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ORIGINAL ARTICLE

Prevalence and pattern of dyslipidemia in hyperglycemic patients and its associated factors among Pakistani population



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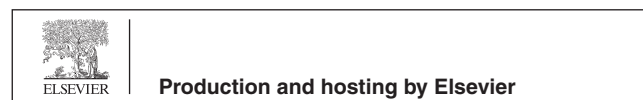
Abstract In diabetes mellitus dyslipidemia is one of the major risk factors for cardiovascular disease. In type 2 diabetes mellitus early detection and treatment of dyslipidemia can avoid risk for cardiovascular disorder. The present study was carried to determine the prevalence and pattern of hyperlipidemia in patients with hyperglycemia. The cross sectional study was done in different laboratories of Pakistan, the laboratories served patients referred from different government and private hospitals between July 2014 and June 2015. All known cases of diabetes mellitus were evaluated for their lipid profile. Totally 200 diabetic patients were included in the study in which 120 (60%) were males and 80 (40%) were females. Prevalence of dyslipidemia among diabetic males was 97.18% while for females 87.15%. Among dyslipidemic male the proportion with mixed dyslipidemic patients was 17.5%, combined two parameters dyslipidemia was 47.5% and isolated single parameter dyslipidemia was 35%. In females these proportions in mixed, combined two parameters and isolated single parameter were 16.25%, 51.25% and 32.5%, respectively. Majority of hyperglycemic patients were dyslipidemic. The most prevalent pattern among male was combined dyslipidemia with high triglycerides (TG) and low High Density Lipoprotein (HDL) and in female it was high Low Density Lipoprotein (LDL) and low HDL. The most prevalent lipid abnormality in our study was low HDL followed by high TG.

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1. Introduction

Diabetes mellitus frequency is increasing many folds in South Asian population. Many factors like high body fat percentage, high susceptibility to environmental insulin, high degree of genetic predisposition and high level of insulin resistance are

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involved in this metabolic disorder (Uttra et al., 2011). It is characterized by absolute deficiency in insulin secretion and insulin action associated with hyperglycemia, metabolism of protein, carbohydrate and lipids are disturbed (Abou-Seif and Youssef, 2004). Different research studies show that body composition components like lipid profile and body fat are responsible for the increased prevalence of this disease (Elinasri and Ahmed, 2008). In diabetes mellitus the lipid abnormalities are more prevalent because major key enzymes and lipid metabolism pathways are affected due to deficiency of insulin production and secretion (Taskinen, 2002). Dyslipidemia is one of the major risk factors for cardiovascular disease in hyperglycemic patients. High triglycerides (TG), low High Density Lipoprotein (HDL) cholesterol, and increased Low Density Lipoprotein (LDL) cholesterol are the characteristic feature of diabetic dyslipidemia. Type 2 diabetes affects an estimated 21 million people in the United States (CDCP, 2013). About 70–80% of diabetic patients will die of cardiovascular disease (ADS, 1998; Feher, 2004). The prevalence of hypercholesterolemia is not increased in patients with diabetes mellitus but mortality from coronary heart disease increases (Mooradian, 2009). American Diabetes Association (ADA) guidelines recommend maintaining serum levels of TG below 150 mg/dl, LDL cholesterol below 100 mg/dl and HDL cholesterol of more than 40 mg/dl in males and 50 mg/dl in females (ADA, 2004).

In the whole world about 382 million people are the victim of hyperglycemia. The regions of high prevalence are North America and Caribbean about 11%. According to International Diabetes Federation (IDF) estimates in 2013, 35 countries out of 219 countries have about 12% prevalence of diabetes. 10–19% of Asian population is currently affected due to diabetes. In Pakistan 7.1 million people suffer due to diabetes. The data from Pakistan showed a prevalence rate of 18–46% while 46–75% Pakistani patients with diabetes had metabolic syndrome (Sohail et al., 2006; Basit and Shera, 2008). The rationale of this study was to detect the lipid abnormality in hyperglycemic patients because in diabetes mellitus early detection and treatment of hyperlipidemia can prevent the progression of lipid abnormalities and minimize the risk for cerebrovascular accident and cardiovascular disorder.

2. Material and method

2.1. General data

A prospective cross sectional study was planned to analyze the pattern and prevalence of dyslipidemia in hyperglycemic patients during July 2014–June 2015. The study was carried out in different laboratories of Pakistan; a number of patients were referred from different government and private hospitals. A total of 200 patients 120 males and 80 females were included in the study. Diabetes was already diagnosed in all persons. Information about participants' age, sex, life style, monthly income, occupation and family history of diabetes were recorded. Before registering for the study written consent was obtained from the participants, expressing their willingness to participate in the study. Patients who have already taken lipid lowering drug and pregnant women were excluded from the study. Detailed history and clinical examination of all the included patients were done.

2.2. Blood sample collection

Five milliliters of venous blood samples were collected from fasting diabetic patients into fluoride oxalate plastic for estimation of blood glucose level and serum was separated by centrifuging the blood samples at 8000 rpm for 10–15 min for lipid profile analysis including TC, TG, HDL-C, LDL-C. CHOD-PAP Enzymatic Colorimetric (HUMAN GmbH, Wiesbaden, Germany) method was used for determination of lipid profiles using the Microtech 3000 plus clinical chemistry analyzer.

2.3. Statistical analysis

All the observations were tabulated and results were expressed as percentage and mean \pm standard error. Data analysis was performed using mini tab software. To determine the coefficients CHI-SQUARE was used. ($P \leq 0.05$) is significant and ($P \geq 0.05$) is not significant.

3. Results

A total of 200 patients were studied.

3.1. Distribution of patients according to age, height and weight

In this study 31.5% ($n = 63$) were below 40 years of age while 68.5% ($n = 137$) were above 40 years and prevalence among male and female is 95.4% and 86.75%, respectively. According to the height 43 patients were between 5 and 5.2 inches, 70 were 5.3–5.5 while 59 and 28 persons were fall between 5.6–5.8 and 5.9–5.11 inches, respectively. Most of the patients in the study had weight 61–70 kg, while 21 and 44 diabetic persons had 80 kg and 71–80 kg, respectively shown in (Table 1).

Table 1 Number of patients according to different characteristics.

| Characteristics | N (%) | Characteristics | N (%) |
|--------------------|-------------|----------------------------|-------------|
| <i>Gender</i> | | <i>Obesity</i> | |
| Male | 120 (60%) | Obese | 84 (42%) |
| Female | 80 (40%) | Non-obese | 116 (58%) |
| <i>Age (Years)</i> | | <i>Hypertension</i> | |
| Below 40 | 63 (31.5%) | Yes | 123 (61.5%) |
| Above 40 | 137 (68.5%) | No | 77 (38.5%) |
| <i>Height</i> | | <i>Smoking</i> | |
| 5–5.2 | 43 (21.5%) | Yes | 56 (28%) |
| 5.3–5.5 | 70 (35%) | No | 144 (72%) |
| 5.6–5.8 | 59 (29%) | <i>Sedentary lifestyle</i> | |
| 5.9–5.11 | 28 (14%) | Yes | 86 (43%) |
| <i>Weight</i> | | No | 114 (57%) |
| 41–50 | 12 (6%) | <i>Work</i> | |
| 51–60 | 52 (26%) | Field | 93 (46.5%) |
| 61–70 | 71 (35.5%) | Office | 65 (32.5%) |
| 71–80 | 44 (22%) | No | 42 (21%) |
| 81–90 | 21 (10.5%) | | |

3.2. Distribution on the basis of obese, hypertensive, smoking and sedentary life style

The mean Body Mass Index BMI of study population was 26.6 ± 5.81 (female 26.2 ± 6.81 , male 25.5 ± 4.71). 42% ($n = 84$) of all diabetic patients were found obese. 61.5% ($n = 123$) was hypertensive while 43% ($n = 86$) had sedentary life style, 29% ($n = 58$) males were smoker shown in (Table 1).

3.3. Prevalence and pattern of dyslipidemia

In our study prevalence of dyslipidemia in hyperglycemic patients was 95%. The most prevalent lipid abnormality was high LDL (88%) followed by low HDL (71.5%).

Combined dyslipidemia was most common in both male (47.5%) and female (45.88%). Combined dyslipidemia with high TG and low HDL (27.5%) was most common in male while in female high LDL and low HDL (22.5%) were most common. The second most common pattern was isolated dyslipidemia in males (35%) and in females (28.33%). In this dyslipidemia high LDL affects 21.6% males and low HDL affects 22.5% females Table 2.

3.4. Prevalence of dyslipidemia association with age, obesity and hypertension

In our study hyperglycemic male patients with disturbed cholesterol level were 29.5%, most of them were above the age of 40, obese and hypertensive were 14 and 21, respectively. In abnormal triglyceride level out of 45 patients 17 were <40 years and 28 > 40 years. 53.3% had obesity while 30 were hypertensive. 59 patients had less than 40 mg/dl abnormal HDL level while 34 had increased LDL level (Table 3).

In female abnormal cholesterol was identified in 28.2%, 10 were <40 years and 14 were >40 years and 75% was hypertensive. 45.8% had greater than 150 mg/dl abnormal triglyceride level, 17 were below 40 years and remaining were above 40 years of age. 16 were obese and 25 had hypertension. With reduced HDL less than 50 mg/dl 53.18 were obese and 30 suffering from hypertension (Table 3, Figs. 1 and 2).

3.5. Serum lipid profile

Individual serum lipid levels for males and females are shown in Table 4. In male serum TG was 141.01 ± 36.93 , HDL, 38.5

Table 2 Pattern of dyslipidemia in male and female.

| Pattern of dyslipidemia | Male N (%) | Female N (%) |
|---|------------|--------------|
| <i>Mixed dyslipidemia</i> (LDL ≥ 100 mg/dl, TG ≥ 150 mg/dl & HDL < 40 mg/dl{male}, < 50 mg/dl{female}) | 21 (17.5%) | 13 (16.25%) |
| <i>Combined two parameter dyslipidemia</i> | | |
| (a) (LDL ≥ 100 mg/dl, TG ≥ 150 mg/dl & HDL > 40/50 mg/dl) | 18 (15%) | 15 (18.75%) |
| (b) (LDL < 100 mg/dl, TG ≥ 150 mg/dl & HDL < 40/50 mg/dl) | 6 (5%) | 8 (9.41%) |
| (c) (LDL ≥ 100 mg/dl, TG < 150 mg/dl & HDL < 40/50 mg/dl) | 33 (27.5%) | 18 (22.5%) |
| <i>Isolated single parameter dyslipidemia</i> | | |
| (a) (LDL ≥ 100 mg/dl, TG < 150 mg/dl & HDL > 40/50 mg/dl) | 26 (21.6%) | 7 (8.75%) |
| (b) (LDL < 100 mg/dl, TG ≥ 150 mg/dl & HDL > 40/50 mg/dl) | 6 (5%) | 0 (0%) |
| (c) (LDL < 100 mg/dl, TG < 150 mg/dl & HDL > 40/50 mg/dl) | 10 (8.3%) | 19 (23.75%) |
| Total | 120 | 80 |

LDL: Low Density Lipoprotein, TG: triglyceride, HDL: High Density Lipoprotein

Table 3 Specific prevalence association of dyslipidemia with age, obesity and hypertension.

| Lipid profile N (%) | Age | | Obesity N (%) | HT N (%) |
|-----------------------------------|------------|------------|------------------|-------------|
| | < 40 N (%) | > 40 N (%) | | |
| <i>Cholesterol > 200 mg/dl</i> | | | | |
| Male | 34 (29.5%) | 8 (23.5%) | 26 (76.4%) | 14 (41.1%) |
| Female | 24 (28.2%) | 10 (41.6%) | 14 (58.3%) | 10 (41.6%) |
| <i>TG > 150 mg/dl</i> | | | | |
| Male | 45 (39.1%) | 17 (37.7%) | 28 (24.3%) | 24 (53.3%) |
| Female | 39 (45.8%) | 17 (43.5%) | 22 (56.4%) | 16 (41%) |
| <i>HDL < 40/50 mg/dl</i> | | | | |
| Male | 59 (51.3%) | 26 (44%) | 33 (55.9%) | 25 (42.3%) |
| Female | 53 (62.3%) | 13 (24.5%) | 40 (75.4%) | 18 (33.9%) |
| <i>LDL > 100 mg/dl</i> | | | | |
| Male | 34 (29.5%) | 11 (32.3%) | 23 (67.6%) | 15 (44.1%) |
| Female | 22 (25.8%) | 8 (36.3%) | 22 (99.9%) | 7 (31.8%) |

LDL: Low Density Lipoprotein, TG: triglyceride, HDL: High Density Lipoprotein

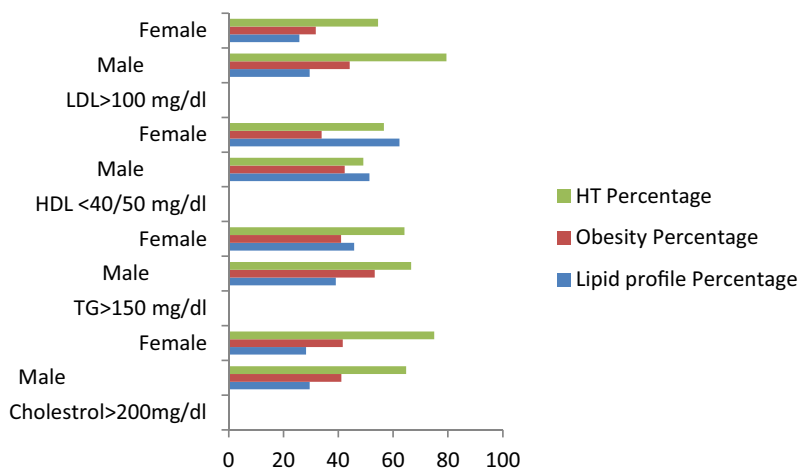


Figure 1 Graphical presentation of association of dyslipidemia with obesity and hypertension.

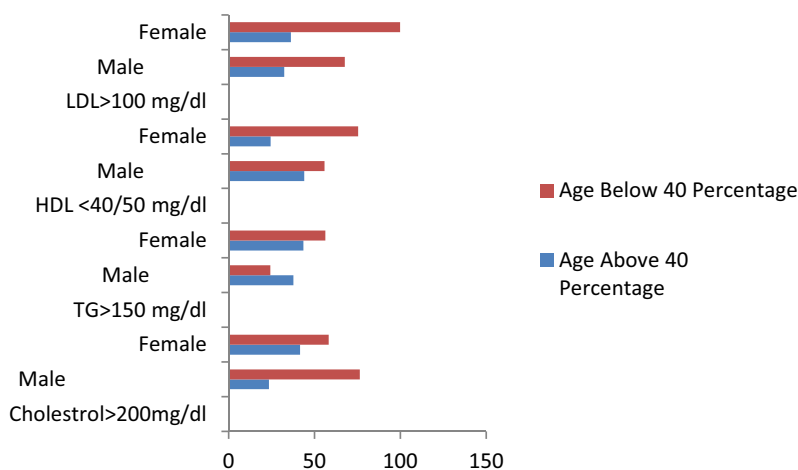


Figure 2 Graphical presentation of association of dyslipidemia with age.

Table 4 Serum lipid levels in male and female.

| Serum lipid level | Male | Female |
|-------------------|----------------|----------------|
| Triglyceride | 141.01 ± 13.03 | 147.75 ± 12.16 |
| LDL | 121.60 ± 7.16 | 115.72 ± 6.07 |
| HDL | 38.5 ± 4.10 | 46.64 ± 3.19 |

LDL: Low Density Lipoprotein, HDL: High Density Lipoprotein

± 7.18 and LDL, 121.60 ± 15.36. Serum TG was 147.75 ± 34.66, HDL, 46.64 ± 6.89 and LDL, 115.72 ± 17.57 in female patients (Table 4) (see Fig. 3).

3.6. Prevalence of complications in hyperglycemic patients

In Table 5 prevalence of complications in diabetic patients is shown. Neuropathy and retinopathy affect 41% and 32% patients, respectively, 23% patients were suffering from gangrene and 20 patients had carbuncles. Among 200 patients 126 were hypertensive (see Fig. 4).

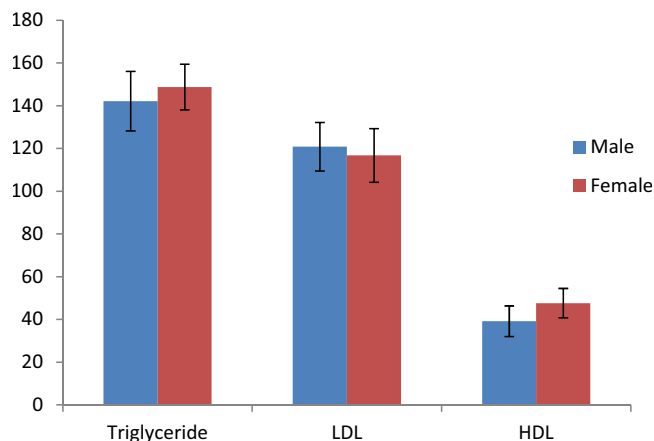


Figure 3 Lipid profile in male and female.

4. Discussion

Diabetes mellitus patients have a high prevalence of coronary artery disease. Coronary artery disease is the most common

| Complications | N (%) |
|---------------|-----------|
| Neuropathy | 82 (41%) |
| Retinopathy | 64 (32%) |
| Nephropathy | 62 (31%) |
| Gangrene | 46 (23%) |
| Carbuncles | 20 (10%) |
| Hypertension | 126 (63%) |

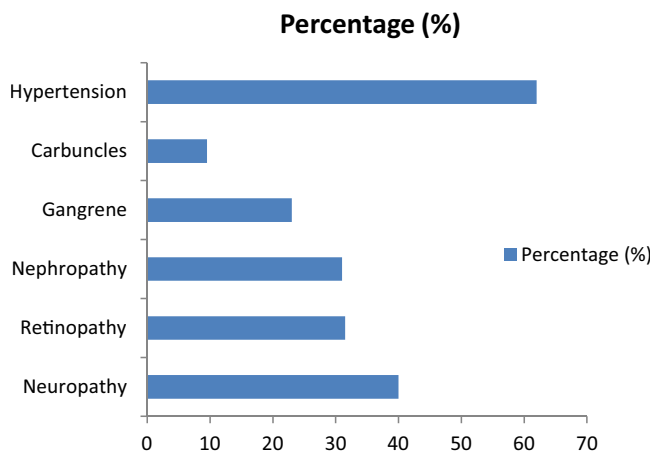


Figure 4 Graphical presentation of complications of hyperglycemic patients.

mortality in hyperglycemic patients and is associated with increased level of serum LDL. The risk of cardiovascular heart diseases in hyperglycemic patients is two to four times more as compare to normal. Lipid abnormalities (hyperchylomicronemia, increased level of LDL, VLDL and triglycerides; and low levels of HDL) are an important cause of atherogenesis and known as atherogenic dyslipidemia. Lipid abnormalities may be the result of unbalanced metabolic state of diabetes and improved control of hyperglycemia does moderate diabetes-associated dyslipidemia (Ahmad et al., 2008). Two hundred subjects were recruited for this study and there was a significant difference between the number of male (120) and female (80) subjects. Majority (68.5%) of the hyperglycemic patients were aged above 40 years. The age of diabetic patients was observed to be above 40 years confirmed by earlier workers, their studies reported that age plays a major role in the risk of developing type 2 diabetes especially after 40 years (Tagoe and Amo-Kodieh, 2013; Agrawal et al., 2014). The results showed in the present study that in hyperglycemic patients the lipid profile is higher and the similar results were shown by Agrawal et al. (2014) and Huang et al. (2014).

In our study prevalence of dyslipidemia was 95% in hyperglycemic patients. Two different studies conducted in India showed the prevalence of dyslipidemia in hyperglycemic patients was 89% and 92.4% (Udawat et al., 2001; Jayarama et al., 2012). Prevalence of dyslipidemia in diabetic patients was 99.13% in males and 89.14% in females, whereas in the study of Jayarama it was 95.40% and 86.75% for male and female, respectively (Jayarama et al., 2012). In this study high prevalence of dyslipidemia could be credited to urbanization in

the population from villages. Modernized life style associated with increasing urbanization, characterized by no physical activity, change of diet plan causes obesity leads to development of diabetes type 2.

The most common pattern of dyslipidemia among males was combined dyslipidemia with high LDL and low HDL (27.5%) but in females it was combined dyslipidemia with high LDL and low HDL (22.5%), this pattern of combined dyslipidemia was also studied in another study conducted in Southern India by Jayarama, it was found that the prevalence of dyslipidemia in type 2 diabetes mellitus as a whole in females was 86.75% with 29.7% single parameter of dyslipidemia, triglycerides was found in about 56.46% and low HDL was found in about 72.92% (Jayarama et al., 2012). And the total prevalence of dyslipidemia and triglyceridemia was found almost similar to our study group. Isolated dyslipidemia was the second most common pattern among males it was 35% and in females 32.5%. The most prevalent lipid abnormality in our study was high LDL (89.5%) followed by low HDL (70.5%), whereas in another study conducted in Kuwait isolated dyslipidemia is the second most common pattern with increased LDL-cholesterol, observed in 21% of the patients (Al-adasni et al., 2004). Ramu Kandula et al. conducted a study in Hyderabad (India) showing that prevalence of dyslipidemia was 86%, while high total cholesterol was 41%, LDL was 64%, triglycerides was 47% and low HDL was 71% (Kandula and Shegokar, 2013). This prevalence of dyslipidemia was relevant to our study. A study conducted in Nishtar Hospital Multan showed that 21% patients with diabetes had raised serum cholesterol and 34.2% had raised serum triglyceride level (Ahmad et al., 2008), while in another study conducted in 2011, 14% diabetic patients had raised cholesterol level while 31% patients had raised TG level (Uttra et al., 2011). In our study high cholesterol level was found in 29% patients and serum TG found in 42% hyperglycemic patients. Different values of serum cholesterol may be due to different dietary habits of people in different cities of the country.

In diabetic patients dyslipidemia was observed in the present study and there was a significant difference in the levels of HDL and LDL but when the mean \pm standard error of the variables were separated for male and female patients then there was no significant difference found between them. The results showed no gender difference in the lipid metabolism of diabetic patients which was in agreement with the finding of Vinter-Repalust et al. (2007). However Gustafsson et al. reported a significant difference in the prevalence of hyperglycemic patients between genders (Gustafsson et al., 2004).

According to different survey reports diabetes mellitus has been one of the most prevailing diseases. Its complications may cause death directly and indirectly (Wan et al., 2003). According to a survey of 100 patients, 31% hyperglycemic patients had vision problem, 81% were hypertensive, 40% with neuropathy and 26% had nephropathy (Torangti and Naik, 2000) but in our study most prevalent complication associated with hypertension secondly neuropathy and then retinopathy which was about 63%, 41% and 32%, respectively. The complications can be reduced by management of diabetes. Further research would be done to determine the management of dyslipidemia and other complications. Adequate knowledge about the different factors controlling diabetes and its complications are important. Improper diet, treatment and life style may be the leading cause of dyslipidemia and other complications.

5. Conclusion

Our study showed common abnormal lipid levels during hyperglycemia induced dyslipidemia are hypercholesterolemia, hypertriglyceridemia and elevated Low Density Lipoprotein cholesterol. Results suggest dyslipidemia is more prevalent in patients having poor glycemic control which might play a major role in the development of cardiovascular disease among diabetic patients. Combined lipid abnormalities are more as compared to isolated or single abnormality in lipid profile. Optimal care, routinely monitoring of blood glucose level and lipid profile should be helpful to cure this abnormality.

Questionnaire for hyperglycemic patients

Hospital name:

Laboratory name:

Date:

(1) Status of patients

Name

Age

Height

Weight

Gender

Male

Female

Work status

Office work

Field work

Marital status

Married

Single

Divorced

(2) Health status

Obesity

Yes

No

Drug intake

Yes

No

Family History

Yes

No

Other chronic disease

Yes

No

Sedentary lifestyle

Yes

No

Smoker

Yes

No

(3) Lab data

Normal value

Lab value

Blood glucose level at fasting

Lipid profile

HDL-C

LDL

TG

Cholesterol

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