Research Article

Association between glycemic control and serum lipid profile in known diabetic patients of civil hospital, Ahmedabad

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Received June 18, 2015. Accepted July 20, 2015

Abstract

Background: Patients with type 2 diabetes have more chances of developing dyslipidemia when compared with nondiabetic persons; hence, they are at risk of developing cardiovascular complications. A timely intervention to normalize circulating lipids could reduce the chances of cardiovascular complications.

Objective: (1) To study the prevalence, pattern, and severity of dyslipidemia in diabetic patients, and (2) to find the association between glycemic control and serum lipid profile in diabetic patients.

Materials and Methods: A prospective cross-sectional study was conducted to analyze the pattern of dyslipidemia in diabetic patients who are attending the Diabetes Clinic at Civil Hospital, Ahmedabad. After obtaining informed consent from eligible patients, detailed history, clinical examination, and laboratory testing of all the enrolled patients were done. Standard criteria were used to classify the patient in diabetes under control or not. If a patient showed any lipid component abnormality, he was classified as a dyslipidemic subject. Mean and standard deviation were used to express all parameters. The χ^2-test and unpaired *t*-test were used to know statistical significance. Pearson's correlation test was performed to examine various correlations. All data entry was done in Microsoft Excel and analyzed with statistical software, Epi Info 7.

Result: Of 187 diabetic patients enrolled in the study, over 80% patients showed dyslipidemia. The prevalence of dyslipidemia was more among males when compared with female patients. Age, duration of diabetes, and obesity-like confounding factors were not able to influence the prevalence and pattern of diabetic dyslipidemia in our study. Only proper control of diabetes has shown statistically significant difference ($p < 0.05$) on prevalence and severity of dyslipidemia, consolidating the fact that the proper treatment and strict control of diabetes is the most important step in prevention of dyslipidaemia.

Conclusion: Only proper control of diabetes has shown statistically significant difference on the prevalence and severity of dyslipidemia, consolidating the fact that the proper treatment and strict control of diabetes is the most important step in the prevention and treatment of complications of diabetes.

KEY WORDS: Diabetes, glycemic control, dyslipidemia, glycated hemoglobin (HbA1c)

Access this article online	
Website: http://www.ijmsph.com	Quick Response Code:
DOI: 10.5455/ijmsph.2016.18062015306	

Introduction

The term diabetes mellitus (DM) describes a metabolic disorder with different causative factors, which is characterized by chronic hyperglycemia and disturbances of carbohydrate, fat, and protein metabolisms resulting from defects in insulin secretion, insulin action, or both.[1] It is a global endemic with rapidly increasing prevalence in both developing and

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developed countries.[2] India, which is an emerging Asian country with rapid industrialization and a modern lifestyle, is experiencing a serious issue in holding the largest number of people with diabetes,[3,4] which is expected to reach 80 million by the year 2030.[5,6] The WHO has stated India as "Diabetic Capital" of the world.[7] It is close to becoming the diabetic capital of the world. The literature on Indian studies revealed a threefold increase in the occurrence of diabetes in rural and urban areas.[8,9] Gujarat is no exemption to the abovesaid increase, and it harbors a considerable number of people with diabetes.

The long-term complications of diabetes include development of retinopathy, nephropathy, and neuropathy.[10] People with diabetes are also at increased risk of cardiac, peripheral arterial and cerebrovascular diseases.[11] Abnormal serum lipids are likely to contribute to the risk of coronary artery disease in diabetic patients, and the determination of the serum lipid levels in people with diabetes is now considered as a standard of the diabetes care.[12,13] Glycemic control with decreased level of HbA1c probably reduces the risk of complications.[14] Estimated risk of cardiovascular disease (CVD) has shown to be raised by 18% for every 1% rise in absolute HbA1c value in the diabetic population.[15] Even in nondiabetic cases with HbA1c levels within normal range, positive relationship between HbA1c and CVD has been demonstrated.[16,17] A few studies have formerly tried to discover the connection between HbA1c levels and lipid profile. Some of these have revealed that all the parameters of lipid profile exhibit an important relationship with glycemic control.[18]

There are very limited data available for occurrence of dyslipidemia and diabetes from Indian continent, which are mainly from South Indian urban population and few from North Indian urban population.[19–22] We were not capable to find studies on occurrence and pattern of dyslipidemia in diabetic Gujarati population. This study aims to bridge the gap by studying the prevalence, pattern, and severity of dyslipidemia in diabetic patients. Other aim is to find the association between glycemic control and serum lipid profile in diabetic patients.

Materials and Methods

A prospective cross-sectional study was conducted to analyze the pattern of dyslipidemia in diabetic patients attending the Diabetes Clinic at Civil Hospital, Ahmedabad, Gujarat, India. All the known diabetic patients who visited the diabetic clinic during the period of January 2013–December 2013 were covered as study participants. The patients who already showed history of cerebrovascular disease or were diagnosed as presenting cerebrovascular disease on enrolment and patients already taking lipid-lowering drugs were excluded from the study. Diabetic patients with other chronic systemic or metabolic disorders were not included in the study.

After obtaining informed consent from eligible patients, detailed history was obtained, and clinical examination of all the enrolled patients was done. Anthropometric measurements (weight, height, waist circumference, and hip circumference) were taken using standard methods. Fasting blood sample was collected for serum lipid profile investigation after 10 h overnight fast. Cutoff normal values for individual lipid levels were taken as per the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III).[23] The term mixed dyslipidemia is used when two or more individual lipid levels were abnormal. All diabetic patients were categorized obese or nonobese using body mass index (BMI) criteria of ≥ 23 kg/m^2 proposed for South Asian population (IDF-modified ATP III criteria)[23] ADA criteria for treatment of diabetes (HbA1C <7% or fasting/preprandial plasma glucose <130 mg/dL and postprandial plasma glucose <180 mg/dL for two consecutive visits) were used to divide the patients in controlled and uncontrolled groups.[24]

All data entry was done in Microsoft Excel and analyzed with statistical software Epi Info 7. The values of all the parameters were given in mg/dL, and they were expressed as mean ± SD. The statistical significance of the difference between the control and the study groups were evaluated by the Student's *t*-test. Pearson's correlation test was performed to examine various correlations.

Result

Of 187 diabetic patients enrolled in the study, 98 were male and 89 female patients. The mean age of study population was 55.8 ± 10.12 years. The mean duration from diagnosis of diabetes for the study patients was 4.8 ± 3.64 years. Only 12.38% of patients showed DM since >10 years, and 37.97% were diagnosed as diabetic patients in the last 2 years only. Around 29.95% were diabetic patients since 2–5 years, and 19.79% were diabetic cases since 5–10 years. The mean BMI (kg/m^2) of study population was 25.6 ± 5.81 (male: 24.5 ± 4.71 and female: 27.2 ± 6.81). Moreover, 73.80% (n = 138) of all diabetic patients participated in study were found to be obese by modified ATP III criteria of BMI ≥23 for South Asian population. Only 17.11% of study patients exhibited well-controlled sugar level. There were 29.95% smokers among study participants [Table 1].

The level of mean serum cholesterol level was 197.76 mg/dL, mean serum triglyceride (TG) 173.69 mg/dL, mean serum HDL 34.64 mg/dL, mean serum low-density lipoprotein (LDL) 107.91 mg/dL, and mean serum very-low-density lipoprotein VLDL 38.34 mg/dL [Table 2]. Of 187 DM patients, 48.66% (n = 91) patients showed high serum cholesterol level, while almost similar number of patients [47.59% (n = 89)] showed high serum TG levels. About 49.20% (n = 92) showed high serum LDL level, while 52.94% patients had abnormally low serum high-density lipoprotein (HDL) level [Table 2].

Of 187 patients, 32 patients showed HbA1c values less than or equal to seven (GGC), while rest of patients showed HbA1c values more than seven (PGC). The mean values of

Table 1: Patient characteristics and prevalence of dyslipidemia

Characteristics	Number of patients, (*n* = 187)	Patients with dyslipidemia*, (*n* = 151)	*P*
Age (in completed years)			
<45	54 (28.88)	45 (83.33)	0.7073
45–60	108 (57.75)	85 (78.70)	
>60	25 (13.37)	21 (84)	
Sex			
Male	98 (52.40)	83 (84.69)	0.1937
Female	89 (47.60)	68 (76.40)	
Control of DM			
Controlled	32 (17.11)	20 (71.87)	0.008
Noncontrolled	155 (82.89)	131 (82.58)	
Obesity			
Nonobese (BMI < 23 kg/m^2)	49 (26.20)	35 (71.43)	0.3341
Obese (BMI > 23 kg/m^2)	138 (73.80)	116 (84.06)	
Smoking			
Smoker	56 (29.95)	50 (89.28)	0.0678
Nonsmoker	131 (70.05)	101 (77.09)	
Duration of DM (years)			
<2	71 (37.97)	57 (80.28)	0.7137
2–5	56 (29.95)	43 (76.78)	
5–10	37 (19.79)	31 (83.78)	
>10	23 (12.38)	20 (86.97)	

*Percentage in each group is from total patient in that group.

Table 2: Serum lipid levels of diabetic patients

Parameter	Mean ± SD	Abnormal value	Number of patients with abnormal value, *n* = 187
Cholesterol	197.76 ± 31.46	> 200 mg/dL	91 (48.66)
Triglyceride	173.69 ± 43.64	> 150 mg/dL	89 (47.59)
LDL	107.91 ± 21.54	> 100 mg/dL	92 (49.20)
VLDL	38.34 ± 11.21	> 32 mg/dL	98 (52.41)
HDL	34.64 ± 6.60	< 40 mg/dL	99 (52.94)

Table 3: Lipid parameters categorized by patient's long-term glycemic control (HbA1c)

Parameter	Mean in patient with controlled diabetes (HBA1c < 7 mg/dL)	Mean in patient with uncontrolled diabetes (HBA1c > 7 mg/dL)	*P*
Cholesterol	178.78 ± 27.01	199.57 ± 29.58	0.0036
Triglyceride	158.46 ± 45.67	186.24 ± 46.56	0.0138
LDL	83.65 ± 19.89	108.45 ± 20.23	<0.0001
VLDL	32.65 ± 9.23	37.97 ± 10.76	0.0379
HDL	37.76 ± 5.57	34.98 ± 6.77	0.0825

Table 4: Control of diabetes and lipid profile

Parameter	FBS (fasting blood sugar) correlation coefficient	PPBS (Postparandial blood sugar) correlation coefficient
Weight	–0.15473	–0.15254
BMI	–0.16682	–0.12102
Total cholesterol	0.25886	0.28566
Triglycerides	0.16280	0.17560
HDL	–0.11597	–0.12482

total cholesterol (TC), TG, LDL, and VLDL in GGC groups were significantly lower than PGC group [Table 3].

Fasting and postparandial blood glucose levels showed positive correlation coefficient with TC and TG levels, while it showed negative correlation coefficient with serum HDL level. Fasting and postparandial blood glucose levels also showed negative correlation coefficient with body weight and BMI of patients [Table 4].

Discussion

Patients with DM exhibit a two-fold–four-fold increased risk of CVDs, which are the leading causes of morbidity and mortality in this population. Many Western epidemiological studies have shown an association between diabetic dyslipidemia and the occurrence of CVD.[25–27] The analysis of data from our study provides an opportunity to examine dyslipidemia, a major cardiovascular disease risk factor, in known type 2 diabetic individuals. This study shows very high prevalence of dyslipidemia (80.74%) in ethnic Gujarati diabetic population. Male subjects showed deranged lipid levels in higher numbers compared with female subjects, and this result is similar to the study finding conducted in a rural-based teaching hospital in Gujarat.[28]

Most of the diabetic patients revealed uncontrolled sugar status (82.89%), and, of these, 82.58% of patients also presented dyslipidemia, while only 71.87% of controlled or well-treated diabetes group showed dyslipidemia ($p < 0.05$). This finding supports the theory that control of diabetes is very necessary for favorable lipid profile.

In our study, most of the diabetic patients showed mixed dyslipidemia (i.e., more than one lipid abnormality). The most common mixed abnormality detected was hypertriglyceridemia and high LDL level (39.1%), which is different from our western counterparts showing hypertriglyceridemia and low serum HDL as major abnormality.[29,30] The other types of mixed dyslipidemia observed in study were: (1) Hypertriglyceridemia with hypercholesterolemia, and (2) hypercholesterolemia with high LDL level. All lipid components were found to be deranged in 10.5% of the diabetic patients, suggesting very high rate of severe form of dyslipidemia in diabetic patients.

Fasting and postparandial blood glucose levels show positive correlation coefficient with TC and TG levels, while it shows negative correlation coefficient with serum HDL level. Fasting and postparandial blood glucose level also show negative correlation coefficient with body weight and BMI of patients.

A very high rate of dyslipidemia was observed in patients with diabetes, which suggests that obesity, diabetes, dyslipidemia, and all major CAD risk factors go hand-in-hand in Gujarati population. As observed in all other subgroups, hypertriglyceridemia and high LDL levels were also noted in diabetic group. But, more surprisingly, even nonobese diabetic patients also showed high prevalence of dyslipidemia (71.43%) with similar pattern as obese patients. Age, duration of diabetes, and obesity-like confounding factors were not able to influence the prevalence and pattern of diabetic dyslipidemia in our study. Only proper control of diabetes has shown statistically significant difference ($p < 0.05$) on prevalence and severity of dyslipidemia, consolidating the fact that the proper treatment and strict control of diabetes is the most important step in prevention of dyslipidemia.

Conclusion

As shown in our study, dyslipidemia in diabetes, very critical CAD risk factor has a high prevalence in Gujarati population; but, surprisingly, only very few diabetic patients were investigated for their lipid profile in past. For this reason, we strongly recommend detailed lipid profile to be done for each and every diabetic patient at the time of diagnosis and, regularly, on follow-up. Overall uncontrolled DM is closely associated with dyslipidemia. Thus, it is of great importance to opt for lifestyle modification so that complications of diabetes could be avoided.

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How to cite this article: Agarwal M, Patel JP, Lala MK. Association between glycemic control and serum lipid profile in known diabetic patients of civil hospital, Ahmedabad. Int J Med Sci Public Health 2016;5:356-360

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