ORIGINAL ARTICLE

CORRELATION BETWEEN GLYCATED HAEMOGLOBIN LEVELS AND RANDOM BLOOD GLUCOSE

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Background: Glycated haemoglobin or glycosylated haemoglobin (HbA1c) is a form of haemoglobin that is measured primarily to identify the average plasma glucose concentration over prolonged periods of time. Levels of HbA1c represent the average blood glucose levels of diabetic patients over the previous 120 days. The objective of this study was to see the correlation between HbA1c levels and random glucose levels. **Methods:** This descriptive study included 106 randomly selected patients with known diabetes from the outpatients department. Random sugar levels were measured by using venous blood samples. HbA1c levels were measured in venous blood by BIO-RAD D-10 HPLC Method. Data were recorded on a proforma. Pearson's correlation was applied to find out any significant correlation between the glycated haemoglobin levels and the random blood glucose levels. Results were plotted on simple scatter plot and $p<0.01$ was considered significant. **Conclusions:** A significant linear positive correlation exists between levels of HbA1c and random blood sugar.

Keywords: Diabetes, HbA1c, blood glucose levels, HbA1c

J Ayub Med Coll Abbottabad 2013;25(1–2):86–8

INTRODUCTION

For 2,000 years diabetes has been recognised as a deadly disease. References towards patients with diabetes can be found as early as the first century. Diabetics were believed to have a short, suffering life. It was not until 1921 that the first breakthrough was made by Fredrick Banting and Charles Best who used extracts of insulin from pancreas to treat diabetes.[1,2] Ever since this major breakthrough, smaller breakthroughs have continued to improve life, to minimize complications associated with diabetes and to modify the assessment of glycaemic control and the delivery of insulin. In 1935 Roger Hinsworth discovered two types of diabetes, insulin sensitive type I and insulin insensitive type II. Portable glucometer was first used in 1969. Before that urine sugar was measured to assess glycaemic control.[1]

It was not until 1979 that the HbA1c test was devised for more precise blood sugar measurement. With A1c, haemoglobin is used to track glucose changes over a period of 4 months, that is the life span of red blood cells. Assessment of glycaemic control in diabetics is extremely important as people who were able to keep their glucose levels as close to normal as possible have less chance of developing complications. Glycated haemoglobin was initially identified as an unusual haemoglobin in patients with diabetes over forty years ago.[3] After this discovery, numerous small studies were conducted correlating it to glucose measurements resulting in the idea that HbA1c could be used as an objective measure of glycaemic control. One of the earlier studies included 643 participants and established a validated relationship between HbA1c levels and average blood glucose across a range of diabetes types and patient populations.[4] Subsequently HA1c was introduced into clinical use in 1980s and now has become a corner stone of clinical practice. In patients with diabetes mellitus the glycated haemoglobin value is used to determine the degree of glycaemic control and to make decisions regarding therapy.[5]

The understanding that glycated haemoglobin represents the average blood glucose level of patients over the previous 120 days underlines the current management of diabetes. Having more than one measurement of HbA1c and taking these measurements in the preceding months improves the correlation further. HbA1c can be performed at any time of the day and does not require any special preparations such as fasting.[6]

When blood glucose levels are high, glucose molecules attach to the haemoglobin in red blood cells. The longer hyperglycaemia occurs in blood, the more glucose binds to red blood cell and the higher the glycosylated haemoglobin.[7]

Once a haemoglobin molecule is glycated, it remains that way. A build-up of glycated haemoglobin within the red cell, therefore, reflects the average level of glucose to which the cell has been exposed during its life-cycle. Measuring glycated haemoglobin assesses the effectiveness of therapy by monitoring long-term serum glucose regulation. Some researchers state that the major proportion of HbA1c value is weighted toward the most recent 2–4 weeks.[8,9] Compared to the inconvenience of measuring fasting plasma glucose levels or performing an OGTT, and day to day variability in glucose, it can be performed at any time of the day and does not require any special preparations such as fasting.[10] In addition the concentration of glycated haemoglobin predicts the progression of diabetic micro vascular and cardiovascular complications.[11] These properties have made it the

preferred test for assessing glycaemic control in people with diabetes. Now-a-days there is a substantial interest in using it as a diagnostic test for diabetes and as a screening test for persons at high risk of diabetes.[12] Several studies have shown that modern continuous glucose monitoring accounts for the vast proportion of the variation of HbA1c. HbA1c expressed as an average blood glucose may be more understandable to patients and improve their understanding and ability to improve their diabetes management.[13] In screening and diagnosis, some results that may be seen include a non-diabetic person will have an A1c result less than 5.7% (39 mmol/mol). Diabetes: A1c level is 6.5% (47 mmol/mol) or higher. Increased risk of developing diabetes in the future: A1c 5.7–6.4% (39–46 mmol/mol).[14,15]

The American Diabetic Association recommends that HbA1c should be measured at least twice a year in person with diabetes patients with diabetes that are meeting treatment goals (and that have stable glycaemic control) and quarterly in patients with diabetes whose therapy has changed or that are not meeting glycaemic goal.[16] In diabetic children it should be measured at least 3–4 times per year for a profile of long term glycaemic control. When measured by standardised methods the fraction of HbA1c is not influenced by isolated episodes of hyperglycaemia and consequently used as an index of long term glycaemic control, and is superior to measurement of glycosuria or even multiple blood glucose determination. The reference level in non-diabetics is <6%, in known diabetics levels between 6–7.9% represent good glycaemic control. Levels between 8.0–9.9% indicate fair control, and levels >10% represent poor control.[17]

The objective of this study was to see the correlation between HbA1c levels and random glucose levels.

MATERIAL AND METHODS

The study was a descriptive study and 106 known diabetics were included randomly from outpatients. Random sugar levels were measured by using venous blood samples, HbA1c levels were measured in venous blood by BIO-RAD-D-10 HPLC Method. Data were recorded on a proforma. SPSS-16 was used for analysis. Descriptive statistics were used to find frequencies of parameters. Pearson's correlation was applied to find out correlation between the glycated haemoglobin levels and the random blood glucose levels in known diabetics. Results were plotted on simple scatter plot, and $p<0.01$ was considered significant.

RESULTS

A total of 106 patients were included in the study. Minimum age was 20 years and maximum was 88 years with mean age being 49.9±13.084 years. The lowest level of HbA1c was 5% and the highest was 15% with a mean of 8.79±2.605%. The lowest for random blood sugar was 110 mg/dl and highest was 498 mg/dl with a mean of 228.27±79.088 mg/dl. (Table-1). Out of 106 patients 29 (27.4%) were male and 77 (72.6%) were female.

Pearson's (2-tailed) correlation was applied to find out the correlation between levels of random blood glucose and percentage of HbA1c. The correlation was significant (p=0.000). A simple scatter graph was plotted between levels of random blood glucose and glycated haemoglobin levels shows an increase in random blood glucose is directly proportional to an increase in levels of glycated haemoglobin. (Figure-1)

Table-1: Descriptive Statistics

Variable	Min	Max	Mean±SD
Age years	20	88	49.49±13.084
Glycated Haemoglobin (HbA1c)	5	15	8.79±2.605
Random Blood Sugar	110	498	228.27±79.088

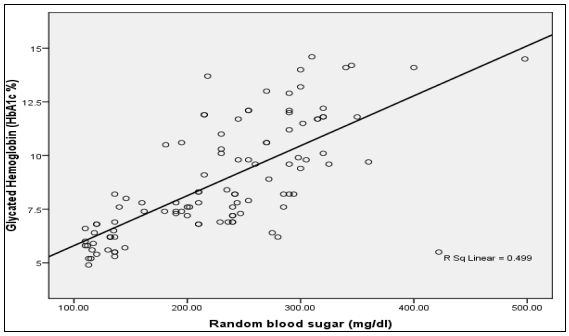

Figure-1: Simple scatter graph between random blood glucose (mg/dl) and percentage of glycated haemoglobin

DISCUSSION

HbA1c is superior way to monitor long term glycaemic control. The superiority of HbA1c over discrete blood glucose measurements should be acknowledged and may also be extended to diabetes screening and diagnosis.[18] It provides far more revealing information on glycaemic behaviour than a fasting blood sugar value. However, fasting blood sugar tests are crucial in making treatment decisions.

The results of our study showed a significant correlation between levels of random blood glucose and levels of HbA1c expressed as percentage. We compared the results with studies done elsewhere.

A study conducted in the Pathology Department of Army Medical College, National University of Sciences and Technology, Rawalpindi, from January 2010 to April 2010, including three hundred and fifteen patients showed a significant correlation (p<0.001) between the HbA1c levels and the random plasma.[19] Another study conducted by David B. Sacks at the Department of Pathology, Brigham and Women's Hospital, and Harvard Medical School

Boston, Massachusetts in 2007 included 700 hundred subjects and revealed a god correlation between HbA1c and average blood glucose levels, and also suggested to derive a regression equation that permits conversion of HbA1c results into estimated average values.[20]

CONCLUSION

Blood levels of HbA1c have a significant correlation with levels of blood sugar and can give a clear idea about glycaemic control in the past three months and hence can be used as a preferred method to assess glycaemic control in diabetics.

SUGGESTIONS

HbA1c levels can be used as an index for glycaemic control in known diabetes and should be considered as first-line investigation in known diabetics and should replace doing random blood sugar levels. HbA1c should be considered a preferred test for having an idea about glycaemic control rather than the traditional oral glucose tolerance test. HbA1c levels can be used as a screening test in people who are at high risk of developing diabetes.

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