Original Article

The Correlation of Blood Glucose with Salivary Glucose Level in Diabetic Patients

A. Azizi [1], A. Modaberi [2].

[1]Associate Professor, Department of Oral and Maxillofacial Medicine, School of Dentistry, Islamic Azad University, Tehran, Iran
[2]Dentist

Abstract

Background and Aim: Finding a relationship between the blood glucose level and its concentration in other body fluids such as the saliva can help in developing a conservative method for blood sugar assessment replacing venous sampling .The aim of this study was to evaluate the relationship of blood glucose level with salivary glucose in diabetic patients.

Materials and Methods: This case-control study was conducted on **75** diabetic patients as the case and 75 healthy subjects as the control group. Blood and salivary glucose levels were measured in the two groups. Pearson's correlation coefficient was used to assess the correlation of blood glucose with salivary glucose in the two groups.

Results: The mean (±SD) blood glucose and salivary glucose level was 247±24.2mg/dl and 1.4±0.2mg/dl in the case group, respectively. These rates were 84.97±15.8 and 1.09±0.12mg/dl in the control group, respectively**.**
Statistical analyses showed a high correlation between blood glucose level and salivary glucose in diabetic patients (r=0/9); whereas this correlation was insignificant in the healthy control group (r=0.18)**.**

Conclusion: This study showed a high correlation between blood glucose level and salivary glucose in diabetic patients.

Key Words: Blood glucose level, Salivary glucose level, Diabetes Mellitus

Corresponding author:
A. Azizi, Associate Professor, Department of Oral and Maxillofacial Medicine, School of Dentistry, Islamic Azad University, Tehran, Iran
drarashazizi@yahoo.com

Received: 24 Jul 2012
Accepted: 30 Sept 2013

Journal of Islamic Dental Association of IRAN (JIDAI) Winter 2014 ;26, (1)

Introduction

Diabetes mellitus (DB) is a complex disease with vascular and metabolic components. This chronic condition is characterized by hyperglycemia (increased blood sugar) and affects different body systems namely kidneys, eyes, mucosa and etc. Approximately 9.5% of the American population suffer from DM [1].

The blood glucose level needs to be closely monitored in diabetic patients. Typically, a blood sample is obtained for blood sugar analysis by venipuncture, finger stick or other invasive techniques. This type of blood collection is associated with physical and mental stress and pain for patients. Thus, it would be optimal to use another biologic fluid like saliva for determination of blood glucose level and avoid the abovementioned invasive procedures [2].

Falace [3], Marcheti in 1989 [4] and Amer in 2001 reported similar results [5]. But, Leach in 1970 [6] and Ficara in 1975 [7] did not find any significant relationship between blood glucose and salivary glucose level in diabetic patients [7].

Considering the existing controversies regarding the correlation of blood glucose and salivary glucose level, this study sought to assess this correlation in diabetic patients.

Materials and Methods

This case-control study was conducted on 75 uncontrolled diabetic patients with a diagnosis of type 2 DM confirmed by a specialist. These patients were above 40 years of age and selected from the Endocrinology Department of Imam Khomeini Hospital. Eight hours after having the last meal of the day, 2cc non-stimulatory salivary samples were collected into sterile screw-cap test tubes. Salivary samples were obtained from fasted patients during 9-11 am and in a calm environment with no mental pressure on patients [1]. Diabetic patients were under pharmaceutical treatment. However, their status was far from normal in order to be discharged from the hospital. In case of selection of controlled diabetic patients, their blood glucose level would be close to that of healthy individuals making it hard to find a correlation or make a comparison with normal subjects. Thus, we selected uncontrolled DM patients for our study. Our patients were on oral anti-diabetic medications. After collection of salivary samples, the test tubes were screw-capped, placed in ice and transferred to Pars Medical Diagnosis Laboratory. In the laboratory, salivary samples were centrifuged at 5000 rpm for 10 minutes and the supernatant was collected for testing and transferred to -20°C temperature. Glucoseoxidase assay kit (God, Sigma, USA, Lot number: 87001-27, 2008) and glucose oxidase method was used in an Auto Analyzer for determination of glucose level. This machine has 3 rows each with the capacity of 30 blood samples. In other words, 90 samples can be analyzed simultaneously.

Also, 5cc venous blood samples were also taken from subjects, collected in screw-cap test tubes and transferred to the lab. Blood was centrifuged with 2000 rpm for 10 minutes and the serum was separated. The separated serum was transferred to a test tube and stored at -20°C temperature until the experiment. Testing was done using Sigma kit.

The control group consisted of 75 subjects without DM or any other systemic disease. Controls matched the case group patients in terms of age and sex. All subjects were thoroughly informed about the study objectives and written informed consent was obtained from them. This study was approved by the Ethics Committee of the university.

Blood glucose level measured by the device was reported in mg/dl with 0.1 precision. Pearson's correlation coefficient was used to assess the correlation between blood glucose and salivary glucose level in the case and control groups.

Results

The mean and standard deviation of age was 42±4.2 in the case and 45±3.7 in the control group. There were 38 males and 32 females in the case and 42 males and 28 females in the control group. The mean (±SD) blood glucose was 247±24.2 mg/dl and the mean salivary glucose was 1.4±0.2 in the case group. The overall correlation coefficient of the level of blood glucose in diabetic and normal subjects with salivary glucose was found to be 0.67 indicating a significant positive correlation between these two parameters (p=0.02). In other words, salivary glucose level estimates blood glucose alterations by approximately 50%.

The correlation coefficient between the blood and salivary glucose levels was r=0.90 in the diabetic group indicating a very high correlation. As observed, these estimations are very close to actual blood glucose values of subjects. The correlation coefficient of r=0.90 shows that salivary glucose is capable of estimating 90% of blood glucose level in diabetic group (Diagram 1).

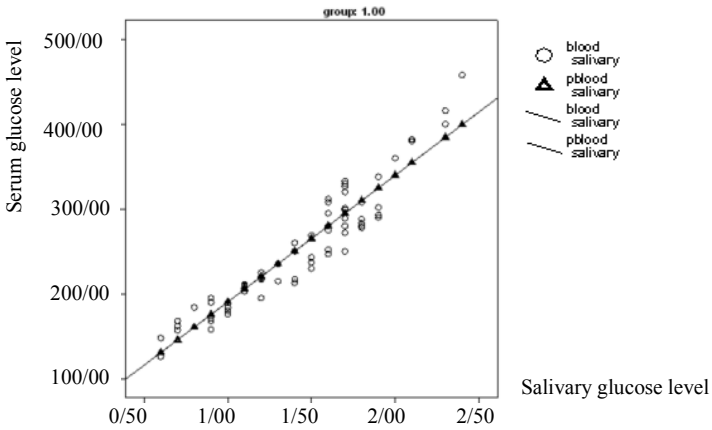

Diagram 1. Estimation of blood glucose based on salivary glucose level in diabetic patients

The mean (±SD) blood glucose was 84.97±15.8 mg/dl and the mean salivary glucose was 1.09±0.12 in the control group.

The correlation coefficient between the blood and salivary glucose levels in the control group (r=0.18) showed no significant correlation between these

two parameters in healthy subjects. As seen in Diagram 2, no significant correlation exists between blood and salivary glucose level of healthy control subjects. The correlation coefficient of r=0.18 indicates that in healthy individuals, salivary glucose level is not capable of estimating the blood glucose level.

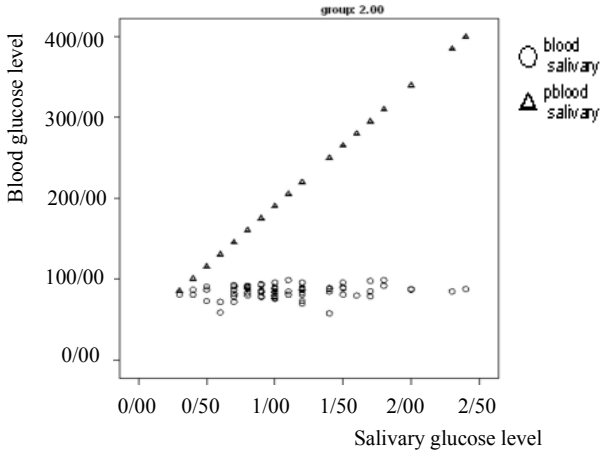

Diagram 2. Estimation of blood glucose based on salivary glucose level in healthy controls

Discussion

Uncontrolled diabetic patients have high levels of blood glucose. Since all biologic fluids are derived from blood, change in blood composition affects body fluids as well. Saliva is an important body fluid and increased blood glucose level raises the salivary glucose level as well [8].

Reuterving, Chavez and Aydin concluded that salivary glucose level in diabetic patients was higher than that in non-diabetics and suggested to use saliva instead of plasma for diagnosis of DM [9-11].

Marchetti found a significant association between salivary glucose level and DM [4].

Amer also demonstrated a significant relationship between salivary and blood glucose levels and recommended using saliva for determination of blood glucose level in diabetic patients [5].

Moreover, Harisson, Darwazeh, Karjalainen and Lopez concluded that the salivary glucose level in diabetic patients was higher than that of healthy subjects [12-15].

However, Leach and Ficara found no significant correlation between blood glucose and salivary glucose in diabetic patients [6, 7]. This difference may be due to the different methodology and design of their study compared to ours and the fact that subjects evaluated in their studies were not fasted and it was not clear what food products had been consumed by subjects within the two hours prior to sampling; whereas, our subjects were fasted in our study. Moreover, this difference may be attributed to the release of carbohydrates by glycoproteins, glucose break down by the bacteria and salivary contamination by crevicular fluid exudate in patients with poor oral hygiene [16].

We found a correlation between blood and salivary glucose levels in both case and control subjects. However, this correlation was not significant in healthy subjects. The reason may be salivary glucose changes in very small range in healthy individuals. As discussed above, measurement of salivary glucose level for blood glucose determination is not recommended as a non-invasive technique in healthy individuals. Considering the strong correlation noted between the salivary and serum glucose levels, further studies are required to better elucidate this correlation and increase its reliability by conduction of sensitivity and specificity testings.

Conclusion

Within the limitations of this study and based on the obtained results, we may conclude that a high correlation exists between blood glucose and salivary glucose level in diabetic patients.

References

1- Greenberg MS, Glick M. Burket's oral medicine diagnosis & treatment, 11th ed. Hamilton: BC Becker Co; 2008, 63-65.

2- Vasconcelos AC, Soares MS, Almeida PC, Soares TC. Comparative study of the concentration of salivary and blood glucose in type 2 diabetic patients. J Oral Sci. 2010 June; 52(2):293-8.

3- Little JW, Falas DA, Miller CS, Rhodus NL. Dental management of the medically compromised patient. 9 editions. Missouri: Mosby; 2013, 280-288.

4- Marcheti P, Tognarelli M, Giannarelli R, Grossi C, Picaro L, di Carlo A, et al. Decreased salivary glucose secretory rate; usefulnessfor detection of diabetic patients with autonomic neuropathy. Diab Res Clin Prac. 2001 May; 7 (3):181-6.

5- Amer S, Yousuf M, Siddiquip, Alam J. Salivary glucose concentration's in patient's with diabet's mellitus-A Minimally invasive technique for monitoring Blood glucose levels. Pak J Pharm Sci. 2001Jan; 14(1):33-37.

6- Leach SA, Melville Th. Investigation of some human oral organisms capable of releasing the carbohydrates from salivary glycoproteins. Arch Oral Biol. 1970 June;15(1):87-8.

7- Ficara M, Levin MP, Grower MF, Cramer GD. A comparison of the glucose and protein content of gingival fluid from diabetic and nondiabetics. J Period Res. 1975 Jan; 10(3):171-5.

8- Negrato CA, Tarzia O. Buccal alteration in diabetes mellitus. Diabetol Metab Syndr. 2010 Jan; 15,2:3.

9- Reuterving CO, Reuterving E, Hagg E, Ericson T. Salivary flor rate and salivary glucose concentration in patients with diabetes mellitus influence of severity of diabetes. Diab Metabol. 1987 July-August; 13(4):457-62.

10- Chavez EM, Borell LN, Taylor GW, Ship JA. A longitudinal analysis of salivary flow in control subjects and older adultswith type 2 diabetes. Oral Surgery Oral Med Oral Pathol Oral Radiol & Endod. 2001 Feb; 91(2):166-73.

11- Aydin S. A comparison of ghrelin, glucose, alpha amylase and protein levelin saliva from diabetics. J Biochem Molecular Biol. 2007 May; 40 (1):29-35.

12-Harrison R, Bowen WH. Flow rate and organic constituents of whole saliva in insulin-dependent diabetic children and adolescents. Pediat Dent. 1987 Dec;9(4):287-291.

13-Darwazeh AMG, Macfarlane TW, McCuish A and Lamey PJ. Mixed salivary glucose levels and candidal carriage in patients with diabetes mellitus. J Oral Pathol & Med. 1991 Jul; 20(6):280-3.

14-Karjalainen KM, Knuuttila ML, Käär ML. Salivary factors in children and adolescent with insulin-dependent diabetes mellitus. Pediat Dent. 1996 Jul-Aug;18(4):306-11.

15-López ME, Colloca ME, Páez RG, Schallmach JN, Koss MA, Chervonagura A. Salivary characterestics of diabete children. Braz Dent J. 2003 June;14(1):26-31.

16-Jurysta C, Bulur N, Oguzan B, Satman I, Yilmaz Tm, et al. Salivary glucose concentration and excretion in normal and diabetic subjects. J Biomed Biotech. 2009.