

Association of HbA1c and Lipid Profile in Type 2 Diabetes Mellitus Patients: A Retrospective Study in the Region of Arar, Saudi Arabia

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ABSTRACT

Introduction: Type 2 diabetes is the most common form of diabetes mellitus and is associated with a cluster of interrelated plasma lipid and lipoprotein abnormalities, including reduced HDL cholesterol, a predominance of small dense LDL particles, and elevated triglycerides. A retrospective study was conducted to analyze the level of various serum parameters (such as glucose, cholesterol, urea, uric acid, total protein and albumin along with body mass index) and to correlate HbA1c and lipid profile in type 2 diabetes mellitus patients.

Methods: This study included 100 patients (males=50, females=50) suffering from type 2 diabetes mellitus, attending Diabetes Centre of Prince Abdul Aziz Bin Mosaad Hospital, Arar, Saudi Arabia, from March 2016 to February 2017. Review of patients' records in the diabetes centre was performed and all available demographic and laboratory data in patients' files were collected and analyzed.

Results: The results of the present study showed that among 100 diabetic patients, 82 patients had urine sugar, 77 had urine albumin and 15 had ketone bodies in urine. The data analysis also revealed that serum fasting glucose, cholesterol, triglyceride, LDL, urea, total protein and HbA1c levels of diabetic patients were significantly higher than the normal range. Serum albumin levels were lower and serum uric acid

levels were within the normal range. The correlational study confirmed a strong positive correlation among the values of HbA1c, serum triglycerides, cholesterol and LDL.

Conclusion: The measurement of HbA1c levels is important not only for monitoring of diabetes but also dyslipidemia associated with diabetes.

Keywords: Type 2 Diabetes Mellitus; HbA1c; Lipid Profile; Glucose.

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INTRODUCTION

Diabetes mellitus characterized by high levels of blood glucose is a major health problem and one of the leading causes of morbidity and mortality worldwide. About 2.2% to 3% of the world's population suffers from type 2 diabetes mellitus.¹ It is one of the fastest-growing health problem in the world, which is now reaching to epidemic proportion in some countries. Saudi Arabia is among top ten countries of the world with highest prevalence.² This increase in incidence of diabetes follows the trend of urbanization and lifestyle changes, perhaps most importantly a "western style" diet. Over the past four decades major socio-economic changes have occurred in Saudi Arabia. The growth and prosperity have brought pronounced changes in the lifestyle of the people leading to unhealthy eating habits and declined level of physical activity. This has resulted in the dramatic increase in the diabetes prevalence.³

Hyperlipidaemia (hypercholesterolemia) is a common finding among DM patients and may be a predictor of diabetes. Elevated cholesterol levels are often seen in patients with insulin resistance, even before they have developed full-blown diabetes. Hyperlipidaemia is associated with high body mass index and this has increased emphasis on other risk factors for cardiovascular disease such as high blood pressure. Hyperuricaemia is also associated with possible confounding factors including elevated serum triglyceride and cholesterol concentration, blood glucose and post carbohydrate plasma insulin concentration.⁴ Hyperuricemia has been described as a strong predictor of well-defined cerebrovascular complication (stroke) in patients with type 2 diabetes. The Glycosylated hemoglobin (HbA1c) widely accepted and used as the most reliable test for assessment of chronic glycaemia,⁵ reflects the overall blood glucose levels over a

period of 2-3 months and may be used to assess changes in metabolic control that follow an alteration in treatment.⁶ Since, adequate glycemic control can delay development of diabetic complication, the purpose of this study was to analyze the serum parameters such as glucose, cholesterol, triglycerides, LDL, urea, uric acid, total protein and albumin along with body mass index (BMI) and glycated hemoglobin (HbA1c) in type 2 diabetes mellitus patients and bring out a possible correlation between HbA1c and different types of lipids, in order to highlight the significance of such a correlation which can prevent exacerbation of cardiovascular risk-related mortality.

MATERIALS AND METHODS

This retrospective study was carried out in the region of Arar, Saudi Arabia, during the period of March 2016 to February 2017. The study included 100 patients (males=50, females=50) suffering

from type 2 diabetes mellitus, attending Diabetes Centre of Prince Abdul Aziz Bin MUSAAD Hospital, Arar. Review of patients' records in the diabetes centre was performed and all available demographic and laboratory data in patients' files were collected and analyzed. Privacy and confidentiality of the obtained data had been insured. The work was approved by local authority committee of Northern Border University, Faculty of Medicine and Applied Medical Sciences and Diabetes Centre of Prince Abdul Aziz Bin MUSAAD Hospital, Arar.

Statistical Analysis

Statistical analysis was performed using ANOVA and descriptive variables such as mean, standard deviations were used. The value $p < 0.05$ was considered significant. Linear regression analysis (Pearson correlation coefficient) was performed for determining the degree of association between different parameters.

Table 1: Summary of some demographic data for type 2 DM patients

Mean age (years)	58.68 ± 10.89
Minimum age (years)	33
Maximum age (years)	81
Gender	Males: 50 (50 %) Females: 50 (50 %)
Positive Family history	18/ 100 cases (18 %)
Mean weight (kg)	78.17 ± 16.15
Mean BMI (kg/m²)	30.90 ± 4.92

Table 2: Distribution of patients according to presence of urine sugar, ketones and albumin

	Present	Absent	Total
Urine albumin	77	23	100
Urine sugar	82	18	100
Urine ketones	15	85	100

Table 3: Analysis of different serum biochemical parameters among male and female type 2 DM patients (Mean ± SD)

Biochemical parameters	Males (n=50)	Females (n=50)	Reference range
Fasting glucose (mmol/l)	10.55 ± 5.48	9.84 ± 2.72	4.4-6.4
Cholesterol (mmol/l)	5.96 ± 0.80	5.61 ± 0.60	1.3-5.2
LDL (mmol/l)	4.36 ± 0.81	4.01 ± 0.78	1.7-3.4
Triglycerides (mmol/l)	2.90 ± 0.60	2.68 ± 0.53	0.4-2.1
Blood Urea Nitrogen (mmol/l)	7.35 ± 1.44	6.92 ± 1.32	2.5-6.4
Uric acid (µmol/l)	422.82 ± 33.58	402.96 ± 43.33	190-446
Total protein (g/L)	85.72 ± 5.55	84.46 ± 3.76	64-82
Albumin (g/dL)	31.77 ± 3.78	31.78 ± 3.16	34-50
HbA1c (%)	8.46 ± 1.18	9.09 ± 1.59	4.5-6

RESULTS

The mean age of studied patients (n= 100) was 58.68 ± 10.89 years with age range of 33-81 years. As outlined in table 1, the studied patients were 50 males (50 %) and 50 females (50%) with a male to female ratio of 1:1. Out of the 100 cases studied, 18 patients had a positive family history of type 2 DM. The mean BMI of these patients was 30.90 ± 4.92 kg/m². Among 100 diabetic patients, 82 patients had urine sugar, 77 had urine albumin and 15 of the patients had ketone bodies in urine (Table 2).

Table 3 outlines the level of some biochemical parameters among the studied participants. The mean value of fasting blood glucose among males and females was 10.55 ± 5.48 and 9.84 ± 2.72 mmol/l respectively which was much above the normal range. The value of cholesterol was 5.96 ± 0.80 and 5.61 ± 0.60 mmol/l in males and females respectively which was slightly higher than the normal range. Mean value of LDL was 4.36 ± 0.81 and 4.01 ± 0.78 in males and females respectively which was also higher

than the normal limits. The level of plasma triglycerides (TAG) was (2.90 ± 0.60 and 2.68 ± 0.53 mmol/l), blood urea nitrogen (7.35 ± 1.44 and 6.92 ± 1.32 mmol/l), uric acid (422.82 ± 33.58 and 402.96 ± 43.33 umol/l), total protein (85.72 ± 5.55 and 84.46 ± 3.76 g/L), albumin (31.77 ± 3.78 and 31.78 ± 3.16), HbA1c (8.46 ± 1.18 and 9.09 ± 1.59 %) in males and females respectively.

The main finding of the study was a significant positive correlation between HbA1c and different types of lipids (triglycerides, cholesterol and LDL) in type 2 DM patients. There was a significant rise in the values of the above parameters with an increase in HbA1c values (Figures 1, 2 and 3).

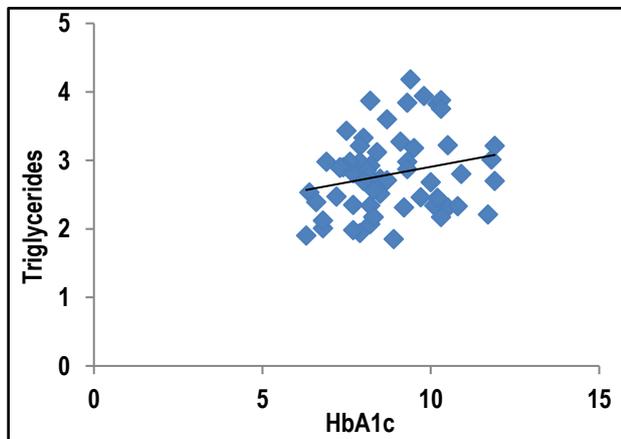


Figure 1: Correlation between HbA1c and serum triglycerides in type 2 DM patients ($r=0.226$, $p<0.05$)

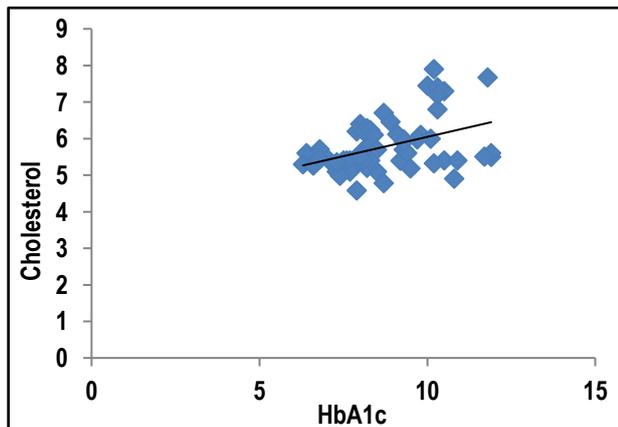


Figure 2: Correlation between HbA1c and cholesterol in type 2 DM patients ($r=0.412$, $p<0.05$)

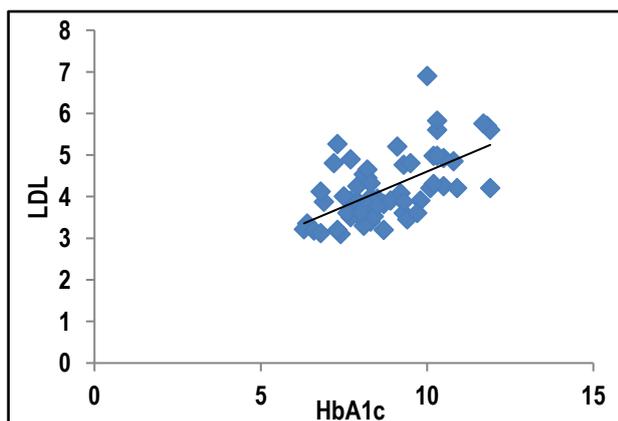


Figure 3: Correlation between HbA1c and LDL in type 2 DM patients ($r=0.591$, $p<0.05$)

DISCUSSION

Diabetes is associated with a high risk of cardiovascular disease (CVD). The increased risk of CVD in subjects with diabetes mellitus can be partially explained by the lipoprotein abnormalities associated with diabetes mellitus. The management of diabetic dyslipidemia, a well-recognized and modifiable risk factor, is a key element in the multifactorial approach to prevent CVD in individuals with type 2 diabetes.

The result of the present study showed that all diabetic subjects had significantly higher fasting blood glucose level. Glycosuria usually occurs when blood glucose concentration is greater than 10 mMol/L though this threshold varies considerably between individuals and increase with age. In this study, among 100 diabetic cases, 82 patients were having sugar in urine. Hyperlipidaemia is a common finding among diabetes mellitus patients. This study indicates that all diabetic subjects had significantly higher cholesterol, triglyceride and LDL levels. Hyperlipidaemia has been linked as a risk factor in coronary heart disease. In the present study total protein level was slightly higher in patients and serum albumin level was slightly lower than normal in the diabetic patients. Patients with end stage renal disease, severe renal failure and moderate renal failure showed lower serum albumin concentration. Serum albumin level decreased significantly in patient with reduced creatinine clearance. In this study among 100 diabetic cases, 77 patients were having albumin in urine. Serum albumin was significantly lower in patient with heavy proteinuria. Hypoalbuminaemia is considered a marker for malnutrition and strongest predictor of death in patients with renal failure. An elevation of blood urea usually signifies decreased renal function.⁷ In this study, patients were found to have higher blood urea than normal. The result of the present study showed that all diabetic subjects had uric acid levels within the normal limits. Uncontrolled HbA1c level is considered to be a strong indicator of uncontrolled glucose level in blood. The HbA1c reflects the overall blood glucose levels over a period of 2-3 months and the major use of the HbA1c assay is to assess changes in metabolic control that follow an alteration in treatment.⁶ In the present investigation, all the patients showed significantly elevated levels of HbA1c in blood. This was in agreement with Murugan,⁸ who reported that there was a strong relationship between fasting blood sugar level, postprandial blood sugar level and HbA1c level in diabetic patients. The measurement of HbA1c levels is important not only for monitoring of diabetes but also dyslipidemia associated with diabetes. Impaired lipid metabolism resulting from uncontrolled hyperglycemia has been implicated in cardiovascular complications in diabetes patients, this fact support our result which showed a significant positive correlation between HbA1c, serum triglycerides, total cholesterol and LDL in patients with DM, which are also confirmed by Khan et al.⁹ who stated that HbA1c exhibited direct correlations with cholesterol and LDL.

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