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Original Research Article

A Case Control Study to Assess of Glycated Haemoglobin, Total Protein and Albumin Levels in Patients with Type 2 Diabetes Mellitus

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Abstract

Aim: The aim of the study to assessment of glycated haemoglobin, total protein and albumin levels in patients with type 2 diabetes mellitus. **Methods:** This case control study was done the Department of Pathology, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India, for 2 years. A total of 140 subjects comprising of 70 diabetic subjects and 70 controls aged between 35 and 75 years were recruited for the study. 5mls of blood sample was collected from each patient and 1ml was dispensed into EDTA for the estimation of glycated haemoglobin, and 4ml was dispensed into plain containers for estimation of serum albumin and total protein levels. Determination of glycated haemoglobin level, estimation of serum albumin level and estimation of total protein done by standard methods. **Results:** The mean level of HbA1c was significantly higher in the diabetic subjects when compared with control group (11.36±1.59Vs 7.01±0.88; p=0.00). There were no significant differences observed between the age, the serum levels of Albumin and Total protein in the test and control subjects (p>0.05). **Conclusion:** We concluded that the present study showed significantly higher mean levels of HbA1c in the diabetic patients compared with the control subjects.

Keywords: Haemoglobin, Total Protein, Total Albumin, Type 2 Diabetes Mellitus.

Introduction

Haemoglobin A1C is formed by the non-enzymatic glycation of haemoglobin and represents a measure of the glucose concentration over the last 2–3 months. Glycation is the non-enzymatic attachment of a reducing sugar to primary or secondary amine groups to form an intermediate Schiff base followed by more stable

ketoamine derivatives, the Amadori products, which in turn undergo further rearrangements to form a heterogeneous group of compounds called advanced glycation end products (AGEs)[1]. Fructosamine (FA) and glycated albumin (GA) are also products of this reaction that have been adapted into clinical practice for use in assessing control In Sub-Saharan Africa the numbers of people with type II diabetes (T2D) are expected to increase from 14.2 million in 2015 to 34.2 million by 2040 with almost 70% of people with T2D undiagnosed[2]. The results of the Diabetes Control and Complications Trial (DCCT) and the UK Prospective Diabetes Study (UKPDS) demonstrated that importance of tight glucose control for the prevention of complications of diabetes and of HbA1c as an indicator of mean glycaemia[3]. Early diagnosis and monitoring are therefore critical to delay the onset of complications. Although glucose measurement, either fasting or 2 h post prandial, is considered the gold standard for diagnosis it is subject to several limitations. This led to a search for alternatives such as haemoglobin A1c (HbA1c) which can be used both for monitoring and diagnosis[4]. Since the 1990s, World Health Organization (WHO) and the diabetes associations or societies in many countries have recommended HbA1c as the preferred diagnostic index for monitoring diabetes but more recently has also been advocated as a diagnostic tool for T2DM[5], while HbA1c is also generally recognized as the “gold standard” for blood glucose testing. However, HbA1c has some limitations. Several studies have shown that HbA1c cannot be used to accurately assess blood glucose levels under certain circumstances, such as changes in red blood cell life and imbalance in the proportion of young and mature erythrocytes[6,7], Hb metabolic disorders and the use of erythropoietin[8,9]. Glycated serum protein (GSP) is a product of non-enzymatic reaction between blood glucose and plasma protein (approximately 70% of which is albumin). The determination of glycosylated serum protein (GSP) is also called fructosamine determination. Glycosylated serum protein (GSP) measurement reflects the total glycosylated plasma protein in plasma, its value is susceptible to the influence of protein concentration, bilirubin, chyle and low molecular weight substances in blood, especially in patients with hypoproteinemia and abnormal albumin transformation. At the same time, non-specific reducing substances in serum can also react with glycation sites. The specificity of glycosylated serum protein (GSP) assay is poor because of the different reaction rates. GA is an emerging indicator for blood glucose monitoring; several studies have suggested that GA is more suitable in patients with certain diseases, such as hemolytic anemia, hepatic cirrhosis with hyperglycemia, than HbA1c[10,11]. GA is the product of glucose and serum albumin in non-enzymatic reactions, representing the average level of blood glucose in recent 2–3 weeks. GA relative to HbA1c can better reflect the changes or fluctuations in blood glucose level. In addition, several investigators have suggested that, compared with HbA1c, GA is more suitable as a diagnostic parameter for recessive diabetes and stress hyperglycemia[12] and as a monitoring glycemic control in patients with anemia[13]. Although there are many advantages of GA over HbA1c, it also has some limitations that it could be affected by changes in the structure and half-life of albumin[14]. In patients with aplastic anemia, the red blood cell life and hemoglobin metabolism are affected by their abnormal proliferation of bone marrow. Therefore, it is particularly important to develop and screening of diabetes and monitoring of glycemic control status for patients with aplastic

anemia and those with diabetes. At present, there is no report on comparative studies of the application value of blood glucose monitoring indexes in patients with aplastic anemia in China.

Material and methods

This case control study was done the Department of Pathology, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India, for 2 years, after taking the approval of the protocol review committee and institutional ethics committee. After taking informed consent detailed history was taken from the patient or relatives.

A total of 140 subjects comprising of 70 diabetic subjects and 70 controls aged between 35 and 75 years were recruited for the study. The patients and controls were aged and sex matched. Subsequently, structured questionnaire was used to obtain patients' bio data and thereafter, 5mls of blood sample was collected from each patients and 1ml was dispensed into EDTA for the estimation of glycated haemoglobin, and 4ml was dispensed into plain containers for estimation of serum albumin and total protein levels.

Inclusion criteria

Known diabetic subjects aged between 35 and 75 years were included in this study.

Exclusion criteria

Younger than 35 or older than 75 years and non-diabetic subjects were excluded from the study.

Determination of glycated haemoglobin level Glycated Haemoglobin level was determined using immunoturbidimetric method as described by Wolf et al., (1984)[15]. Estimation of serum albumin level Serum albumin level was estimated Bromo Cresol green Method as described by Doumas et al., (1971)[16]. Estimation of total protein Estimation of serum total protein level was done using Biuret Method according to Weichselbaum, (1946)[17].

Statistical analysis

The data were presented as mean±SD and the mean values of the control and test group were compared by Students t-test and pearson correlation using Statistical package for social sciences (SPSS) (Version 20) software. Statistical significance was tested at $P<0.05$.

Results

The mean level of HbA1c was significantly higher in the diabetic subjects when compared with control group (11.36±1.59Vs 7.01±0.88; p=0.00). There were no significant differences observed between the age, the serum levels of Albumin and Total protein in the test and control subjects ($p>0.05$).

Table 1: Levels of HbA1c, total protein and albumin in diabetic and control patients

Parameters	Control	Diabeticsubject	t- test	p- value
Age(years)	55.96±7.85	56.88±9.68	-	0.86
HbA1c(%)	7.01±0.88	11.36±1.59	1.69	0.00
Protein(g/L)	76.25±4.03	72.96±4.69	1.65	0.13
Albumin(g/L	40.36±2.98	40.69±3.55	0.33	0.66

Table 2: shows that there is no significant correlation between age, HbA1c, total protein and albumin in diabetic patients.

Table 2: Correlation of HbA1c with age, total protein andalbumin in diabetic patients

Parameters	R	p-value
HbA1c Vs age	0.085	0.59
HbA1c Vs Totalprotein	0.096	0.57
HbA1c Vs Albumin	-0.177	0.37
Age Vs Total protein	-0.069	0.87
Age Vs Albumin	0.088	0.66
Total protein Vs	-0.005	0.89

Discussion

In this study, the mean level of HbA1c was significantly higher in the diabetic subjects than in control. This is in consonance with the report of some previous similar studies[18,19]. This increase can be attributed to hyperglycaemia and disturbances of carbohydrate, fat and protein metabolism that results from abnormalities in insulin secretion, insulin action or even both[20]. This finding implies that there is a poor glycemic control in the diabetic subjects under study. Furthermore, our finding shows a higher mean value of HbA1c (11.36±1.59) than the recommended cut point (0.05). This is in line with the report of previous studies[18]. This may be as a result of Insulin resistance which is a principal cause of type 2 diabetes (Kahn, 1994)[21] and previously, serum albumin has been associated with insulin resistance[22,23]. In diabetic patients, plasma albumin concentration has been reported to be inversely related with HbA1c levels, revealing a large proportion of poorly controlled diabetes in patients with lower plasma albumin concentrations[24,25]. This inverse relationship may also be explained by the fact that poorly controlled type 2 diabetes has been associated with a further decrease in insulin production and secretion by the pancreatic β-cell[26,27]. Furthermore, our finding shows no significant difference between the serum levels of total protein in the diabetic patients and control subjects ($p>0.05$). This is in contrast with the findings of (Malawadi and Adiga, 2016; Nazki et al., 2017)[18,19]. There is no significant correlation between age, HbA1c, total protein and albumin in diabetic subjects. This finding is not in agreement with the finding of Hemangi et al., (2012)[24] in which plasma albumin levels were negatively correlated with HbA1c and low albumin levels was associated with increased plasma protein glycation and that albumin competes for glycation with other plasma proteins in diabetes[28].

Conclusion

We concluded that the present study showed significantly higher mean levels of HbA1c in the diabetic patients compared with the control subjects. However, the mean serum of levels of Albumin and total protein did not differ significantly when compared between the diabetic patients and controls. This finding implies that there was a poor glycemic control in the diabetic subjects studied. Therefore, there is need for better management of diabetic patients through medication and use of diet and exercise.

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