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A Comparative Study of Glucose Levels in Blood and Saliva of Type 2 Diabetic Patients of Balkot

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Abstract **Background and objective:** The increasing trend in prevalence of diabetes mellitus around the world is alarming. Glucose levels in diabetic patients should be regularly monitored to minimize the diabetic complications. The purpose of the present study was to study the correlation between salivary and blood glucose levels. Awareness and knowledge about diabetes and perception on blood glucose maintenance among study population was also assessed. If a close correlation were to exist, diabetic control could be monitoed by the noninvasive method of measuring salivary glucose. **Methods:** Age matched 50 diabetic and 50 healthy non-diabetic individuals were included in the study. Structured questionnaire was used to know the educational status and knowledge about diabetes mellitus. Estimation of serum and salivary glucose levels in fasting state were carried out by Glucose Oxidase Peroxidase (GOD-POD) method, using semi-automated machine. **Results:** Higher percentage of diabetic patients had good knowledge and perception about diabetes and blood glucose maintenance than healthy subjects. Among diabetics mean salivary glucose level was 9.98±3.01 mg/dl. This was much higher as compared to non-diabetic individuals (7.56±1.37 mg/dl). Mean salivary glucose levels were found to be significantly correlated with mean blood glucose levels of diabetics (r= 0.811) and non diabetics (r= 0.506). **Conclusion:** This study suggested that saliva may become an alternative to blood for lab diagnostic procedures if further extensive studies are done in future.

Keywords Diabetes mellitus, Salivary glucose, Non-invasive

1. Introduction

With the increasing incidence of diabetes mellitus it is very important for the patients to have good knowledge about diabetes and its management. It is also important to know about patients' perception about blood glucose maintenance. This will help to limit the complications related to diabetes mellitus.

Saliva is a clear fluid secreted into the oral cavity by major and minor salivary glands. It is very important body fluid with large range of body functions. Nowadays saliva is used regularly to diagnose various endocrine disorders as well as autoimmune and infectious diseases [1]. Saliva consists of 99.5 % water and 0.5 % electrolytes, amylase, lipase, mucin, glycoproteins, glucose and antimicrobial enzymes [2-4].

High risk of transmission of diseases like AIDS and Hepatitis to health care professionals has increased the demand of diagnostic tests that doesn't require blood. These factors have encouraged scientists and researchers in developing new diagnostic methods which can be done easily at home with less risk. Lab diagnostic procedures which are done today regularly use blood and urine and hardly other body fluids like saliva. [5]. Saliva used as a diagnostic fluid can determine both local and systemic alterations [6].

Salivary sample collection is an easy process that can be done with short training period. Sophisticated and costly equipments are not needed for collection of the fluid. Analysis of saliva has potential to become a cost-effective tool for the screening of large populations in future [7]. Various studies in the past have shown correlations between serum and saliva levels. We can collect multiple salivary samples from the same person at required time of period with ease [8].

Regular monitoring of glucose levels in diabetic patients is an important aspect of diabetes management. Use of noninvasive and simple methods offers various advantages. There will be no fear of needle puncture which can increase the frequency of glucose estimation helping in good glycemic control [9, 10].

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The purpose of the present study was to investigate the relationship between salivary and blood glucose. If a close correlation were to exist, diabetic control could be monitored by the noninvasive method of measuring salivary glucose.

2. Methods

This cross sectional study was done in confirmed type 2 diabetic patients and healthy non diabetic subjects attending Gorakh Medical & Diagnostic Centre Pvt. Ltd. Balkot, Bhaktapur. The study period was of 6 months, starting from October 2016 till March 2017. For this study total 100 subjects were selected randomly (50 type 2 Diabetics and 50 age matched healthy subjects). Individuals with past history of salivary gland surgeries, receiving radiotherapy around head & neck region, and taking medicines for long duration except for diabetes mellitus were excluded from study. All subjects were thoroughly informed about the study and written consent was taken. Helsinki guidelines were followed. Structured questionnaire was used to know the educational status, knowledge about diabetes mellitus and blood glucose maintenance.

Collection of samples:

Samples were collected in the morning after overnight fasting. Diabetic patients were advised to take their regular medicine.

1) Saliva: - Approximately 2 ml of unstimulated whole saliva was collected in a sterile tube by spitting over a period of 5 minutes. Subjects were asked to rinse their mouth with clean water before saliva collection. Obtained salivary sample was analyzed immediately or stored in refrigerator, for no more than 2 hours. It was then centrifuged at 3000 RPM for 10 minutes. Obtained supernatant solution was analyzed for salivary glucose concentration.
2) Serum: - Aseptic conditions were maintained. 2 ml of intravenous blood was obtained from median cubital vein of forearm, centrifuged at 3000 RPM for 10 minutes. Obtained serum was then analyzed.
3) Serum Glucose and Salivary Glucose determination: - Serum and salivary glucose were assayed by use of Glucose Oxidase Peroxidase (GOD-POD) method. Semiautoanalyzer was used for assaying procedure.

Methods of Statistical Analysis

Statistical analysis was performed by using the program SPSS 20. The results were evaluated by using Pearson correlation test to assess correlation between blood glucose and salivary glucose. Statistical significance was considered at P values <0.05.

3. Results

The mean and standard deviation of age was 58.18 (10.13) years in diabetics and 54.08 (14.53) years in healthy subjects. There were 32 males and 18 females among diabetics and 26 males and 24 females among healthy subjects. 68% among diabetics were literate compared to 62% in healthy subjects. Based on the questionnaire diabetic patients were more aware about diabetes mellitus than healthy subjects. The mean blood glucose in diabetics was 137.82 (46.44) mg/dl and in non-diabetics 98.76 (7.94) mg/dl. Similarly mean salivary glucose & standard deviation of diabetics was 9.98 (3.01) mg/dl and that of non-diabetics was 7.56 (1.37) mg/dl. Mean salivary glucose level was higher in diabetics.

Table 1. Educational status of study subjects

	Diabetic (n = 50)	**Healthy Subjects (n = 50)**
Illiterate	16 (32%)	19 (38%)
Primary School	5 (10%)	3 (6%)
High School	12 (24%)	10 (20%)
Bachelor	8 (16%)	13 (26%)
Masters or High	9 (18%)	5 (10%)
Total	**50 (100%)**	**50 (100%)**

Table 2. Knowledge about diabetes and monitoring glucose level among study subjects

	Diabetic (n = 50)		**Healthy Subjects (n = 50)**	
	Yes	**No**	**Yes**	**No**
Do you know what diabetes mellitus is?	35 (70%)	15 (30%)	32 (64%)	18 (36%)
Are you aware about causes of diabetes mellitus?	38 (76%)	12 (24%)	26 (52%)	24 (48%)
Do you think it is necessary to regularly monitor glucose level in your body?	42 (84%)	8 (16%)	29 (58%)	21 (42%)
Do you regularly monitor your blood glucose level?	35 (70%)	15 (30%)	9 (18%)	41 (82%)
Have you heard about evaluating salivary glucose for monitoring Diabetes mellitus?	1 (2%)	49 (98%)	0 (0%)	50 (100%)
Are you aware about complications of diabetes mellitus?	38 (76%)	12 (24%)	20 (40%)	30 (60%)
Do you know about management of diabetes mellitus?	41 (82%)	9 (18%)	12 (24%)	38 (76%)

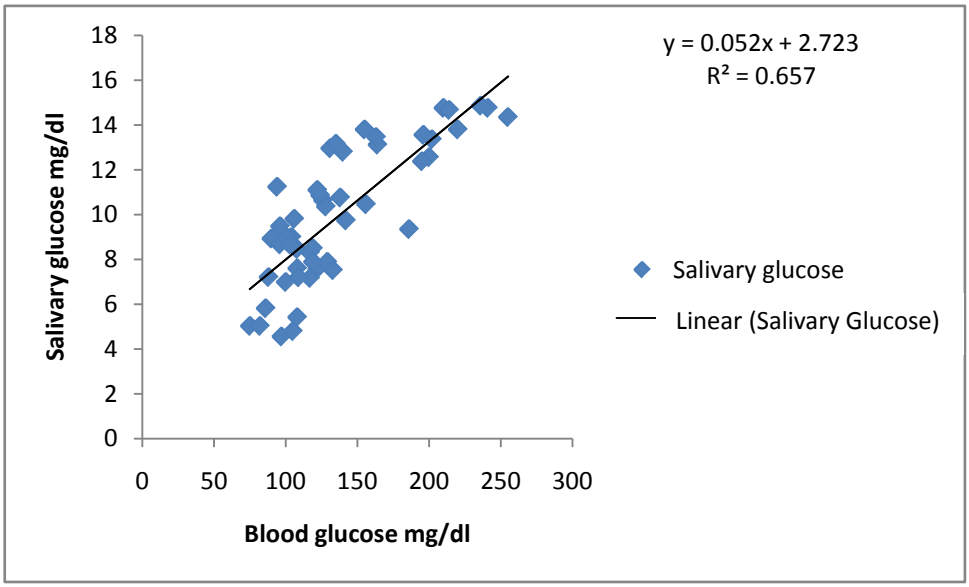
Table 3. Mean blood glucose and salivary glucose of Diabetics and healthy subjects

Group	Mean blood glucose (mg/dl) ± SD	Mean salivary glucose (mg/dl) ± SD
Diabetics (n=50)	137.82 (46.44)	9.98 (3.01)
Healthy subjects (n=50)	98.76 (7.94)	7.56 (1.37)

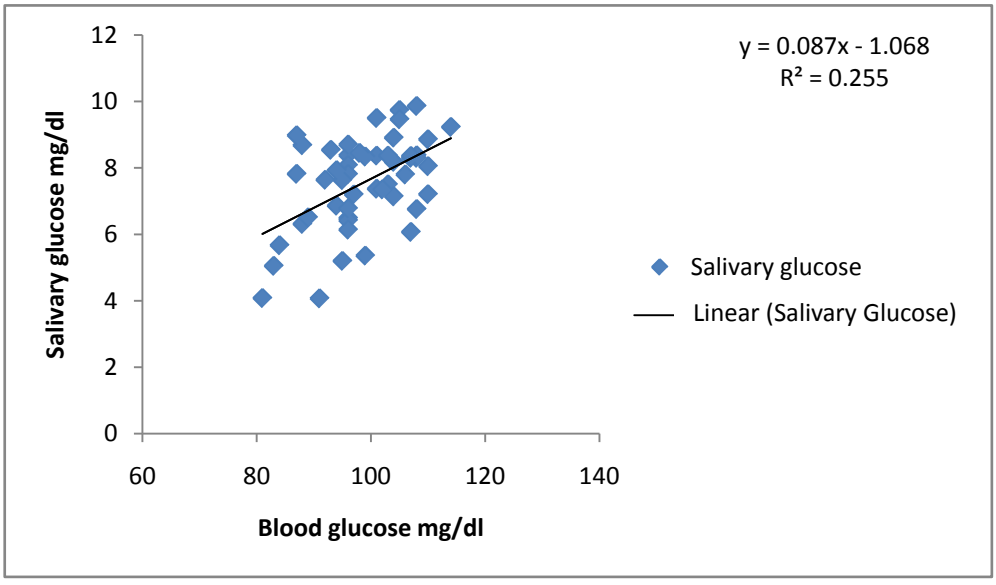
Table 4. Correlation between blood glucose and salivary glucose of diabetics and healthy subjects

Parameters		R (Pearson correlation coefficient)	P value	Remarks
Blood glucose of diabetics	Salivary glucose of diabetics	0.811**	.000	Highly significant positive correlation
Blood glucose of healthy subjects	Salivary glucose of healthy subjects	0.506**	.000	Highly significant positive correlation

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)



Graph 1. Correlation between blood glucose and salivary glucose in diabetics



Graph 2. Correlation between blood glucose and salivary glucose in healthy subjects

The results showed that the correlation coefficient between the blood and salivary glucose levels was r=0.811 in the diabetic group indicating a very high correlation. This shows that salivary glucose is capable of estimating 81% of blood glucose in diabetics. Similarly there was positive correlation coefficient between blood and salivary glucose levels in healthy subjects (r=0.50).

4. Discussion

A good knowledge and awareness of diabetes is a major determinant for control of diabetes mellitus. Patients should have positive attitude towards regular glucose monitoring so that future complications can be minimized. In Nepal only few studies have been done on knowledge about diabetes mellitus among subjects [11, 12]. In our study higher percentage of diabetic patients had good knowledge about diabetes mellitus. They were more positive towards monitoring of blood glucose than healthy subjects.

The salivary glucose level in diabetic patients (9.98±3.01 mg/dl) was much higher as compared to healthy non-diabetic individuals (7.56±1.37 mg/dl). These results are in agreement with reports of other researchers who found the same increased levels of glucose in the saliva of diabetics [13-15]. Iqbal S et al and Vasconcelos ACU et al found significantly higher mean salivary glucose level in diabetic patients than that of control in a similar study [16, 17].

Glucose is a small molecule which can easily pass through the blood vessels membranes to the fluid present in gingiva, and mixing in the saliva [18]. In the diabetic patients, glucose metabolic end products cause microvascular damages in blood vessels and basal membranes of salivary gland cells causing higher levels of glucose in saliva [19, 20]. However, in studies done by done by Vaziri PB et al and Hegde A et al no significant difference in salivary glucose concentration was found between diabetics and non -diabetics [21, 22].

In the present study mean salivary glucose levels were found to be significantly correlated with mean blood glucose levels of diabetics (r=0.811) and healthy non diabetics (r=0.50). Consistent with this study, a significant correlation was found between salivary and blood glucose concentrations by Amer S et al in Karachi [13]. This finding is similar to other studies done by Jurysta C et al, Hedge A et al and Panda A et al [14, 22, 23]. These results have indicated that the concentration of glucose in saliva may depend on its concentration in serum.

In contrast, some of the studies have contradicted the correlation between blood glucose and salivary glucose [17, 24, 25]. It was suggested that saliva may not be used to indicate blood glucose level in diabetics.

The analysis of glucose level in saliva is an attempt to find a noninvasive and painless method for frequent monitoring of blood glucose in diabetic patients. Considering the high correlation obtained between blood glucose and salivary glucose, further research is required to establish it as a reliable diagnostic tool in future.

5. Conclusions

On the basis of obtained results, we may conclude that there is a high correlation between blood glucose and salivary glucose. Saliva may be a potential diagnostic fluid in future. However, there are few issues that need consideration for further extensive research by increasingly sophisticated techniques.

REFERENCES

[1] Sandhu SV, Bhandari R, Gupta S, Puri A., 2011, Salivary Diagnostics: An Insight., IJDS., 3, 19-23.

[2] Sherwood L., 2010, Human physiology from cells to system. 7th ed. Belmont: Brooks/Cole, Cengage Learning,. p. 597-98.

[3] Little JW, Falace DA, Miller CS, Rhodus NL., 2002, 64th ed. St Louis: Mosby., Diabetes. Dental Management of Medically Compromised Patients, p. 248–70.

[4] de Almeida Pdel V, Grégio AM, Machado MA, de Lima AA, Azevedo LR., 2008, Saliva composition and functions: A comprehensive review., J Contemp Dent Pract., 9 (3), 72–80.

[5] Malamud., 1992, Saliva as diagnostic fluid., BMJ., 305, 477.

[6] Carlson GW., 2000, The salivary glands. Embryology, anatomy & surgical applications. Surg Cling North Am., 80(1), 261-73.

[7] Kaufman E, Lamster IB., 2002, The Diagnostic Applications of Saliva: a Review., Crit Rev Oral Biol Med., 13 (2), 197-212.

[8] Hofman LF., 2001, Human Saliva as a Diagnostic Specimen., J Nutr., 131, (5), 1621-25.

[9] Khalil OS., 1999, Sterosscopic & clinical aspects of non invasive glucose measurements., Clin Chem.,45(2), 165-77.

[10] Patel BJ, Dave B, Dave D, Karmakar P, Shah M, Savaiya B., 2015, Comparison and Correlation of Glucose Levels in Serum and Saliva of Both Diabetic and Non-diabetic Patients., J Int Oral Health., 7(8), 70–6.

[11] Gautam A, Bhatta DN, Aryal UR., 2015, Diabetes related health knowledge, attitude and practice among diabetic patients in Nepal., BMC Endocr Disord., 15, 25.

[12] Upadhyay DK, Palaian S, shankhar PR, Mishra P., 2008, Knowledge, attitude and practice about Diabetes among Diabetes patients in western Nepal., RMJ., 33(1), 8-11.

[13] Amer S, Yousuf M, Siddiqui PQR, Alam J., 2001, Salivary glucose concentrations in patients with diabetes mellitus- a minimally invasive technique for monitoring blood glucose levels., Pak J Pharm Sci., 14(1), 33-7.

[14] Jurysta C, Bulur N, Oguzhan B, Satman I, Yilmaz TM, Malaisse WJ et al., 2009, Salivary Glucose Concentration and Excretion in Normal and Diabetic Subjects., J Biomed Biotechnol., 10, 1-6.

[15] Panchbhai AS, Degwekar AS, Bhowtemean RR., 2010, Estimation of salivary glucose, salivary amylase, salivary

total protein and salivary flow rate in diabetics in India., J Oral Sci., 52 (3), 359-68.

[16] Iqbal S, Kazmi F, Asad S, Mumtaz M, Khan AA., 2011, Dental caries & diabetes mellitus., Pak Oral Dental J., 31 (1), 60-3.

[17] Vasconcelos ACU, Soares MSM, Almeida PC, Soares TC., 2010, Comparative study of the concentration of salivary and blood glucose in type 2 diabetic patients., J Oral Sci., 52 (2), 293-8.

[18] Belazi MA, Galli-Tsinopoulou A, Drakoulakos D, Fleva A, Papanayiotou PH., 1992, Salivary alterations in insulin-dependent diabetes mellitus., Int J Paediatr Dent., 8(1), 29-33.

[19] Jones RB, Maccallum RM, Kay EJ, Kirkin V, Mcdonald P., 1992, Oral health and oral health behavior in a population of diabetic outpatient clinic attenders., Community Dent Oral Epidemiol., 20, 204-7.

[20] Qureshi A, Qureshi H, Khan AA., 2007, Blood glucose level, salivary PH & oral Bacterial count in type 1 diabetic children., Infect Dis J.,16, 45-8.

[21] Vaziri PB, Vahedi M, Mortazavi H, Abdollahzadeh S, Hajilooi H., 2010, Evaluation of Salivary Glucose, IgA and Flow Rate in Diabetic Patients: A Case-Control Study., J Dent (Tehran)., 7(1), 13-8.

[22] Hegde A, Shenoy R, D'Mello P, A Smitha, A Tintu, Manjrekar P., 2010, Alternative markers of glycemic status in diabetes mellitus., Biomedical Research., 21 (3), 252-6.

[23] Abikshyeet P, Ramesh V, Oza N., 2012, Glucose estimation in the salivary secretion of diabetes mellitus patients., Diabetes Metab Syndr Obes., 5, 149–54.

[24] Gheena S, Chandrasekhar T, Ramani P., 2011, Salivary characteristics of diabetic children., Braz J Oral Sci., 10(2), 93-7.

[25] Forbat LN, Collins RE, Maskell GK, Sonksen PH., 1981, Glucose concentrations in parotid fluid and venous blood of patients attending a diabetic clinic., J R Soc Med., 7, 725-8.