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Glycemic Control of Type 2 Diabetic Patients Managed in Tertiary Care Internal Medicine Clinics Using HbA1c

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ABSTRACT

Background /Objective: The aim was to assess the glycemic control in patients with type 2 *diabetes mellitus* using American Diabetes Association HbA1c definition of good control of ≤ 7.0%.

Methods: This retrospective study conducted in internal medicine outpatient clinics at King Abdulaziz Medical City in Riyadh, Kingdom of Saudi Arabia. All patients with type 2 *diabetes mellitus* attending the clinic from August 2005 to January 2006 were evaluated. Patients with HbA1c measured regularly and under anti-diabetic therapy were included in the study. Last measured HbA1c was used to evaluate diabetic control.

Results: Data for 968 (81.5%) patients out of 1188 were available for analysis. Only 211 (21.8%) patients had their HbA1c within the American Diabetes Association recommended target of HbA1c ≤ 7%. Mean HbA1c was 8.98%. Patients were stratified into groups of good (HbA1c ≤ 7%), average (HbA1c 7.1% - 9.9%) and poor diabetic control (HbA1c ≥ 10%) included 21.8%, 46.2% and 32.0% of the study population, respectively. Mean HbA1c in patients on diabetic diet only, oral hypoglycemic agents, insulin and oral hypoglycemic agents plus insulin was 7.62%, 8.67%, 8.92% and 9.70%, respectively.

Conclusion: Majority of patients in our study did not meet the American Diabetes Association recommended target HbA1c for type 2 *diabetes mellitus*. Causes for this failure need to be assessed in Saudi type 2 *diabetes mellitus* population.

Keywords

Diabetes mellitus, Glycemic control, HbA1c, Treatment

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INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defect in insulin secretion, insulin action, or both. The chronic hyperglycemia of diabetes is associated with long term damage, dysfunction and failure of various organs especially the eyes, kidneys, nerves, heart and blood vessels. In patients with type 2 *diabetes mellitus* (T2DM), the cause is combination of resistance to insulin action and inadequate compensatory insulin secretary response[1]. T2DM is responsible for more than 90 percent of cases of diabetes worldwide[2].

Dramatic increases in the prevalence and incidence of T2DM have occurred in many parts of the world, especially in the newly industrialized and developing countries. In 2011, there were 366 million people with diabetes, and this is expected to rise to 552 million by 2030. Most people with diabetes are living in low and middle-income countries, and these countries will also have the greatest increase over the next 19 years. Majority of cases of T2DM in the future will occur in the developing countries particularly in Africa, Middle East and India[3-5].

Overall prevalence of DM in Saudi Arabia is around 23.7%[6,7]. A general relationship exists between degree of hyperglycemia as manifested by mean level of HbA1c and the frequency, severity and progression of microangiopathy. In both Control and Complication Trial (DCCT) and United Kingdom Prospective Diabetes Study (UKPDS), the relationship between glycemic control and the risk of development of complications was evident across the range of HbA1c, and even persisted beyond the study period. Recently, HbA1c was also recommended for use as a screening and diagnostic tool for T2DM[8-10].

Due to wide fluctuations in circulating glucose concentrations in patients with diabetes, random and fasting glucose measurements are often not reflective of overall glycemic control and do not provide a complete picture. Glycated hemoglobin or hemoglobin A1 is a post-translational modification of hemoglobin A formed by the covalent attachment of glucose or other sugars to hemoglobin. Hemoglobin A1c (HbA1c) is produced by glucose attachment to the N-terminal valine of the β globin chain[11]. HbA1c is therefore, a commonly used laboratory test for assessing long term diabetes control and for diagnosis of T2DM. However, HbA1c values are affected by anemia, hemolysis and hemoglobinopathies[12-13].

In a previous study at our center, evaluation of American Diabetes Association (ADA) 2005 recommended targets[14] of HbA1c (≤ 7.0%), blood pressure (≤ 130/80 mm Hg), and low-density lipoproteins cholesterol (LDL-C) of ≤ 2.6 mmol/L was performed, and found it to be 21.8%, 39% and 55.5%, respectively[15]. This study was conducted to assess the diabetic control in patients with T2DM on different modalities of treatments using HbA1c according to ADA definition of good control.

METHODS

This was a retrospective sub-study of 1188 patients with T2DM attending internal medicine clinics at King Abdulaziz Medical City (KAMC) in Riyadh, Kingdom of Saudi Arabia to evaluate the degree of glycemic control by measuring HbA1c. The patients and methodology used for HbA1c has been previously described in the main study[15]. In brief, HbA1c was determined on whole blood by ion-exchange high performance liquid-chromatography by using Bio-Rad Variant II Hemoglobin testing system (US). The study was approved by Research and Ethics Committee at KAMC. The present study included patients who had their HbA1c measured at the last visit, and had available information on electronic medical records (MISYS) about methods of treatment *i.e.* diet, oral hypoglycemic agents (OHA), insulin or combination of OHA and insulin. The degree of glycemic control using last measured HbA1c was assessed according to the ADA guidelines, which recommend it to be ≤ 7.0%. Patients were stratified into three groups based on level of HbA1c control. Group one included patients with good control (HbA1c ≤ 7%), group two with average control (HbA1c 7.1% - 9.9%) and group three with poor control (HbA1c ≥ 10%).

The information was copied on a pre-designed standardized data capture Microsoft Excel spreadsheet. The data was subsequently computed on a PC by using Microsoft Excel on Windows 2000 professional. SPSS software (release 13.0, SPSS Inc., Chicago, IL USA) was used for all statistical analyses to calculate the number and percentage of different parameters.

RESULTS

Out of a total of 1188 patients with T2DM, 968 (81.5%) patients qualified to be included in this audit with 220 (18.5%) patients having missing information about the diet or antidiabetic medications used to achieve diabetic control. Study population included 590 (61%) females and 378 (39%) males, respectively with a female to male ratio of 1.6. Mean age of these patients was 65.7 years. Most of the patients, 859 (88.7%) were older than 65 years. Oral hypoglycemic agents (OHA) were the most common type of anti-diabetic treatment in 495 (51.5%) followed by a combination of OHA and insulin in 305 (31.6%) of the patients. Mean HbA1c in patients on diabetic diet only, OHA, insulin or a combination of OHA plus insulin was 7.62%, 8.67%, 8.92%, 9.70%, respectively. The mean HbA1c for all T2DM patients was 8.98%. Different type of anti-diabetic treatments, number and % of patients as well as the mean HbA1c in each group are shown in Figure 1.

Only 211 (21.8%) of 968 patients had their HbA1c controlled to target of good control (HbA1c ≤ 7%) whereas most of the patients, 757 (78.2%) did not achieve this target. According to diabetic control based on HbA1c, patients in group one with good control (HbA1c ≤ 7%), group two with average control (HbA1c 7.1-9.9%) and group three with poor control (HbA1c ≥ 10%) included 211 (21.8%), 447 (46.2%) and 310 (32.0%) patients, respectively (Fig. 2).

In patients with good control, type of treatment achieving this target was determined. Twenty-one (2.2%) patients were controlled on diet alone, 130 (13.4%) patients on oral hypoglycemic agents (OHA) alone, 31 (3.2%) patients on insulin alone, while 29 (3%) patients were controlled on combination of OHA and insulin (Fig. 3).

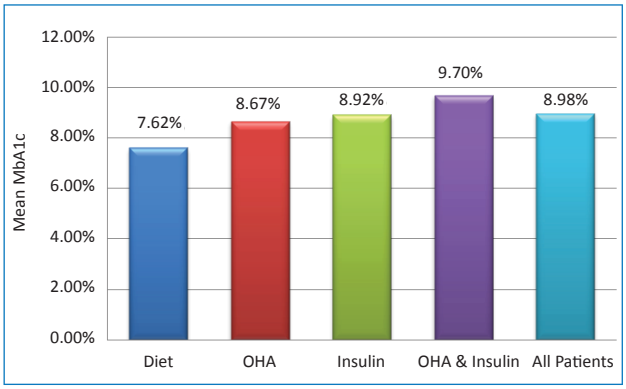
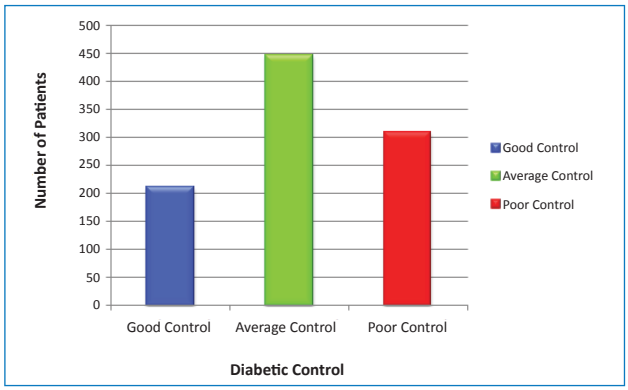


Figure 1.
Type of anti-diabetic treatment and mean HbA1c.



Good control (HbA1c ≤ 7%), average control (HbA1c 7.1-9.9%), poor control (HbA1c ≥ 10%), T2DM: Type 2 *diabetes mellitus*

Figure 2.
Degree of diabetic control according to HbA1c in T2DM patients.

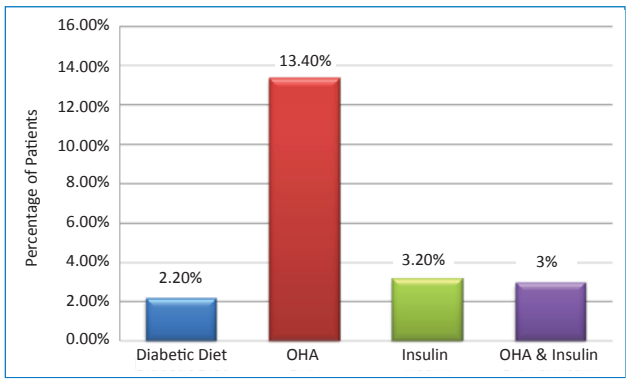


Figure 3.
Percentage of patients with good diabetic control (HbA1c ≤ 7%) according to type of anti-diabetic treatment.

DISCUSSION

Tight diabetic control is associated with a decrease in the risk of many of the complications of DM[16,17] Despite all efforts, it is often difficult to achieve glycemic targets in diabetic patients, and in order to achieve this too aggressive and rapid decrease in HbA1c can be even harmful[18]. In our study, only 211 (21.8%) had their HbA1c within target recommended by the ADA, and 757 (78.2%) patients did not achieve this target. Diabetic control in patients on OHA was better than those on insulin or a combination of OHA and insulin. This may be because most of these patients have more advanced and complicated disease. Such patients often delay the use of insulin from injection phobia and fear of gaining weight. The usually use lower than the prescribed dose of insulin due to hypoglycemic episode caused by missing a meal as a result of poor appetite induced by diabetic gastropathy. Being a retrospective study, duration of diabetes in our patients could not be assessed. Furthermore, patients who had hemoglobinopathies or other factors affecting measurement of HbA1c could not be specify. Our results are similar to a previous cross sectional study conducted at the outpatient department of King Abdulaziz University Hospital, Jeddah, Kingdom of Saudi Arabia on 265 diabetic (type 1 and 2) patients showing poor glycemic control in 77% of the patients using ADA definition of good HbA1c target of ≤ 7%[19].

International studies in diabetic patients have shown almost similar results to our study. In effect of multifactorial intervention on mortality in T2DM, 160 patients with T2DM were randomly assigned to intensive therapy or conventional therapy and follow-up for 13.3 years. At the end of the follow-up period, HbA1c for intensive therapy group and for conventional therapy group was 7.7 ± 1.2 and 8.0 ± 1.4, respectively. Patients who achieved HbA1c target of < 6.5% in intensive therapy and conventional therapy group were 18% and 11%, respectively[16]. After the intervention trial of United Kingdom Prospective Diabetes Study (UKPDS) closed on September 30, 1997, all surviving patients entered the post-trial monitoring program and 10-year follow-up was conducted. Total of 4029 patients were randomly assigned to receive either conventional glucose control or intensive glucose control therapy. Results showed that the patients on conventional therapy of sulfonylurea-insulin group had HbA1c range of 7.3-9.7%, while those on intensive therapy had a range of 6.8-9.2%. In the metformin group, those who were on conventional therapy had HbA1c range of 7.5-10.0%, while those who were on intensive therapy had range of 7.2-9.7%[20].

HbA1c of ≤ 7% in 21.8% of diabetic patients in our study compares to 11.2% in Bahrain[21], 22.8% in Muscat, Oman[22], 1.1% in Iran[23], 34.9% in Jordan[24], and 37.4% in Indonesia[25]. Using HbA1c of < 7.5% as good glycemic target, a study from Abbotabad, Pakistan revealed 42% of the diabetic patients achieving it[26].

Differences in the results of glycemic control using HbA1c in our study compared to studies from other

developing countries as mentioned above, may be due to different methodology or setting of the studies as well as the duration of diabetes in the study population. Poor glycemic control in our study compared with other gulf countries can be speculated as most of the patients referred to our tertiary care center have long-standing diabetes with multiple cardiovascular complications. This makes diabetic control less of a priority compared with control of dyslipidemia and hypertension. Moreover, targeting hypertension and lipid control in diabetic patients are important quality improvement strategies in management of diabetic patients[27], and are recommended by American Diabetes Association (ADA) guidelines[14]. Their control also needs to be addressed in diabetic patients in developing countries.

Because of progressive nature of T2DM with different phenotypes and genotypes of patients, it is important to tailor the treatment according to individualized glycemic targets as it has been recommended by global partnership for effective diabetes management[28]. With increasing number of diabetic patients as projected by estimates of 2030[5], the cost of managing these patients in resource-poor developing countries will be a prohibitive challenge. Therefore, individualized, realistic targets in the management of T2DM patients are needed. There is need for more efforts in developing countries in the primary prevention of the imminent ever increasing tide of DM.

Therefore, we recommend to conduct large multicenter studies in Saudi Arabia and Middle East to evaluate myths and knowledge about DM in the public. There is also need to study the reasons for poor diabetic control and causes for reluctance of the T2DM patients to start insulin therapy until very late in the disease when irreversible complication has already set in. Initiation of a web-based national registry of diabetes in Saudi Arabia is a positive step forward in the right direction[29].

CONCLUSION

Our results highlight that the majority of patients with T2DM attending outpatient clinics in KAMC do not meet the target HbA1c definition of good glycemic control. Causes for this failure need to be assessed in Saudi T2DM population.

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مراقبه نسبة السكرفي الدم لدى مرضى الداء السكري من النمط الثاني باستخدام الهيموغلوبين الغلوكوزي(HbA1c) في عيادات الطب الباطني للرعايهالثالثيه

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الملخص:

خلفية الدراسة و الهدف:
تهدف هذه الدراسه الى تقييم نسبة سكر الدم لدى مرضى الداء السكري من النمط الثاني، وقد تم فيها اعتماد تعريف الجمعيهالأمريكيه للداء السكري اللذي يشير الى مراقبه جيده مساويه ل ٧٪ أو أقل، عند استخدام الهيموغلوبين الغلوكوزي (HbA1c).

الطرائق:
هذا البحث عبارة عن دراسه راجعه أجريت على المرضى المراجعين لعيادات الطب الباطني الخارجيه في مدينة الملك عبد العزيز الطبيه في الرياض ،المملكهالعربيهالسعوديه.
تم تقييم جميع مرضى الداء السكري من النمط الثاني اللذين راجعوا عياداتنا الخارجيه في الفترهالزمنيهالممتده من أغسطس ٢٠٠٥ الى يناير ٢٠٠٦.
شملت هذه الدراسهالمرضى اللذين يعالجون بمضادات السكر ويخضعون لقياس الهيموغلوبين الغلوكوزي (HbA1c).
يشكل منتظم، كما قمنا بمراجعة القياسات السابقهلل (HbA1c) من أجل تقييم مدى انضباط سكر الدم عندهم.

النتائج:
أجريت هذه الدراسه على ٩٦٨ مريضا (٨١،٥٪) من أصل ١١٨٨، توفرت عندهم الشروط المطلوبهللبحث. ولوحظ أنه فقط في ٢١١ (٢١،٨٪) منهم كان مستوى قياس الهيموغلوبين الغلوكوزي (HbA1c) متوافقا مع توصيات الجمعيهالأمريكيه للداء السكري "(HbA1c) مساويه ل ٧٪ أو أقل"، وبلغ متوسط الهيموغلوبين الغلوكوزي (HbA1c) لديهم ٩٨،٨٪.
قمنا بتوزيع المرضى الى مجموعات ثلاث،وذلك بناء على نتائج قياس الهيموغلوبين الغلوكوزي ومدى ضبط سكر الدم.
عندهم.
"جيد، (HbA1c) مساويه ل ٧٪ أو أقل، متوسط (HbA1c) ٧،١ - ٩،٩٪، ضعيف (HbA1c) مساوي أو أكثر من ١٠٪"، وحصلنا على النسب التاليه، ٢١،٨٪، ٤٦،٢٪، ٣٢،٠٪، على التوالي.
قمنا أيضا بقياس متوسط الهيموغلوبين الغلوكوزي (HbA1c) لدى مرضى الداء السكري الخاضعين فقط لحميه غذائيه، خافضات السكر الفمويه، خافضات السكر الفمويه مع والانسولين، الانسولين، وكانت النتائج تتابعا "٧،٦٢٪ ، ٨،٦٧٪، ٨،٩٢٪، ٩،٧٠٪".

الخلاصة:
ان نتائج قياس الهيموغلوبين الغلوكوزي (HbA1c) لدى غالبيه المرض المشمولين في هذه الدراسه لم تكن متوافقه مع توصيلتالجمعيهالأمريكيه للداء السكري من النمط الثاني، هذا الأمر يحتاج الى ابحاث مستفيضه لمعرفة الأسباب المؤديه الى هذا التباين لدى مرضى الداء السكري من النمط الثاني في المجتمع السعودي.