Hemoglobin A1c in Muscat, Oman – A 3 year study

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Abstract

Background: Glycosylated Hemoglobin (HbA1c) reflects the average blood glucose level during the previous 2-3 months. HbA1c is used as marker for long term blood glucose control in diabetic patients. In this retrospective study, the prevalence of diabetic control was evaluated from HbA1c tests of diabetic patients over a period of 3 years (January 2005-December 2007) from Muscat Region, Sultanate of Oman. Blood samples from a total number of 7442 patients were analysed at Al Nahdha Hospital Laboratory received from different Primary Health Care Centers and Hospitals of Muscat region as this hospital was the referral hospital for HbA1c testing.

Method: The method used for the estimation of HbA1c was Turbidimetric inhibition immunoassay and the test was carried out in Hitachi 902 an automated chemistry analyzer. Result:

Results: The results show that only 22.8% of patients had good glycemic control and 77.2% had bad glycemic control.

Conclusion: Diabetic patients should be informed of the fact that maintaining HbA1c below 7% will minimize their risk of developing the complications.

Keywords: Glycosylated Hemoglobin; Glycemic control.

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Introduction

Diabetes is considered as one of the major health problems worldwide. The WHO and IDF (International Diabetes Federation) estimate that the number of diabetic patients in the world is approximately between 194 and 246 million, and this figure will rise to between 333 and 380 million people by 2025. In some countries of the Eastern Mediterranean and Middle East Region, diabetes prevalence is among the highest in the world (9.4 in 2007). Sultanate of Oman is one of the six Middle Eastern countries (including United Arab Emirates, Bahrain, Kuwait, Saudi Arabia and Egypt) which has shown diabetes prevalence among the top 10 countries in the world.[1,2] The number of diabetic patients in Oman till the end of 2005 was 48,972 patients; around 4862 new cases of diabetes were diagnosed in 2005 in Oman. On an average 4000 new cases of diabetes are diagnosed each year in Oman.

HbA1c is a marker of evaluation of long term glycemic control in diabetic patients and predicts risks for the development and/or progression of diabetic complications.[3] The risk of diabetic complications, such as diabetic nephropathy and retinopathy increases with poor metabolic control.[4] Lowering A1c has been associated with a reduction of micro vascular and neuropathic complications of diabetes and possibly macro vascular disease. A1c goal for patients in general is less than 7%.[5] The findings of a major diabetes study (Diabetes Control and Complications Trial), revealed that people who keep their HbA1c levels less than 7% have a better chance of delaying or preventing complications that affect the eyes, kidneys and nerves than people with HbA1c at higher levels.[6]

HbA1c, also known as glycosylated hemoglobin/ glycated hemoglobin is the measure of the average blood glucose level during the preceding 2-3 months. It is the largest portion of the three glycated Hb fractions; the other two fractions are HbA1a and HbA1b.[7] HbA1c is the product of non-enzymatic reaction between glucose and free amino groups of hemoglobin (Hb). This reaction called glycosylation, involves many other proteins as well.[3] The glucose remains complexed to the Hb molecule through out the 120 day life span of RBC and therefore the concentration of glycated Hb circulating in red cells is a guide to the average blood glucose level over a period of the previous 2-3 months.[8]

A1c testing should be performed routinely in all patients with diabetes, first to document the degree of glycemic control at initial assessment and then as part of continuing care. Since the A1c test reflects mean glycemia over the preceding 2-3 months, measurement approximately every 3 months is required to determine whether a patient's metabolic control has been reached and maintained within the target range.[5]

The test provides vital information about the success of treatment of diabetes such as: adequacy of dietary or drug therapy; allows determination of duration of hyperglycemia in new cases of juvenile onset diabetes with acute ketoacidosis; provides a sensitive estimate of glucose imbalance in mild cases of diabetes, and is an evaluation of effectiveness of old and new forms of therapy such as oral hypoglycemic agents; single or multiple insulin injections and Beta- cell transplantation.[7]

Methods

In this study, 7442 blood samples were collected from Type 1 and Type 2 Diabetes mellitus patients. These patients were having minimum diabetic duration of one year. Venous blood samples in EDTA tubes were received from Primary Health care centers and hospitals of Muscat region, Sultanate of Oman. Analysis of HbA1c was carried out in the Biochemistry Department of Al-Nahdha hospital using an automated chemistry analyzer, Hitachi 902.

The method used for HbA1c was standardized according to IFCC (International Federation of Clinical Chemistry) and transferable to DCCT/NGSP (Diabetes Control and Complications Trial/National Glycohemoglobin Standardization Program). Turbidimetric inhibition immunoassay was carried out on the whole blood of all our patients.[4] 10 µl of whole blood was added to 1 ml of hemolyzing solution, mixed well and kept for 5 minutes and then run in the analyzer. The liberated Hb in hemolysed sample is converted to a derivative having a characteristic absorption spectrum which is measured bichromatically.[4]

Normal range established in Al-Nahdha hospital laboratory for HbA1c is 4.4% to 6.0%. In this study patients were not given any instructions regarding dietary intake, medications and others. Test results are not affected by time of day, meal intake, exercise, just administered diabetic drugs or emotional stress of the patient.[7] The results were analysed using one way analysis of variance (ANOVA).

Results

A total number of 7442 diabetic mellitus patients were included in the study with more than 1 year duration of diabetes. The patients had an average age of 52 years (range 16 – 100). 3568 (48%) male patients and 3875 (52%) female patients were involved in the study. The normal range for HbA1c is 4.4% to 6.0%. The mean HbA1c value was 8.9% with the range of 4.2-26.7% and CI 95%. Patients in the study were divided into two groups based on criteria shown in Table 1 below.[9]

Table 1: Glycemic Control Criteria

Good Glycemic Control	Poor Glycemic Control
<7%	7% and above

As per the above mentioned criteria, 1699 (22.8%) diabetic patients had good control and 5743 (77.2%) had poor control. One way analysis of variance was done and the values obtained are shown in Table 2 below.

Table 2: Mean SD and CV of glycemic control

	Good Glycemic Control	Poor Glycemic Control
Mean	6.2	9.6
SD	20.98	68.5
CV	29.5	27.4

SD: Standard Deviation; CV: Coefficient of Variation

The significance level (p-value) for the difference between good and poor control was $p = 0.011$.

Discussion

Al Nahdha Hospital evaluated a total of 7442 samples from diabetic patients. Out of this only 22.8% had good glycemic control and 77.2% did not have a good glycemic control. 48% of diabetic patients were males and 52% were females. Age distribution revealed that 59.2% of them were in the 40-60 years age group, 14.9% were below 40 years and 25.9% were above 60 years. More than 75% of our diabetic patients did not maintain good glycemic control. Glycemic control is fundamental to the management of diabetes. The goal of therapy is to achieve an HbA1c as close to normal as possible (<7%) in the absence of hypoglycemia[5] A good glycemic control can help prevent the risks of developing complications, including kidney disease , eye disease , heart diseases, stoke, nerve damage, amputations and circulatory problems.[10]

Diabetic patients should be aware of the fact that maintaining HbA1c below 7% will minimize their risk of developing complications. To achieve this, health care professionals should provide lifestyle guidance, education support & titrate therapies. Patients with HbA1c levels below target level, should be advised that any improvement is beneficial. Sometimes tighter HbA1c target levels set for patients on insulin or sulfonylurea therapy may increase the risks of hypoglycemia episodes that present particular problems for people with other physical or mental impairment.[11] To avoid these problems, diabetic patients should be closely monitored with frequent blood testing for glucose levels. They should use HbA1c at least twice a year.[9]

HbA1c is subject to certain limitations. Conditions that affect erythrocyte turn over (hemolysis, blood loss) and Hb variants must be considered, particularly when HbA1c result do not correlate with the patent's clinical picture.[5] This fact is of paramount significance in Oman as genetic blood diseases are prevalent in almost 25% of the population.

HbA1c is estimated by a number of different measurement principles: ion exchange chromatography, HPLC, affinity chromatography and immunoassay. These methods differ in their specificity for HbA1c and in some methods other glycated moieties

may co-elute. Scientifically, correct standardization of these measuring systems in terms of HbA1c was not possible before.[12] In 1994 the International Federation of Clinical Chemistry (IFCC) formed a working group to improve standardization of HbA1c measurement.[13] Accordingly, after several years of work, IFCC developed a more scientifically based standardization for HbA1c.[12, 14] Accurate and precise reporting of HbA1c warrants following strict standardization systems.

HbA1c test should be performed at least 2 times a year in patients who are meeting treatment goals (and who have good glycemic control). It should be performed quarterly in patients whose therapy has changed or who are not meeting glycemic goals.[5]

Conclusion

The evaluation of the glycemic control in diabetic patients in Muscat, Oman using Glycosylated Hb levels as an indicator shows that 77.2% of our patients did not maintain good glycemic control. In conclusion, such patients should be closely monitored with frequent blood testing for glucose levels, quarterly HbA1c estimation and also education, diet, exercise, smoking cessation plus compliance with medications need to be stressed. In addition, modifying the antidiabetic medications or adding insulin therapy when necessary is needed to achieve good diabetic control.

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