Research Article

Malays. j. med. biol. res.

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Clinical Significance of HbA1c in the Management of Complicated Type 2 Diabetic Patients in Bangladesh

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ABSTRACT

Diabetic patients are generally suffered by several other diseases such as dyslipidemia, cardiovascular and urinary diseases. Glycated hemoglobin (HbA1c) is a commonly used marker for identifying long-term glycemic control. The objective of this study is to investigate the co-relation of HbA1c with blood glucose level, serum lipid, cholesterol and creatinine level in type 2 diabetes patients. A prospective study was carried to collect data from the diabetic hospital, Dhaka, Bangladesh though interview and from the current pathological reports of the patients and then data was analyzed using Excel. Results showed that serum lipid concentration, fasting and postprandial blood glucose are directly related with the percentage of HbA1c in the blood. In addition, risks of hypertension, dyslipidemia and kidney diseases also showed higher in high percentage of HbA1c in the blood of the patients. However, HbA1c is independent with age, weight and height of the patients. This study will help to mange complicated diabetic patients by controlling HbA1c from the beginning of the treatment.

Key words: HbA1c, complicated diabetes, type 2 diabetes

INTRODUCTION

Diabetes is a metabolic disease and it is two types depending on their insulin secretion type and type 2. Type 2 diabetes is one of the most rapidly increasing life style related disease in throughout the world and have become complexed due to the presence of several associated diseases such as, cardiovascular disease (CVD), hyper lipidemia, dyslipidemia, increased level of LDL, decreased level of HDL, hypercholesterolemia and kidney disease where the risk factor is type 2 diabetes [Rader, 2007; Giansanti et al., 1999]. It has been reported that by reduce triglycerides and LDL and to increase HDL, significantly reduce cardiovascular events and mortality in patients with type 2 diabetes [Jones, 2006; Smith 2007]. There has been a significant correlation between dyslipidemia and systolic blood pressure in type 2 diabetics [Nasri and Yazdani, 2006]. It is assumed that the combination of hyperglycemia, diabetic dyslipidemia, insulin resistance and hypertension produces an enhanced atherogenic environment within the circulation [Gotto, 2007]. Severe hyperlipidemia in diabetes may also lead to lipid infiltration into the retina, that may cause macular edema and retinal hard exudates [Miljanovic et al., 2004] and blindness [Davey et al., 2006].

Glycated haemoglobin (HbA1c) was called as unusual haemoglobin in patients with diabetes when it was first discovered. After that discovery, it was established that HbA1c could be used as an objective measure of glycaemic control and a validated relationship between A1C and average glucose across a range of diabetes types and patient populations by an International Expert Committee recommendation which was later adopted by WHO (International Expert Committee, 2009; World Health Organisation, 2011). HbA1c was introduced into clinical use in the 1980s and subsequently has become a cornerstone of clinical practice and this recommendation was adopted by the American Diabetes Association in the following year and then by the WHO (Simon et al., 1985, American Diabetes Association, 2010). Nowadays, there has been increasing interest in using it as a diagnostic test for diabetes

and as a screening test for persons at high risk of diabetes. However, HbA1c may be affected by a variety of genetic, haematologic and illness-related factors such as erythropoiesis, altered haemoglobin, glycation, erythrocyte destruction etc. An International Expert Committee recommended that HbA1c can be used to diagnose diabetes and that the HbA1c level is 6.5%. However, long term prospective studies are required in all major ethnic groups to establish more precisely the glucose and HbA1c levels predictive of microvascular and macrovascular complications (World Health Organisation, 2006; Christensen et al., 2010, Dagogo-Jack et al., 2010).

In this research we tried to investigate the relationship among the various ranges of HbA1c levels with other conditions such as blood glucose, serum lipid, serum creatinine etc. and evaluated the relevance of HbA1c as an indicator of several other pathologies in type 2 diabetic patients.

PATIENTS AND METHODS

This prospective study comprised a total of 509 type 2 diabetic patients who visited a diabetic care hospital, Dhaka, Bangladesh. There were 75 males and 424 females within the average age of 46-54. All the patients were categorized into nine groups depending on their glycemic (HbA1c) values: 5-5.9 (17 patients), 6.0-6.9 (84 patients), 7.0-7.9 (120 patients), 8.0-8.9 (106 patients), 9.0-9.9 (88 patients), 10.0-10.9 (53 patients), 11.0-11.9 (24 patients), 12.0-12.9 (11 patients), 13.0-13.9 (6 patients). Data was collected from their reports while they were present in the hospital for the treatment after taking their verbal consent. Then, data was analyzed using Microsoft Excel.

RESULTS

Effect of age, weight and height on HbA1c

In this survey, it was found that height of the patients have no effect on the HbA1c as the average height of the patients were 105-154 cm. In respect to the weight and age of the patients, it also showed that there was not observed any significant effect on HbA1c. The result has shown in table 1:

Table 1: Effect of age, weight and height on HbA1c

HbA1c (%)	Age(yrs)	Weight(Kg)	Height(cm)
5.64	46.71	57.76	152.00
6.69	49.25	62.07	151.89
7.62	52.01	62.23	153.20
8.56	50.76	61.14	153.14
9.49	53.77	62.51	152.01
10.46	51.33	61.03	151.63
11.37	53.24	64.48	154.00
12.49	50.75	62.27	150.27
13.40	48.43	60.86	153.43

Effect of HbA1c on fasting and postprandial blood glucose

In order to investigate the effects of HbA1c on blood glucose level a comparison was made with their fasting and postprandial blood glucose concentrations and it was found that increased levels of HbA1c proportionately increased blood glucose concentrations both in fasting and postprandial states that shown in figure .
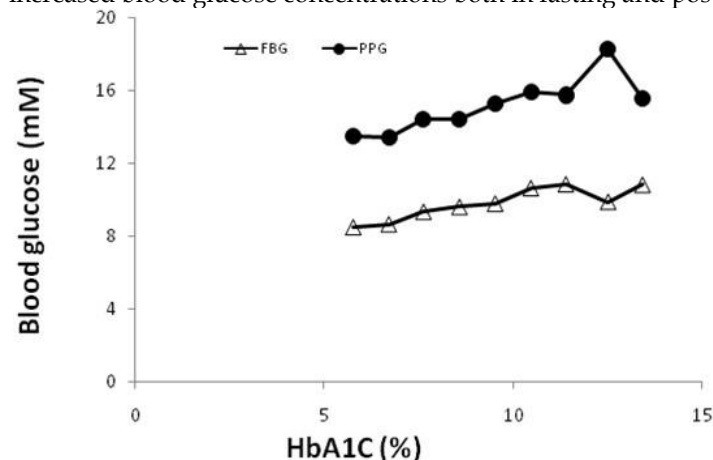

Figure 1: Effect of HbA1c on fasting and postprandial blood glucose. Open triangles indicate fasting blood glucose, close circle indicates postprandial conditions.

Effect of HbA1c on serum lipid

It has been found that there was no significant changes on HDL variations although HbA1c values changed from 5%-13%. However, LDL and cholesterol level were increased steadily with the higher values of HbA1c indicates that it has a direct relation with serum lipid. On the other hand, triglycerides concentrations were fluctuated over the varying concentrations of HbA1c. The result is shown in figure 2.
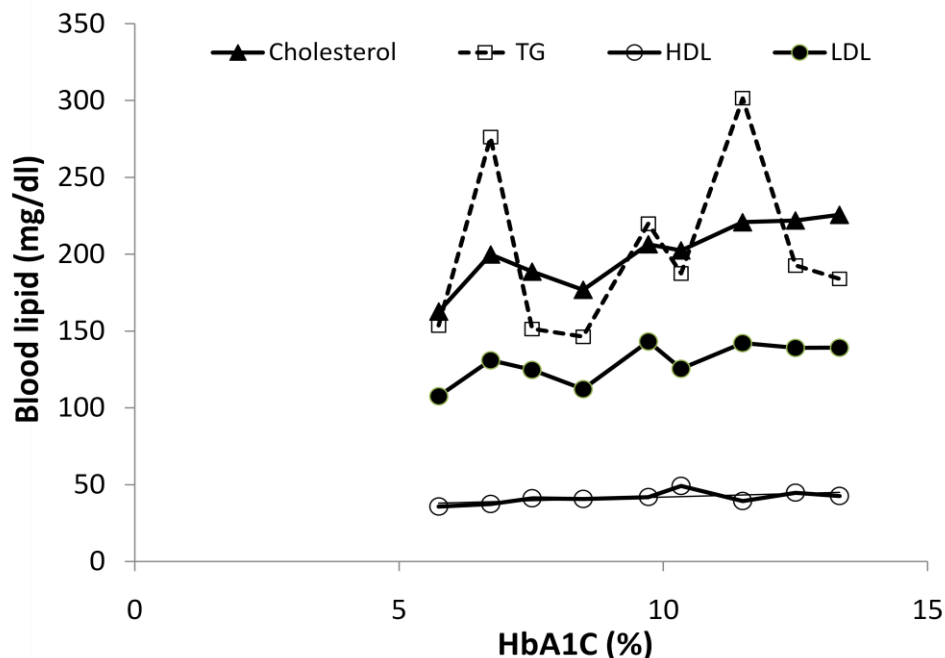

Fig. 2: Effect of HbA1c on serum lipid. Open circle indicates HDL, Close circle indicates LDL, Close triangles indicates cholesterol, Open square indicates triglycerides.

Effect of HbA1c on serum creatinine and SGPT

Increasing with the concentrations of HbA1c the values of serum creatinine and SGPT increases proportionately as shown in figure 3 & 4, although SGPT level rose more steeply than serum creatinine concentration.
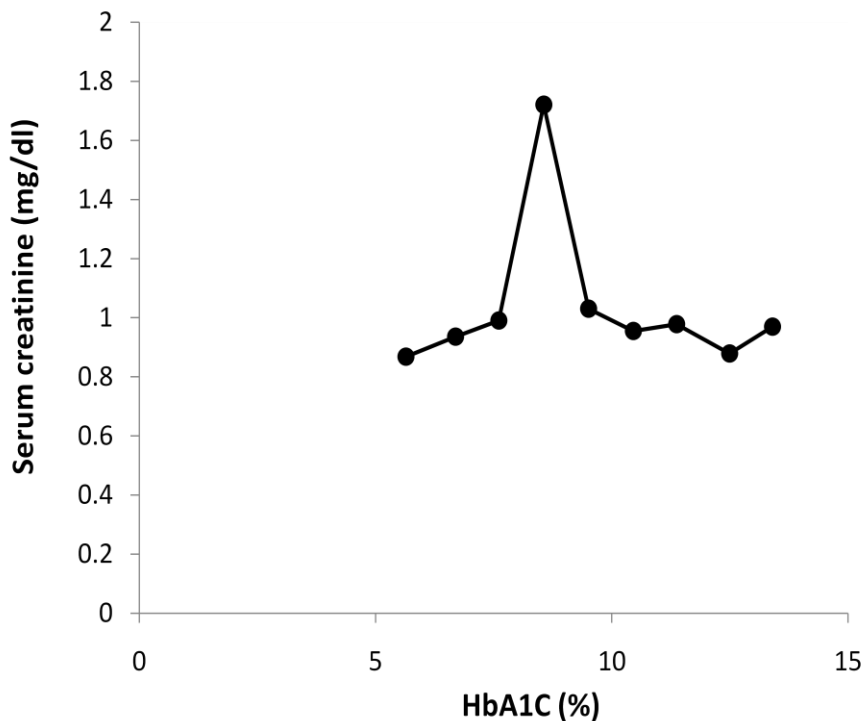

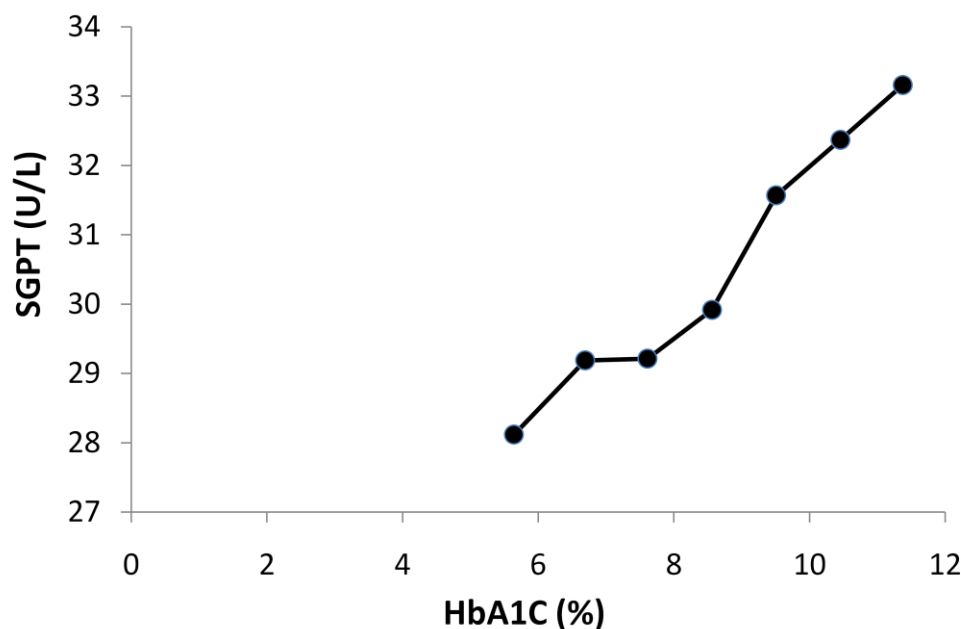*Fig. 3: Effect of HbA1c on serum creatinine*

Fig. 4: Effect of HbA1c on SGPT

Effect of HbA1c on associated diseases

There were a number of associated diseases found in type 2 diabetes patients related with their HbA1c values. Among them hypertension, dyslipidemia and urinary tract infection are common that has shown in table 2. Some patients had single, some had double and few had triple associated diseases.

Table 2: Effect of HbA1c on associated diseases

HbA1C	Hypertension	Dyslipidemia	UTI
5-5.9	5	1	4
6.0-6.9	50	21	11
7.0-7.9	77	53	10
8.0-8.9	60	45	9
9.0-9.9	68	37	7
10-10.9	43	20	3
11.0-11.9	19	16	
12.0-12.9	8	12	
13.0-13.9	3	5	
Total	**333**	**210**	**44**

DISCUSSION

The distribution of subjects according to age, weight, height and specific HbA1c showed that most of the type 2 diabetic patients experience higher percentages of glycemic control irrespective of their age, weight, height (Table 1). A significant correlation among HbA1c , FBG and PPG (Fig. 1) is in agreement with earlier reports [Rosediani et al., 2006; Ito et al., 2000; Ko et al., 1998]. We also observed significant correlations between HbA1c and cholesterol, triglycerides, HDL and LDL in type 2 diabetic

patients (Fig. 2). Several investigators have reported significant correlations between HbA1c and lipid profiles and suggested the importance of glycemic control [Faulkner et al., 2006; Chan, et al., 2005] that are similar to our results. High serum triglyceride levels in diabetic patients can cause cardiovascular diseases (CVD) [Esteghamati et al., 2006]. It has also been reported that clinical significance of various lipid parameters including total cholesterol, triglycerides, HDL and LDL in predisposing diabetic patients leads to cardiovascular complications. Significant correlations between HbA1c and all these lipid parameters (Fig. 2) and a linear relationship between HbA1c and dyslipidemia point towards the usefulness of HbA1c for screening high-risk diabetic patients. In addition, there were no significant interactions between age, weight, height and HbA1c with respect to lipid profile suggesting the validity of HbA1c for predicting dyslipidemia irrespective of patient's height, weight and age.

In conclusion, the observations of this study clearly suggest that HbA1c has the relations with serum lipid profile, blood glucose level, serum creatinine and SGPT in diabetic patients. Thus, tripple biomarker capacity of HbA1c (glycemic control, lipid profile indicator and creatinine level) may be utilized for screening high-risk diabetic patients for preventing cardiovascular and kidney damage.

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