a disease duration of >10 years than in the population group with a disease duration of 10 years. The value of HBA1C is reduced with the duration of the disease, which was much higher during early onset, but in both cases, it remains on the bad side. When comparing total cholesterol, LDL, HDL, triglyceride, and very low-density lipoprotein levels between the two groups. The values remain unaffected during the duration of the disease. EPSS and EF remain unaffected or nearly the same during the duration of the disease. E/A ratio values are substantially lower in the population group with a disease duration > 10 years than in the population with a disease duration of 10 years. The values for the FBS and PPBS are substantially higher in the population group with an HBA1C > 10. When comparing total cholesterol, LDL, HDL, triglyceride, and very low-density lipoprotein levels between the two groups, the values remain unaffected with respect to HbA1C values. The E/A ratio was found to be constant irrespective of the sex of the individual. Only 19 out of 79 cases showed any kind of ECG abnormality, accounting for only 24% of the population under study. **Conclusion:** The current investigation clearly demonstrates that cardiovascular dysfunction affects people with diabetes. As the condition worsens, the dysfunction becomes more obvious; therefore, it depends on how long the sickness has been present. No association was found between systolic dysfunction and the severity of the disease among the study group. With the increase in the duration of the disease, the blood glucose levels during fasting and post-meal steadily rise. Also, diastolic dysfunction, there is independent of the sexes.

INTRODUCTION

Multisystemic diabetes mellitus, which has been known to exist since ancient civilizations, is a

plague on humanity in terms of death and morbidity. Rapid urbanisation and rising incomes are major contributors to the rising tide of type-2 diabetes. Cardiovascular disease is responsible for 70% to

75% of deaths in people with diabetes, with acute myocardial infarction being responsible for 30% of these deaths. There is a significant risk of diabetes-related cardiovascular disease worldwide, particularly among the 33 million people in China and India. Compared to non-diabetic patients, survival rates for diabetic subjects with angiographically demonstrated coronary artery disease are 30% lower.^[1] Type 2 diabetes mellitus (T2DM) is one of the most common chronic diseases, affecting 463 million people worldwide in 2019, and is predicted to affect more than 690 million by the year 2045.^[2] Overall, diabetics are at a significant risk for cardiovascular disease. According to a 7-year prospective research, this risk is comparable to that of non-diabetic individuals who have already experienced a myocardial infarction or stroke.^[3] Since diabetes is linked to an earlier onset, a faster rate of development, and a higher density of atheromatous lesions, this fact doesn't require an explanation.^[4]

Most cardiac anomalies in diabetes can be attributed to coronary artery disease and hypertension. However, Post-mortem, experimental, and observational studies also offer proof of a distinct cardiomyopathy in diabetes that, in the absence of coronary artery atheroma, may contribute to cardiac dysfunction. In non-hypertensive diabetic individuals, particularly in women, left ventricular hypertrophy has also been noted. The most significant side effect of myocardial illness is heart failure, which affects diabetics more frequently than non-diabetics and frequently complicates acute myocardial infarctions.^[3]

Type 2 diabetes mellitus is linked to a web of interconnected plasma lipid and lipoprotein abnormalities that are acknowledged as significant risk factors for coronary artery disease and other macro vascular ramifications. These lipid abnormalities, including qualitative and quantitative, are possibly atherogenic lipoproteins. HDL cholesterol increases as triglycerides, apolipoprotein (Apo B), total cholesterol, very low-density lipoprotein (VLDL), and low-density lipoprotein (LDL) cholesterol decreases. Obesity and insulin resistance lead to type 2 diabetes mellitus, which in turn increases hepatocyte production of VLDL and triglycerides via increased adipocyte lipolysis and free fatty acid flow.^[5] The link between dyslipidemia and type 2 diabetes mellitus is clear. This dyslipidemia, part of the metabolic syndrome, may already be present when type 2 diabetes mellitus is diagnosed. Modern treatment for persons with type 2 diabetes mellitus often includes monitoring their blood lipid levels.^[3,6,7] Dyslipidemia, caused by obesity and insulin resistance, increases the danger of heart disease and other major vascular complications. As it has become clear, the majority of diabetics suffer from lipid metabolism issues that increase their risk of developing cerebrovascular illnesses and coronary artery disease.^[7]

The goal of this research was to compare the lipid profiles of individuals with type 2 diabetes and those without the disease by estimating the prevalence of cardiovascular disease in type-2 diabetes without primary cardiological disease and by correlating cardiac dysfunction with the status of glycemic control and lipid profile.

MATERIALS AND METHODS

The present study is a retrospective comparative study. The analysis will be performed in type-2 diabetes mellitus patients with reference to lipid profile and cardiovascular abnormalities. It was performed in Darbhanga Medical College and Hospital, Laheriasarai, between January 2021 to June 2022 in the Department of Medicine.

The study will be consisted of four parts:

Selection of Cases

Inclusion Criteria

- a. A patient with undisputed diabetes mellitus will be taken as a case. They will be either known diabetics and controlled by anti-diabetic therapy or they fulfilled WHO criteria for diagnosis of diabetes without any therapy.

Diabetes is confirmed by

- Plasma glucose, measured either before or two hours after a 75 g glucose load, less than 11.1 mmol/L (200 mg/dl). or
- A blood glucose level of 126 mg/dL or less in the fasting state
- HbA1c \geq 48 mmol/mol

Diabetes must be confirmed by two separate diagnostic tests in asymptomatic individuals, with the second test being identical to the first.

'Pre-diabetes' is classified as:

- Fasting plasma glucose between 6.1 mmol/L (110 mg/dl) and 7.0 mmol/L (126 mg/dl) is considered impaired.
 - Impaired glucose tolerance is defined as a fasting plasma glucose level of 7.0 mmol/L (126 mg/dl) and a 2-hour glucose level of 7.8-11.1 mmol/L (140-200 mg/dl) after ingesting 75 grammes of glucose orally.
- b. Anti-diabetic therapy meant either oral hypoglycemic agents or insulin therapy.
 - c. Cases that fulfilled the criteria of type 2 Diabetes Mellitus will be taken of any age group on a basis of random sampling.

Exclusion Criteria

- a. Patients having diseases which can affect the left ventricular function (like high blood pressure, previously known cardiomyopathy of definite etiology other than diabetes, rheumatic heart disease and congenital heart disease) were excluded from the study after clinical evaluation and proper investigations.
- b. Patients who are asymptomatic as well as symptomatic were taken in the study. Patients with severely symptomatic (like palpitation,

- dyspnea, easy fatigability) or critically ill were not taken.
- c. Patients having known risk factors for coronary artery disease were also excluded from the study, as far as possible. We took non-smokers, non-hypertensive, non-obese (BMI < 27) cases without positive family history.
 - d. Dyslipidemia were taken as a part of our study and not the exclusion criteria.
 - e. The patients having the following diseases which could adversely affect the outcome were excluded from the study.
 - i. Chronic liver disease
 - ii. Renal disease
 - iii. Anaemia
 - iv. C.O.P.D.

All these were excluded after proper history, clinical examination and relevant investigations.

Measurement of Variables

After selection, the patients and controls were subjected to the following procedures:

History taking

Patients were subjected to history taking and thorough physical examination as outlined in the proforma.

Detailed clinical examination

- i. The body weight and height were measured and body mass index (BMI) was calculated by the following formula.

$$\text{BMI} = \frac{\text{Body weight in kgs}}{(\text{Height in Meters})^2}$$

- ii. The Mean arterial pressure (MAP) was calculated as MAP = Diastolic pressure + 1/3rd pulse pressure. Blood pressure was measured in both supine and erect posture for detection of any postural hypotension.
- iii. Patients were subjected to detailed ophthalmoscopic examination after dilating the pupils.
- iv. The test to detect autonomic dysfunction was done as follows
 - Resting pulse rate and variation with respiration undue resting tachycardia or bradycardia, absence of slowing pulse rate with deep inspiration.
 - Postural change Patients were asked to lie on a couch for 15 minutes with cuff and lead I ECG was attached. Then blood pressure was measured. Patient was then asked to stand. ECG was taken and blood pressure was measured at first minute and third minute after standing. Pulse rate was calculated at 15th and 30th beats after standing.
 - Fall in systolic blood pressure <10 mm of Hg (Normal).
 - Fall in systolic blood pressure >30 mm of Hg (Autonomic Neuropathy).
 - 30th/15th pulse ratio = 1.03 (Normal)
 - 30th/15th Pulse Ratio = 1 (Autonomic Neuropathy)

- v. Chest X-ray (PA view) was done and cardio thoracic ratio was noted.

Investigation

To confirm the inclusion and exclusion criteria and to know the duration of disease, the following investigations were done in all cases and controls.

- i. Venous plasma glucose estimation both fasting and post prandial by enzymatic glucose oxidase method.
- ii. Long term glycemic control was assessed by estimation of glycosylated haemoglobin (HbA1C) and quantified by the method of ion exchange chromatography (Normal range – 4.5 to 8%).
- iii. Fasting serum cholesterol estimation was done enzymatically using cholesterol oxidase method (Normal 150 – 30 mg%).
- iv. Serum triglyceride was determined by enzymatic hydrolysis method of spinella (Normal 60 – 150 mg%).
- v. Serum HDL cholesterol was estimated by phosphotung-stane method of Burnssein (Normal 35 – 65 mg%).
- vi. Serum LDL cholesterol was measured by the formula of Friedwald.

$$\text{LDL Cholesterol} = \text{Total cholesterol} - \frac{\text{Triglyceride}}{5} - \text{HDL} - \text{C}$$

- vi. Serum urea estimation was done spectrophotometrically (Normal 15 – 40 mg%).
- vii. Serum creatinine estimation was done by Method of Brod and Sirota using Jaffe reaction (Normal upto 1.8 mg%).
- viii. Urine protein estimated by the Method of Rein hold.

In every case resting ECG was taken in usual 12 lead system and long strip of lead II was taken in deep inspiration and expiration.

Echo Doppler Study

Non-invasive assessment of left ventricular function was done by using echo doppler machine in the Department of Cardiology, DMCH, Laheriasarai.

The echocardiographer was kept uninformed about the clinical details of the patients in order to eliminate the possibility of biased observations. All the patients were subjected to echocardiography at approximately the same time in the morning in order to minimize changes in the results due to diurnal variations of the sympathetic nervous system function. Each patient underwent two dimensional, M-mode echocardiogram and doppler examination.

M-MODE

After imaging the left ventricular chamber by 2-D echo in the parasternal short axis view, the M-Mode cursor was positioned through the centre of the cavity and M-Mode recordings were taken just beneath the mitral valve for determination of left ventricular dimensions. The following parameters were derived from five consecutive cardiac cycles:

- a. Left ventricular internal diameter in diastole (LIVIDD).

- b. Left ventricular internal diameter in systole (LVIDS).
- c. Left ventricular posterior wall thickness (LVPWT).
- d. Interventricular septal wall thickness (IVS).

First three measurements were taken by 'leading edge to leading edge' technique. Septal thickness was taken from leading edge of the right septal echo to trailing edge of left septal echo.

Amplitude of septal motion was noted, as it is related to the left ventricular filling.

The M-Mode cursor was then positioned at the mitral valve for the following readings –

Mitral E-point septal separation (EPSS): The EPSS is seen to correlate with angiographic ejection fraction fairly well.

Left ventricular ejection fraction (EP%) was calculated as.

$$EP \% = \frac{(LVIDD)^3 - (LVIDS)^3}{(LVIDD)^3} \times 100$$

Fractional shortening of left ventricle was calculated as

$$EF \% = \frac{LVIDD - LVIDS}{LVIDD} \times 100$$

Doppler Echocardiographic Study

From an apical four chamber perspective, with the sample volume towards the tips of the mitral leaflets, pulse wave doppler recordings of mitral inflow velocities were made. What follows was quantified.

E – Peak velocity of early (E) diastolic phase of rapid passive filling (cm/sec)

A – Peak velocity of late (A) diastolic phase of active atrial contraction (cm/sec).

Normally peak velocity is greater with early diastolic flow. E/A ratio being about 1.6 + 0.5. In patients with impaired left ventricular relaxation, peak E velocity is reduced while peak A velocity is increased.

Any ischaemic segment exhibiting regional wall motion abnormality was looked for in M-Mode and 2-D echo, in both long axis and short axis view, in all patients.

Clinical examination and investigations to exclude pertinent selected disease.

- Liver disease: From history, clinical examination.
- Renal disease: From history, clinical examination. Urine for RE/ME
Blood for urea, creatinine
- Cerebrovascular disease: By history and clinical examination
- Anaemia: By clinical examination and blood for complete haemogram.
- C.O.P.D.: By history, clinical examination, St x-ray chest – PA view.

Comparison, Analysis and Interpretation

Variables related to both case group i.e. (1) type 2 diabetes of <10 yrs. and >10 yrs. duration, (2) type 2

diabetes with HBA1C <10 & >10 were compared. The standard deduction and mean is calculated for each variable. The p value is calculated using S PLUS statistical software.

- i. Evidence of dyslipidemia
- ii. Evidence of left ventricular dysfunction as evidenced by –
- iii. Systolic dysfunction by –
- iv. EPSS – (E point septal separation) (cm)
EF% - (ejection fraction)
FS% - (Fractional shortening)
- v. Diastolic dysfunction by –
E – Peak velocity of early diastole (cm/sec)
A – Peak velocity of late diastole (cm/sec)
E/A ratio –
- vi. Evidence of coronary artery disease : with positive ECG changes for ischaemia – as evidenced by OT segment depression of 0.2 mv and persistent for 0.08 m sec. Either horizontal or downsloping

RESULTS

Patients were recruited for the study from the Department of General Medicine OPD at the Darbhanga Medical College and Hospital, Laheriasarai, over the course of eighteen months.

79 type-2 diabetes mellitus patients with reference to lipid profile and cardiovascular abnormalities were enrolled for this trial. In the study population, the number of men outnumbered women, with 57 men and 22 women. The youngest participant was of 19 years, whereas the age of the eldest one was recorded as 65 years. Average age of study group was 48.4 years. Participants' average of duration of disease was recorded as 9.6 years. The other baseline data are as provided in Table 1.

In the study that followed, we attempted to examine how the duration and severity of diabetes correlated with cardiovascular and lipoprotein abnormalities.

S PLUS Statistical software was used to conduct the study's statistical analysis. The following variables are used in statistical calculations in the following order: Fasting blood glucose, Post prandial blood glucose, concentration total cholesterol, LDL, HDL, triglycerides, VLDL, E-point septal separation (EPSS), Ejection fraction, Fractional shortening, Ratio of E/A flow velocity etc.

Other factors are determined to be statistically not significant.

Using statistical analysis software "S PLUS," the following variables are compared to duration of disease and HBA1C, i.e., severity of disease.

Through echocardiography, the left ventricular functions are accessible. It is researched separately how the heart works in systole and diastole. The following parameters are used to access the systolic functions: E point septal separation (EPSS), ejection percentage (EF), use of fractional shortening (FS)

The ratio of the "E" flow velocity and "A" flow velocity can be used to determine diastolic

abnormalities. A straightforward, reproducible method for determining left ventricular function is pulse Doppler echocardiography. It has some significant restrictions. The location of the sample volume, which moves during the cardiac cycle and breathing, is a determinant of the measurement of mitral input velocity. By planning at least five consecutive cycles, we were able to reduce these restrictions.

2.1 Cardiovascular and lipoprotein abnormalities in relation to the duration of diabetes. A time limit of 10 years was set while doing this analysis. Diabetes patients with a duration of more than 10 years and less than 10 years were compared for cardiovascular and lipoprotein abnormalities.

As a result, the FBG and PPBG have substantially higher values in the population group with a disease duration of >10 years than in the population group with a disease duration of 10 years, P 0.05. Though the values are not differing much but are of concern, particularly the values of PPBG (Table 2 and Figure 1).

From the findings (Table 3 and Figure 2) it was clear that the value of HBA1C is reduced with duration of disease, which was much higher during early onset, but in both the cases it remains on alarming sides.

When comparing total cholesterol (Table 4 and Figure 3), LDL, HDL, triglyceride, and very low density lipoprotein levels between the two groups, a P-value greater than 0.05 implies no statistically significant difference. The values remain unaffected during the duration of disease.

From the data (Table 5 and Figure 4a and 4b) it was found that the value of both EPSS and EF remains unaffected or nearly same during the duration of disease. There is no statistically significant difference between the two groups for the systolic function measures (EPSS, EF), P > 0.05.

E/A ratio values are substantially lower in the population group with disease duration > 10 years than in the population with disease duration 10 years, P = 0.05. When compared to the length of the disease, the other variables are measured and determined to be unimportant (Table 6, Figure 5).

2.2 Cardiovascular and lipoprotein abnormalities in relation to the severity of diabetes.

We set a time limit of 10 years while doing this analysis. With glycated haemoglobin readings (HBA1C) above and below 10, abnormalities of the heart and lipoproteins were studied.

As a result (Table 7, Figure 6), the values for the FBS and PPBS are substantially higher in the population group with an HBA1C > 10 than in the population group with an HBA1C < 10, P > 0.05. The values are alarming in case of HBA1C > 10, and it has substantially increased from values for HBA1C < 10.

When comparing total cholesterol, LDL, HDL, triglyceride, and very low density lipoprotein levels between the two groups, a P-value greater than 0.05 implies no statistically significant difference. The values remain unaffected with respect to HbA1C values (Table 8, Figure 7).

The systolic function metrics (EPSS, EF) between the two groups are not substantially different (P > 0.05) and lies in the normal range, depicting no serious threat in relation to HbA1C levels (Table 9, Figure 8a and 8b).

There is no statistically significant difference (P > 0.05) between the two groups in the aforementioned diastolic function (E/A) measurements (Table 10, Figure 9).

Measurements of the other factors reveal that they are not significant in terms of the severity of the illness.

2.3 Comparison of Diastolic Dysfunction among both Sexes

The E/A ratio were found to be constant irrespective of the sex of the individual. In terms of the aforementioned criteria (E/A), the two groups do not substantially differ from one another (P > 0.05) (Table 11, Figure 10).

2.4 ECG Abnormality

ECG was carried out in each of the patients used for our investigation, and the following table 12, lists any abnormalities found. It was recorded that the cases of RBBB findings were four times as that of ischemic changes and intra-ventricular conduction defect. Only 19 out of 79 cases showed any kind of ECG abnormality which accounts for only 24% of the total population under study.

Table 1: Baseline data of the study group

	Mean	Standard Deviation
Age	48.4	8.99
Body mass index (BMI)	24.96	27.03
Fasting blood glucose (FBG)	178.85	21.08
Post-pandial blood pressure (PPBS)	290	37.76
Glycated haemoglobin (HBA1C)	10.55	9.17
Mean arterial pressure (MAP)	100.3	86.11
Total cholesterol	203.85	12.37
Low density lipoprotein (LDL)	130	16.8
High density lipoprotein (HDL)	42.1	5.22
Triglyceride	185	34
Very low density lipoprotein (VLDL)	36.92	7.13
E-point septal separation (EPSS)	0.362	0.16
Ejection fraction (EF)	70	7.8
Fractional shortening (FS)	34	5.6

	Mean	Standard Deviation
Ratio of E-flow/A-flow velocity (EA)	1.4	0.3
Duration of disease	9.6	5.53

Table 2: Fasting and Post-prandial Blood Glucose Level Abnormality Study

Parameters	Case group < 10 years duration n = 35	Case group > 10 years duration n = 44	P Value
FBG	Mean 172.36 S.D. + 17.884	Mean 187 S.D. + 23.476	0.0023
PPBG	Mean 281.63 S.D. + 27.859	Mean 300.571 S.D. + 45.204	0.0249

Table 3: Severity of Diabetes

Parameters	Case group < 10 years duration n = 35	Case group > 10 years duration n = 44	P Value
HBA1C	Mean 11.27 S.D. + 12.212	Mean 9.651 S.D. + 1.091	0.383

Table 4: Lipid Profile Abnormality Study

Parameters	Case group < 10 years duration n = 35	Case group > 10 years duration n = 44	P Value
Total Cholesterol	Mean 204.75 S.D. + 13.643	Mean 202.71 S.D. +10.456	0.4540
LDL	Mean 132.43 S.D. + 19.107	Mean 127.71 S.D. +12.938	0.2080
Triglyceride	Mean 188.63 S.D. + 40.09	Mean 180.88 S.D. +22.231	0.2792
HDL	Mean 41.93 S.D. + 6.333	Mean 42.4 S.D. + 3.314	0.6720
VLDL	Mean 37.566 S.D. + 8.39	Mean 36 S.D. +4.985	0.3057

Table 5: Echocardiographic Systolic Function Study

Parameters	Case group < 10 years duration n = 35	Case group > 10 years duration n = 44	P Value
EPSS	Mean 0.35 S.D. + 0.132	Mean 0.377 S.D. + 0.189	0.4755
EF	Mean 70.68 S.D. + 7.516	Mean 68.54 S.D. + 8.082	0.2317

Table 6: Echocardiographic Diastolic Function Study

Parameters	Case group < 10 years duration n = 35	Case group > 10 years duration n = 44	P Value
E/A Ratio	Mean 1.6 S.D. + 0.153	Mean 1.048 S.D. + 0.104	0.0001

Table 7: Fasting and Post-prandial Blood Glucose Abnormality Study in context of HBA1C

Parameters	Case group having HBA1C < 10 years n = 26	Case group having HBA1C > 10 years n = 53	P-Value
FBS	Mean 173.50 S.D. + 18.21	Mean 189.42 S.D. + 24.29	0.0002
PPBS	Mean 279.86 S.D. + 30.63	Mean 311.54 S.D. + 40.45	0.0001

Table 8: Lipid Profile Abnormality Study in context of HBA1C

Parameters	Case group having HBA1C < 10 years n = 26	Case group having HBA1C > 10 years n = 53	P-Value
Total Cholesterol	Mean 204.604 S.D. + 11.875	Mean 202.1154 S.D. +13.197	0.4187
LDL	Mean 133.321 S.D. + 17.585	Mean 124.1538 S.D. +13.21	0.0114
Triglyceride	Mean 185.358 S.D. + 35.392	Mean 184 S.D. +29.245	0.8570
HDL	Mean 42.2642	Mean 41.9615	0.7893

	S.D. + 5.647	S.D. + 4.192	
VLDL	Mean 36.773 S.D. + 7.609	Mean 37.07692 S.D. + 5.941	0.8464

Table 9: Echocardiographic Systolic Function Study in context of HBA1C

Parameters	Case group having HBA1C < 10 years n = 26	Case group having HBA1C > 10 years n = 53	P Value
EPSS	Mean 0.38302 S.D. + 0.1598	Mean 0.31154 S.D. + 0.16	0.0658
EF	Mean 70.4528 S.D. + 8.085	Mean 68.7308 S.D. + 7.074	0.3353

Table 10: Echocardiographic Diastolic Function Study in context of HBA1C

Parameters	Case group having HBA1C < 10 years n = 26	Case group having HBA1C > 10 years n = 53	P Value
E/A	Mean 1.37226 S.D. + 0.305	Mean 1.318846 S.D. + 0.299	0.4546

Table 11: Comparison of Diastolic Dysfunction among both Sexes

Parameters	No. of Male Person n = 57	No. of Female Person n = 22	P Value
E/A ratio	Mean 1.373 S.D. + 0.306	Mean 1.305 S.D. + 0.293	0.3733

Table 12: List of ECG abnormalities

ECG Changes	Percentage
RBBB	12
Sick Sinus Syndrome	1
Ischemic Change	3
Intra-ventricular conduction defect	3

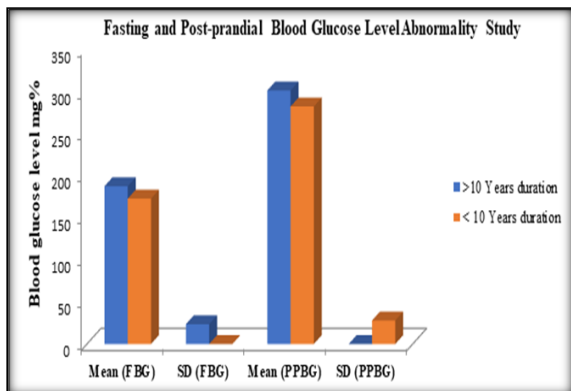


Figure 1: Fasting and Post-prandial Blood Glucose Level Abnormality Study

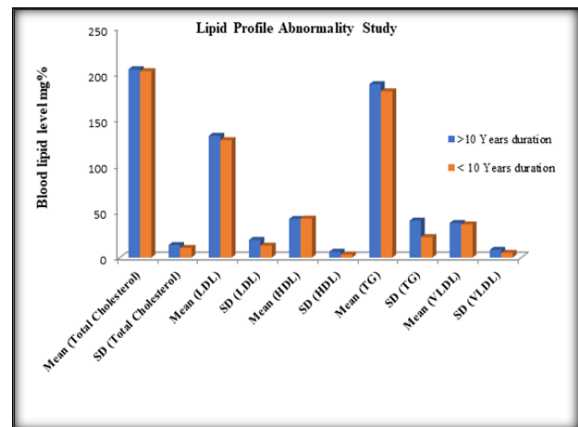


Figure 3: Lipid Profile Abnormality Study

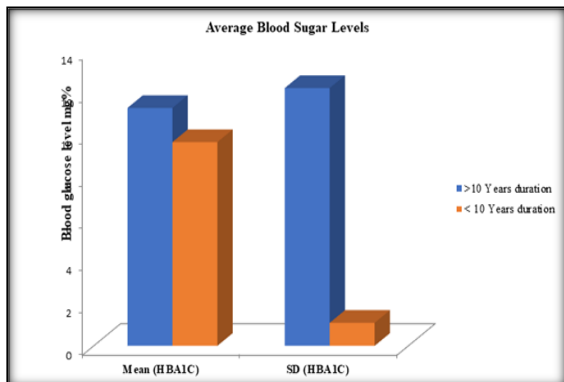


Figure 2: Average Blood Sugar Levels

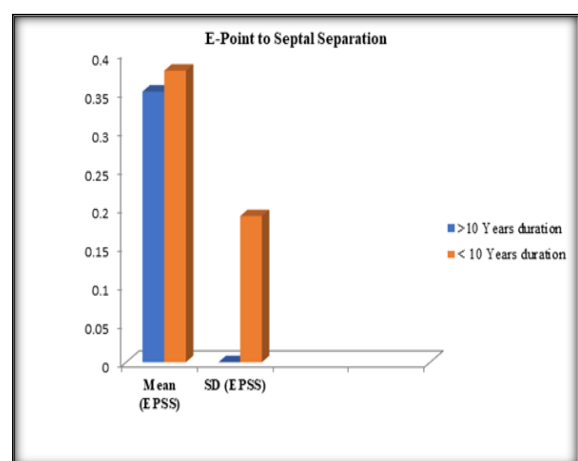


Figure 4a: E-Point to Septal Separation values

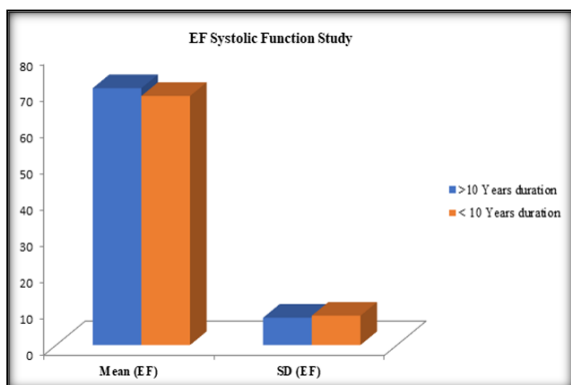


Figure 4b: EF Systolic Function Study

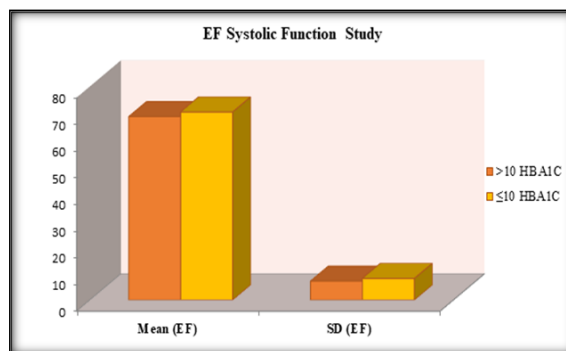


Figure 8b: EF Systolic Function Study in context of HBA1C

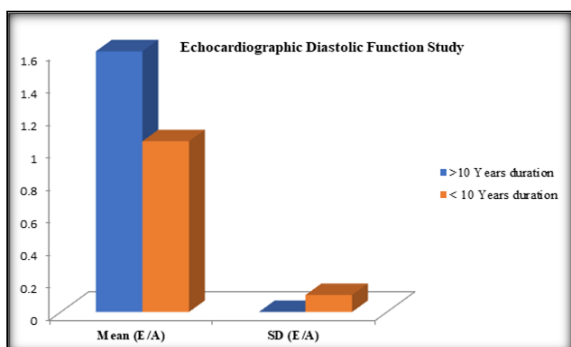


Figure 5: Echocardiographic Diastolic Function Study

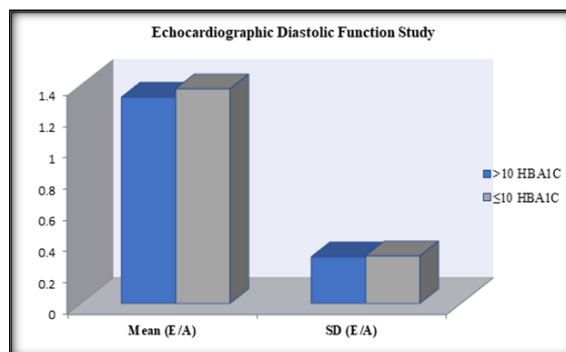


Figure 9: Echocardiographic Diastolic Function Study in context of HBA1C

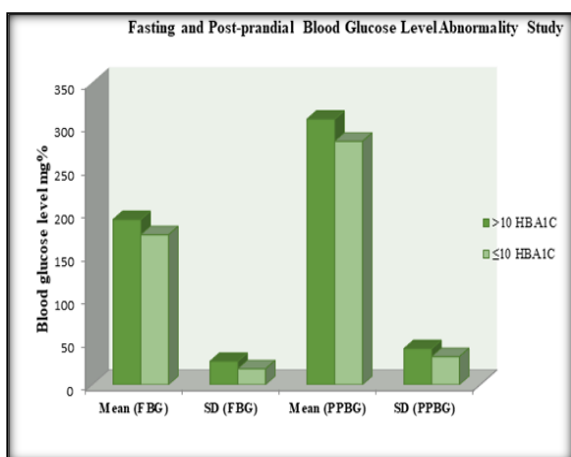


Figure 6: Fasting and Post-prandial Blood Glucose Level Abnormality Study in context of HBA1C

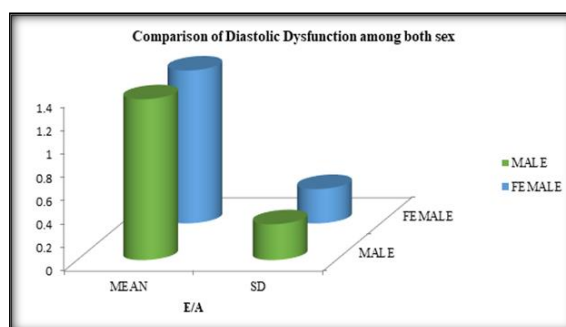


Figure 10: Echocardiographic Diastolic Function Study Among Male and Female Counterparts

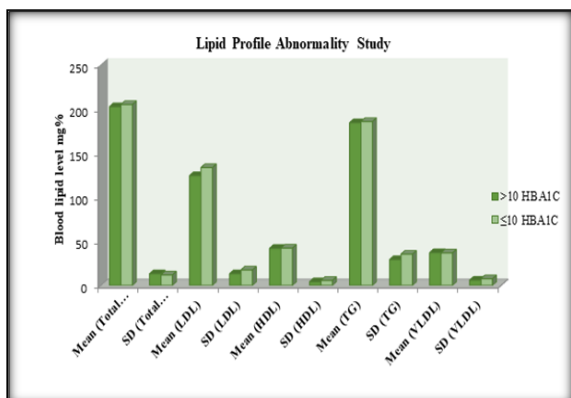


Figure 8a: E-Point to Septal Separation Study in context of HBA1C

DISCUSSION

The current investigation was conducted between January 2021 to June 2022 in the Department of Medicine at Darbhanga Medical College and Hospital, Laheriasarai, as a retrospective comparative study. The study population's average age is 48.4, there were 79 cases, and the male to female ratio is 2.6 to 1. The goal of the current study is to investigate instances of diabetes mellitus with a focus on how hyperlipidemia affects the cardiovascular system. By connecting cardiovascular manifestation with the duration and severity of diabetes, it is possible to determine a common standard for preventative and therapeutic measures for such individuals in order to reduce mortality and morbidity in a more general sense.

In our study, we only include patients who are largely asymptomatic or very minimally

symptomatic. As much as possible, we made an effort to rule out additional co-morbid disorders such as familial dyslipidemia, essential hypertension, obesity, and smoking. Additionally, we made an effort to rule out any other medical conditions that can influence ventricular function, such as chronic liver disease, renal illness, thyroid issue, anaemia, and COPD. Additionally, we ruled out any secondary causes of diabetes, such as pancreatitis, endocrinopathy, drug-induced diabetes, or other syndromes connected to the disease. Additionally, patients with any congenital, hypertensive, or valvular cardiac disease are carefully excluded. The study is somewhat comparable to the Mustonen et al. study from 1988, which examined the left ventricular function in middle-aged, asymptomatic diabetes patients. However, compared to this study, the BMI of our patients is fairly low. The examples that were chosen were not done so in accordance with the statistical sampling principle, therefore selection bias might still be present in the subsequent study. People from all grades and classifications are included in the study group despite the fact that this may be critiqued as not being fully representative of the population as a whole.

In our investigation, the level of glycated haemoglobin was discovered to be on the higher side. Poor patient compliance, a lack of information, and ignorance are likely to blame for this.

Lipid Profile Abnormality

Type 2 diabetes patients are evaluated based on the patient's age of onset, clinical history, BMI, family history, etc. These patients are diagnosed using the ADA 2000 diagnostic criteria.

In type 2 diabetes mellitus, a rise in triglycerides and a reduction in HDL cholesterol levels are the two most common lipid profile abnormalities. In this study, we evaluated the aberrant lipid profiles in the groups with a disease length of <10 and > 10 years and found no discernible difference between the two. However, the mean values of these characteristics for both of these groups are above average. This observation implies that diabetes people do continue to have aberrant lipid profiles. In all cases of diabetes, it can be seen in the higher/below normal range of these values. The lack of difference between the two groups indicates that the lipid profile anomaly is stable throughout time. According to Sultania et al., 2017 study, the typical dyslipidemia associated with diabetes, which is characterised by low HDL and high triglyceride levels, follows a similar trend.^[9] Numerous national and international epidemiological studies on lipid profiles have also shown same dyslipidemia pattern.^[10-14] Between the patients and controls in this study, there was no appreciable change in the absolute LDL and total cholesterol levels. Even when the absolute concentration of LDL cholesterol (LDL-c) is not much increased, there is frequently a preponderance of smaller, denser LDL particles, which may increase atherogenicity (atherogenic

dyslipidemia). Because of insulin resistance, there is an increase in the flow of free fatty acids, which causes these changes.^[13,15-18]

Additionally, we discovered no connection between the groups with HbA1C values below and above 10 in terms of their lipid profiles. This indicates that there is no causal link between the severity of diabetes and abnormalities in lipoproteins. The same study by Sultania et al. (2017) revealed no evidence of a significant relationship between HbA1c and TC, LDL, HDL, or TG.^[9] A perspective study on 109 individuals with type 2 diabetes mellitus was carried out in Tamil Nadu by Senthil Kumar et al.^[19] They discovered no discernible relationship between HbA1c and TC, LDL, HDL, or TG. There are studies which support involvement of HbA1C values in lipid profile of diabetic patients.

A prospective study on the population of western India by Jayesh et al.^[20] included 501 non-diabetic control volunteers and 430 patients with type 2 diabetes mellitus. They discovered a strong association between HbA1c and TC and LDL. Significant HbA1c and LDL association was discovered. In a study by Eglal et al.^[21] conducted on 50 type 2 diabetes patients in Khartoum, Sudan, they discovered a strong association between TG and HbA1C.

Abnormalities of Left Ventricle in Type 2 diabetes patients

In this study, we discovered that the E/A ratio (the ratio of E flow velocity to A flow velocity) was significantly lower in the disease duration group than in the disease duration group with a length of less than 10 years. This merely indicates that the larger the diastolic dysfunction, the longer the disease has been present. It is clear from this study that diabetes patients who are asymptomatic can develop heart diastolic dysfunction. According to a similar study reported by Khalil S. I. et al.^[22], the prevalence of diastolic dysfunction rises with diabetes duration. The study shows that when diabetes had been present for more than 10 years, diastolic dysfunction was 100% prevalent. Diastolic dysfunction began 8 years after the onset of diabetes, according to a study by Raev et al.^[23] In a research, in non-insulin-dependent diabetes mellitus (NIDDM) individuals, Shapiro discovered that diastolic dysfunction was more prevalent than systolic impairment.^[24] Similar findings from other studies that support them suggest that problems in left ventricular diastolic function may indicate diabetic heart disease earlier than decreased systolic function at rest. Even young diabetic patients experience diastolic impairment even while systolic ventricular function is typical. As a result, echocardiography combined with the evaluation of diastolic functional parameters appears to be a sensitive approach for assessing the occurrence and progression of early diabetic cardiomyopathy. In palliable research, the peak E flow velocity was dramatically decreased. Additionally, it was greatly diminished in the Grossman Study.^[25] All of these

investigations demonstrate increased flow velocity. Using pulsed Wave Doppler echocardiography Porrier et al. found, type 2 diabetic patients with well-controlled blood sugar levels had a 60% prevalence of diastolic dysfunction.^[26] Therefore, it is not unexpected that diabetes patients have a higher incidence of idiopathic cardiomyopathy.^[27] The parameters of the heart's systolic functions, such as EPSS, EF, and FS, are examined in our study in two groups in relation to the length and severity of diabetes. No connections between these two groupings were discovered. Small study groups, selection bias, and other factors may be contributing factors, but we also need to keep in mind that aberrant diastolic function comes before bad systolic function, so, the systolic aberration only manifests later in the course of the illness. It is important to discuss one of the study's findings here. The EPSS value was virtually substantially different when comparing two groups based on severity ($P=0.4755$).

This shows that the severity of diabetes is also correlated with systolic dysfunction. The same can be seen in the near significant P value ($P=0.2317$) of EF. Reduced ejection fraction was seen in type 2 patients by Patel et al. However, Shapiro et al 24 could not discover any appreciable alteration in diabetics' systolic function.

Also, it has been found that the E/A ratio in females is not considerably lower than in males. The well-known Framingham Heart Study 28 demonstrated that women were especially at risk for an elevated cardiovascular disease risk. The limited study sample and unequal sex ratio comparison (male: female = 2.6: 1) are likely to blame for the lack of relevance.

Fasting and postprandial blood glucose levels along with the HbA1C levels are considerably higher in the age group with duration >10 years than in the group with a duration <10 years. The reason may be age dependant obesity and insulin resistance; as blood sugar regulation may get harder with people living longer and getting older. This is attributable to a variety of insulin resistance and insulin secretion issues, which together cause a progressive age-related deterioration in glucose tolerance that starts in the third decade and lasts until adulthood. Impairment of insulin-mediated glucose clearance, particularly in skeletal muscle, is likely the most significant mechanism causing age-related glucose intolerance, and this impairment is most noticeable in obese individuals. Additionally, when people get older, obesity increases.

CONCLUSION

The current investigation clearly demonstrates that cardiovascular dysfunction affects people with diabetes. As the condition worsens, the dysfunction becomes more apparent; therefore, it depends on how long the sickness has been present. Dysfunction

in the diastole occurs before the systole. In our investigation, there was no association between systolic dysfunction and the severity of the disease among the study group. There was no discernible difference in lipid profile between the study group with a duration of 10 years and more and a glycated hemoglobin level (HbA1C) of 10 years and more. Here, we discovered that as the disease's duration increases, the blood glucose levels during fasting and post-meal steadily rise. It was demonstrated through the study that glycated hemoglobin (HbA1C), which indicates the control of diabetes, directly varies with fasting and postprandial blood glucose levels. Also, diastolic dysfunction, there is independent of the sexes.

Acknowledgment

The authors thank Aziz Writing Solutions (AWS) for assisting in manuscript preparation and publication.

Declaration of Conflicting Interests

The Authors declare that there is no conflict of interest.

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