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. In Oman, the number of diabetic patients in the Sultanate of 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. 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. 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.

Abstract

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.

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

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From the Department of Laboratory, Al- Nabdha Hospital, Muscat, Sultanate of Oman.
Address Correspondence and reprint request to: Dr. Suresh Venugopal, Department of Laboratory, Al Nabdha Hospital, P.O. BOX 937, Muscat, Sultanate of Oman
E-mail: sure5155@omantel.net.om

Hemoglobin A1c in Muscat, Oman – A 3 year study

Suresh Venugopal, Raseena Kunju, Sheikh Al Harthy, Nafeesa Al Zadjali
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. 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

<table>
<thead>
<tr>
<th>Good Glycemic Control</th>
<th>Poor Glycemic Control</th>
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<tbody>
<tr>
<td>&lt;7%</td>
<td>7% and above</td>
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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

<table>
<thead>
<tr>
<th></th>
<th>Good Glycemic Control</th>
<th>Poor Glycemic Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>6.2</td>
<td>9.6</td>
</tr>
<tr>
<td>SD</td>
<td>20.98</td>
<td>68.5</td>
</tr>
<tr>
<td>CV</td>
<td>29.5</td>
<td>27.4</td>
</tr>
<tr>
<td>SD: Standard Variation; CV: Coefficient of Variation</td>
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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, stroke, 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 patient’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.\textsuperscript{12}
In 1994 the International Federation of Clinical Chemistry
(IFCC) formed a working group to improve standardization of
HbA1c measurement.\textsuperscript{13} Accordingly, after several years of work,
IFCC developed a more scientifically based standardization for
HbA1c.\textsuperscript{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.\textsuperscript{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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