Original Article

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Dentistry Section

Evaluation of Correlation of Blood Glucose and Salivary Glucose Level in Known Diabetic Patients

ANJALI GUPTA[1], SIDDHARTH KUMAR SINGH[2], B.N.PADMAVATHI[3], S.Y.RAJAN[4], G.P.MAMATHA[5], SANDEEP KUMAR[6], SAYAK ROY[7], MOHIT SAREEN[8]

ABSTRACT

Introduction: Diabetes mellitus is a chronic heterogenous disease in which there is dysregulation of carbohydrates, protein and lipid metabolism; leading to elevated blood glucose levels. The present study was conducted to evaluate the correlation between blood glucose and salivary glucose levels in known diabetic patients and control group and also to evaluate salivary glucose level as a diagnostic tool in diabetic patients.

Materials and Methods: A total number of 250 patients were studied, out of which 212 formed the study group and 38 formed the control group.

Result: Among 250 patients, correlation was evaluated between blood glucose and salivary glucose values which on analysis revealed Pearson correlation of 0.073. The p-value was 0.247, which was statistically non significant.

Conclusion: Salivary glucose values cannot be considered as a diagnostic tool for diabetic individuals.

Keywords: Non invasive monitoring, Type I diabetes mellitus, Type II diabetes mellitus, Unstimulated salivary glucose

INTRODUCTION

Diabetes mellitus is a clinically and genetically heterogeneous metabolic disease characterized by abnormally elevated blood glucose levels and dysregulation of carbohydrate, lipid and protein metabolism [1]. The number of diabetic individuals is increasing worldwide because of population growth, ageing, increasing prevalence of obesity and urbanization. It has been reported that the worldwide prevalence of DM will rise from171 million (in 2000) to 366 million by 2030 (Wild et al.,). In India, a number of epidemiological studies with varying sample sizes have reported prevalence of diabetes at different geographical areas ranging from 1.6% to 12.4% [2].

The complications of DM include cardiovascular disorders, nephropathy, retinopathy, peripheral nerve abnormalities and alterations in wound healing [1].The most common oral complication of DM is periodontal disease, which has also been labeled as the “sixth” complication of DM (Löe et al.,). Normalization of blood glucose levels in diabetic patients reduces the risk of development of some of the specific complications of the disease [3].

Trials report that tight control of blood glucose concentrations, by frequent testing and concomitant adjustment of insulin doses, decreases long-term complications resulting from diabetes [4]. The standard methods for measuring blood glucose levels in doctor’s offices and clinics involve drawing blood from a vein in the forearm or from a finger puncture, and then measuring the glucose content of that blood using a variety of biochemical techniques. Consequently, the inconvenience, pain and cost to the patient are considerable; unfortunately this often results in infrequent testing. A number of home methods for assessing blood glucose have become available in the past few years, such as Glucometer, but even they also require a blood sample [5]. Invasive method for self monitoring of glucose is more commonly used but this is a painful procedure. So, noninvasive methods using other body fluids such as urine and saliva has been of particular interest and can lead to tighter control on glucose levels [3].

Diagnosis of disease via the analysis of saliva is potentially valuable for children and older adults, since collection of the fluid is associated with fewer compliance problems as compared with the collection of blood. Further, analysis of saliva may provide a cost-effective approach for the screening of large populations [6,7].

AIMS AND OBJECTIVES

The aim of present study was to evaluate blood glucose and unstimulated salivary glucose level in known diabetic patients and control group. While the objectives of the study were to correlate blood glucose and salivary glucose level in known diabetic patients and control group & also to evaluate salivary glucose level as a diagnostic tool in diabetic patients.

MATERIALS AND METHODS

The study was conducted in Department of Oral Medicine & Radiology and diabetic centre of Maharana Bhupal Singh Medical College, Udaipur, India. Total number of patients was 250, out of which 212 formed the study group and 38 formed the control group. The study was conducted for a period of 10 months i.e. from September 2009 – June 2010.

Study group consisted of 212 patients, with a positive history of either Type 1 or Type 2 diabetes mellitus. There was total number of 47 Type 1 diabetics of which 18 were females and 29 were males between 10-55 years. There was total number of 165 Type 2 diabetics of which 104 were females and 61 were males between 35-80 years. All the diabetic patients were freshly diagnosed patients, not under any medication. Control group consisted of total number of 38 individuals, with a negative history of diabetes mellitus of which 22 were females and 16 were males between 15-47 years. Both type 1 and 2 known DM patients were included in this study, while patients with history of medications causing xerostomia were excluded from the study. All the 250 patients of the study and control groups were examined for blood and salivary glucose levels. Complete examination of the oral cavity was done in 88 patients who volunteered.

[Table/Fig-1]: Glucometer with evaluation strips

[Table/Fig-2]: Method of collecting saliva from floor of the mouth

	N	Mean blood glucose (mg/dl)	Mean salivary glucose (mg/dl)	Std. Deviation of blood glucose	Std. Deviation of salivary Glucose	Pearson Correlation coefficient "r value"	p-value	Correlation b/w blood glucose & salivary glucose
Type 1 DM	47	217.62	10.21	126.216	11.889	-0.075	0.614	Non Significant
Type 2 DM	165	174.24	9.92	75.170	11.551	0.079	0.312	Non Significant
Control Group	38	84.18	6.58	11.130	6.057	0.322	0.049	Significant
Study group	212	183.86	9.98	90.505	11.599	0.030	0.699	Non Significant

[Table/Fig-3]: Correlation between blood glucose & salivary glucose in study and control group

First, a drop of blood was collected for fasting glucose estimation by pricking the middle finger using no. 26, 0.5 inch disposable needle. Then a drop of blood oozing from the finger was absorbed by disposable Johnson blood glucose test strip. The strip was then placed into the glucometer and the reading of blood glucose was recorded [Table/Fig-1].

Salivary samples in all patients were collected immediately after glucometer readings were obtained. All the samples were collected in the morning hours between 9 am to 11 am from patients who were in a fasting state. The patients were made to sit upright in a comfortable position and were asked to rinse the oral cavity using plain water. The saliva secreted for initial 2 minutes was swallowed and subsequently secreted saliva was held in oral cavity for the following 5 minutes. The saliva thus pooled in the floor of oral cavity was collected by suction technique using 2 ml disposable syringe [Table/Fig-2]. This collected salivary sample was preserved in an ice box and then transported to the laboratory within two hours. Blood glucose and salivary glucose levels were estimated and correlated. Fasting blood sugar was recorded using AccuChek Glucometer, while salivary glucose was estimated using GOD {glucose oxidase} method. The readings of glucometer and readings obtained by GOD method were statistically correlated (N=16, p<0.001) and thus standardized.

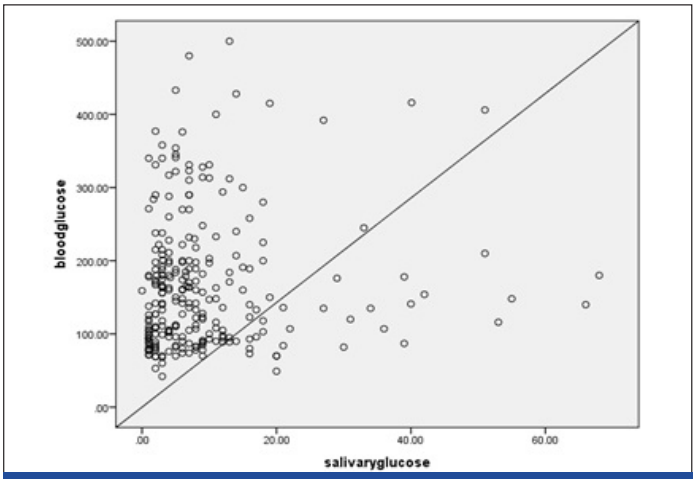
STATISTICAL ANALYSIS

A master chart was prepared using 2007 Microsoft Excel. The mean, standard deviation, standard error, Pearson's correlation, F-value using ANOVA test and Post-hoc analysis was applied for statistical analysis. Probability (p-value) of calculated values was determined by referring to the respective tables and thus results of the study were evaluated for statistical significance.

RESULTS

Among 250 patients, correlation was evaluated between blood glucose and salivary glucose values which on analysis revealed Pearson correlation of 0.073. The p-value was 0.247, which was statistically non significant indicating that the values of salivary glucose and blood glucose did not correlate when study and control groups were considered together [Table/Fig-3,4].

Study group consisted of 212 diabetic patients. There were 90 males and 122 females in study group. Correlation was evaluated between



[Table/Fig-4]: Scatter plot showing the correlation between salivary glucose and blood glucose

blood glucose and salivary glucose values in the study group, which on analysis revealed Pearson correlation value of 0.030. The p-value was 0.669, which was statistically non significant indicating that the values of salivary glucose and blood glucose did not correlate in diabetic patients [Table/Fig-3].

In the study group, 47 patients were suffering from Type 1 diabetes and 165 patients were suffering from Type 2 diabetes. The Pearson correlation between their blood glucose and salivary glucose were -0.075 for Type 1 and 0.079 for Type 2. The p-value was 0.614 and 0.312 which were statistically non significant indicating the values of blood and salivary glucose did not correlate in Type 1 and Type 2 Diabetes [Table/Fig-3].

Among control group of 38 individuals, correlation was evaluated between blood glucose and salivary glucose values which on analysis revealed Pearson correlation value of 0.322. The p-value was 0.049 which was statistically significant indicating that the values of salivary glucose and blood glucose correlated in non diabetic individuals [Table/Fig-3].

DISCUSSION

Diabetes mellitus consists of a group of diseases characterized by abnormally high blood glucose levels [8]. The two main types

of diabetes mellitus are Type 1 or insulin-dependent diabetes mellitus (IDDM) and Type 2 or non-insulin-dependent diabetes mellitus (NIDDM).The primary feature of this disorder is chronic hyperglycemia, resulting from either a defect in insulin secretion from the pancreas or resistance of the body's cells to insulin action, or both [1].

Correlation of blood glucose and salivary glucose: In the present study, no significant statistical correlation was obtained between blood glucose and salivary glucose, when study and control groups were considered together. This is in accordance with a previous study done by George G Guilbault et al., [5]. Similar results were obtained by studies conducted by Jorma Tenovuo et al., [9] and Hanna Ben-Aryeh et al., [10]. Though blood glucose and salivary glucose was assessed by glucose oxidase method, while in our study blood glucose was assessed by glucometer.

Statistically significant correlations between blood glucose and salivary glucose in study and control groups were obtained in the studies done by previous researchers, though similar methods were adopted [6,11-15]. The variability in the results obtained could be because of small number of sample size in their studies [11,12,15,16]. [Table/Fig-5] shows the comparison between our own findings with those of other researchers.

Sr. no.	Reference	Sample size	Salivary/ blood Sample collection	Method used	Results
1.	Present study	212- diabetic patients 38- control group	Unstimulated whole saliva by suction method Capillary blood	Salivary glucose - GOD method Blood glucose - Glucometer	Negative correlation among diabetics and positive among non-diabetics
2.	Shehla Amer et al., [14]	135- diabetic patients 25- control group	Unstimulated whole saliva Venous blood	GOD method	Positive correlation among diabetics and negative correlation among non-diabetics
3.	HR Englander et al., [17]	26- diabetic patients 26- control group	Stimulated Parotid saliva using parotid cap Venous blood	Method of Saifer and Gerstenfeld	Negative correlation
4.	LN Forbat et al., [3]	31- diabetic patients 0-control group	Stimulated parotid saliva Venous blood	GOD method	Negative correlation among diabetic patients
5.	Sreedevi et al.,[6]	60- diabetic patients 60- control group	Whole saliva using draining method Venous blood	GOD method	Positive correlation in both study and control group
6.	Panda Abikshyeet et al., [18]	106- diabetic patients 15- control group	Unstimulated saliva by spitting method Venous blood	GOD method	Positive correlation in both study and control group
7.	SK Jha et al., [19]	60- diabetic patients 30-control group	Both unstimulated and stimulated saliva using suction method Venous blood	GOD method	Positive correlation in both study and control group
8.	V Nagalaxmi et al., [20]	50- type I diabetics 50- control group	Unstimulated whole saliva by draining method Venous blood	GOD method	Positive correlation in both study and control group
9.	Neha Singh et al., [21]	134- type II diabetics 67- control group	Unstimulated whole saliva by draining method Venous blood	GOD method	Positive correlation in study group and negative correlation among control group

[Table/Fig-5]: Comparison of the present study with other studies

In the present study among study group, no significant statistical correlation was obtained between values of blood glucose and salivary glucose.

Results of studies carried out by researchers namely LN Forbat et al., [3], George G Guilbault et al., [5], and JormaTenovuo et al., [9], revealed a non significant correlation of blood glucose and salivary glucose among diabetic patients, concurrent with the present study. In contrast to the present study, another study conducted by Darwazeh AMG et al., revealed a significant correlation of blood glucose and salivary glucose among diabetic patients [11]. An enzymatic ultraviolet detection method of analysis was used in case of salivary glucose and blood glucose was analysed using GOD method. The difference in method of measuring salivary glucose may be responsible for better correlation between salivary and blood glucose in the above study [11].

In the present study, there was no statistical significant correlation between blood glucose and salivary glucose among type I and II diabetic patients. Similar results were obtained in the previous studies done by researchers such as P BakianianVaziri et al., [22].

In the present study, there was statistically significant correlation between blood glucose and salivary glucose among the non-diabetic individuals. While in the previous studies, statistically significant correlation between bloodglucose and salivary glucose among control group was present [6,14]. In one study conducted by Darwazeh AMG et al., correlation between blood glucose and salivary glucose in non diabetic individuals was not present [11].

CONCLUSION

In the present study, it was concluded that salivary glucose does not serve as a reliable indicator of blood glucose level, in diabetic patients who showed elevated blood glucose levels. Saliva did not seem to play a significant role as a non invasive indicator of diabetes in the present study. But, further studies need to be undertaken involving greater sample size and using other methods to estimate salivary glucose levels, which may herald a new era in non invasive method of salivary glucose estimation.

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PARTICULARS OF CONTRIBUTORS:
1. Senior Lecturer, Department of Oral Medicine & Radiology, Sri Aurobindo College of Dentistry, Indore, Madhya Pradesh, India.
2. Reader, Department of Oral Medicine & Radiology, Sri Aurobindo College of Dentistry, Indore, Madhya Pradesh, India.
3. Professor, Department of Oral Medicine & Radiology, Darshan Dental College & Hospital, Loyara, Udaipur, Rajasthan, India.
4. Professor and Head, Department of Oral Medicine & Radiology, Darshan Dental College & Hospital, Loyara, Udaipur, Rajasthan, India.
5. Professor, Department of Oral Medicine & Radiology, CODS, Davangere, India.
6. Senior Lecturer, Department of Public Health Dentistry, Sri Aurobindo College of Dentistry, Indore, Madhya Pradesh, India.
7. Consultant, Department of Oral Medicine & Radiology, Dafodyl Dental Clinic, Kolkata, India.
8. Senior Lecturer, Department of Oral Medicine & Radiology, Rajasthan Dental College and Hospital, Jaipur, Rajasthan, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Anjali Gupta,
Senior Lecturer, Department of Oral Medicine & Radiology, Sri Aurobindo College of Dentistry,
Indore, Madhya Pradesh, India.
E-mail : anjali462007@gmail.com

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