INTERNATIONAL JOURNAL OF BIOASSAYS
ISSN: 2278-778X
CODEN: IJBNHY
ORIGINAL RESEARCH ARTICLE
OPEN ACCESS

Characteristics of monitored diabetic patients by glycated haemoglobin (HbA1c)

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Received: March 12, 2016; **Accepted**: April 21, 2016

Abstract: Glycated haemoglobin (HbA1c) test indicates the blood glucose levels for the previous two to three months. Using HbA1c test may overcome many of the practical issues and prevent infections such as urinary tract infections (UTIs). The study aimed to evaluate the impact of glycemic control using HbA1c test to understand patient characteristics and UTIs prevalence. Glycemic control was evaluated by measuring HbA1c for a total of 208 diabetes patients who were regularly attending diabetes center in Al-Noor specialist hospital in Makkah. The results showed that good and moderate glycemic controlled patients were 14.9% and 16.9% respectively while the poor glycemic patients were 68.3%. Among the good improved glycemic control, 83.9% were females, 48.4% were from age group (15-44y). Among the moderately improved glycemic control, 68.4% were females, 54.3% were from age group (45-64 y) with no significant difference. The total number of the patients with positive UTIs was 55 (26.4%) while the total number of patients with negative was UTIs 153 (73.6%). Among the positive UTIs, 76.3% were with poor glycemic control while only 12.3% and 11% were moderate and good improved glycemic control respectively. Among the negative UTIs, 65.3% were with poor glycemic control while only 19% and 15.7% were with moderate and good improved glycemic control respectively. Prevalence of UTIs among diabetic patients was not significant ($p > 0.05$). It was concluded that HbA1c was useful monitoring tool for diabetes mellitus and may lead to improved outcomes. Using a HbA1c test may overcome many of the practical issues that affect the blood glucose tests.

Key words: HbA1c; Diabetes mellitus; glycemic control; Monitoring; patients.

Introduction

Diabetes mellitus (DM) is the most common chronic endocrine disorder, affecting an estimated 5% to 10% of the adult population. The new diagnostic criteria suggest that the diagnosis of DM to be made on the basis of fasting plasma glucose only, in-contrast to the old criteria, which were based upon an oral glucose tolerance test (OGTT) {1}. The definitions proposed by American Diabetes Association (ADA) and adopted by World Health Organization (WHO) that an individual is said to have DM when fasting plasma glucose)FPG) is ≥7.0 mmol/L (126 mg/dL) or a random value at or above 11.1 mmol/L (200 mg/dL) {2}. It is estimated that 366 million people had DM in 2011; by 2030 this would have risen to 552 million {3}. DM is a major health problem in provinces of Saudi Arabia {1, 4}. It is associated with the development of a variety of complications that have a significant impact on morbidity and mortality. The UTIs is the most common infection in diabetic patients. Most of the UTIs in diabetic patients are relatively asymptomatic, which can lead to severe kidney damage and renal failure. Predisposition to UTIs in diabetes mellitus results from several factors. Susceptibility increases with longer duration and greater severity of diabetes {5}. High urine glucose content and defective host immune factors predispose to infection. Diabetes mellitus and obstruction of the urinary tract are the predominant risk factors for developing emphysematous UTIs. HbA1c of 48 mmol/mol (6.5%) is recommended as the cut-off point for diagnosing diabetes. Association (ADA) standards of care for diabetes, based largely on the opinion of an international expert committee, added HbA1c as diagnostic criteria for diabetes (≥6.5%) and prediabetes (5.7–6.4%) {2, 6}. HbA1c is usually a reliable indicator of diabetic control giving an idea about the blood glucose levels for the previous two to three months except in some circumstances such as situations where the average RBC lifespan is significantly less than 120 days and in patients who fluctuate between very high and very low levels of HbA1c readings {7}. Other abnormalities that can affect the results of the HbA1c include supplements such as vitamins C and E and high cholesterol levels. Kidney disease and liver disease may also affect the result of the HbA1c test {8}. HbA1c has recently been endorsed as a diagnostic test for diabetes by the World Health Organization, the International Diabetes Federation and the American Diabetes Association {9, 10}. HbA1c can be very useful in identifying patients who may be presenting an unrealistically good report of their home glucose tests. In comparison to measurement of plasma glucose, HbA1c levels are least affected by any short term, illness related changes in plasma glucose levels. Those who have their diabetes under good control may be able to wait longer between the blood tests. The study aimed to evaluate the impact of glycemic control using HbA1c test and understand patient characteristics and prevalence of UTIs among diabetic patients.

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Material and Methods

This is a retrospective study where information was extracted from the medical records of diabetes Saudi patients suspected with UTIs who were regularly attending diabetes center in Al-Noor specialist Hospital in Makkah from 2006-2016 (1427-1437 H). Two hundred and eight patients were included to determine the level of glycemic control and whether they have UTIs in Makkah patients. Age was categorized into five groups (<18), (18-44), (45-64, (65-74) and 75 years or above. The patients in the study were classified into one of the following three groups based on their HbAc1 tests, good glycemic control diabetes (HbA1c < 5.7%), moderate glycemic control HbA1c is (5.7–6.4%) and poor glycemic control (HbA1c > 6.4%). Collected variables included patients' age, sex and results of UTIs and HbAc1test. Ethical approval was obtained from the Ethical Committee at Alnoor specialist Hospital. The chi-square test was used to detect association between patient HbA1c, UTIs and frequency of age groups and gender. A P-value < 0.05 (two-tailed) was used to establish statistical significance.

Results

Glycemic control was evaluated by measuring HbA1c for a total of 208 diabetes patients who were regularly attending diabetes center in Al-Noor specialist hospital in Makkah. The results showed that good glycemic and moderate glycemic patients were 31(14.9%) and 35 (16.9%) respectively while the poor glycemic patients were 142 (68.3%). Among the 31 of good controlled patients, the maximum number was in females which was 26 (83.9%), and the maximum number in age group (15-44 y) which was 15 (48.4%). Among the 35 of moderately improved patients, the maximum number was in females which was 24 (68.4%), and the maximum number in age group (45-64 y) which was 19 (54.3%) as shown in tables 1 & 2. The Prevalence of glycemic control results among age groups was significant (p = 0.015). The total number of the patients with positive UTIs was 55 (26.4%) while the total number of patients with negative UTIs was 153 (73.6%) (Table3). Among the 55 positive UTIs, 42 (76.3%) were with poor glycemic control while only 7 (12.3%) and 6 (11%) were with moderate and good controlled respectively as shown in table 3. Among the 153 negative UTIs, 100 (65.3%) were with poor glycemic control while only 29 (19%) and 24 (15.7%) were with moderate and good controlled respectively (Table 3).

Table 1: Glycemic control using HbA1c according to gender

HBAC1	Gender (No)		
	F	M	Total
Good	26	5	31 (14.9%)
Poor	120	22	142 (68.3%)
Moderate	24	11	35 (16.9%)
Total	170	38	208 (100%)

Table 2: Glycemic control using HbA1c according to age group

HbA1c	Age group (No)					Total
	<18	18-44	45-64	65-74	=>75	
Good	1	15	10	3	2	31 (14.9%)
Poor	2	23	72	28	17	142 (68.3%)
Moderate	0	9	19	3	4	35(16.9%)
Total	3	47	101	34	23	208(100%)

Table 3: Glycemic control using HbA1c according to UTIs results

HbA1c	UTIs (No)		
	-ve UTI	+ve UTI	Total
Good	24	7	31
Poor	100	42	142
Moderate	29	6	35
Total	153	55	208

+ve UTI= positive UTI, -ve UTI= negative UTI

Discussion

Diagnosis of diabetes has been traditionally based on plasma glucose measurement including the oral glucose tolerance test (OGTT) {11} but the OGTT has poor repeat-test reproducibility, time consuming and cost effective {12}. Using HbA1c test may have many benefits than the blood glucose tests {13}. HbA1c measures chronic glycaemia rather than acute glycaemia. The test can be performed at any time of the day and does not require special preparation {13}. HbA1c in type 2 DM has become the measurements of choice in monitoring the treatment of DM. In 2011, WHO has recommended use of HbA1c alone as an alternative diagnostic test suggesting an HbA1c level of ≥ 6.5% (≥ 48 mmol/mol) as a cut-off for diagnosing diabetes {14}. In the present study, good glycemic and the moderate glycemic controlled patients were 14.9% and 16.9% respectively while the poor or uncontrolled glycemic patients were (68.3%). Similarly, Nkume *et al.,* (2014) {15} found that 44.8% had good glycemic control, 15.1% had fair glycemic control and 40.2% had poor glycemic control levels. In the present study, the total number of the patients with UTIs was 55 (26.4%) while the total number of patients with negative UTIs was 153 (73.6%). The result is near to some findings {15, 16} and lower than others {17, 18} but higher than others {19}. Among those with positive UTIs, 76.3% were with poor glycemic control while only 12.3% and 11% were with moderate and good improved respectively. Among the 153 negative UTIs, 65.3% were with poor glycemic control while only 19% and 15.7% were moderate and good improved glycemic control. Among those with UTIs, 76.3% were with poor glycemic control while only 12.3%

and 11% were with moderate and good controlled respectively. These results indicate no significant association between UTIs incidence and glycemic control ($p > 0.05$). The results can be explained by that UTIs have other risk factors such as: gender and genital anatomy, sexual activity, menopause, urinary tract abnormalities, blockages in the urinary tract, suppressed immune system due to diseases other than diabetes, catheter use or a recent urinary procedure {21, 21}. However, patients with poorly controlled diabetes mellitus are at increased risk of infections, with the urinary tract being the most frequent infection site {22}. Recent studies have shown a possible connection between hyperglycemia and the ability to fight infection {23}. It is widely known that sepsis is closely associated with a series of inflammatory and metabolic responses, {24} and insulin is thought to have an anti-inflammatory effect on tissues, while glucose exhibits pro-inflammatory effects {25}. It had been reported that the incidence rate of UTI was 46.9 per 1,000 person-years among diabetic patients and 29.9 for patients without diabetes {26}. Standardized measurement of HbA1c with minimum inter-test variability can lead to use the HbA1c test to be done in a non-fasting state and may be more convenient {27}. So it could be concluded that HbA1c is useful monitoring tool for diabetes and may lead to improved outcomes. Using HbA1c test may overcome many of the practical issues that affect the blood glucose tests.

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Cite this article as:
Tariq A. Zafar. Characteristics of monitored diabetic patients by glycated haemoglobin (HbA1c). *International Journal of Bioassays* 5.5 (2016): 4563-4566.

Source of support: Nil
Conflict of interest: None Declared