Correlation of Salivary Glucose with Serum Glucose in Diabetic Patients

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○**Abstract**

Background and aim: Composition of Saliva which has similarity with serum has diagnostic value for different diseases. Recently, studying salivary glucose is the major issue for diagnosing Diabetes mellitus. The aim of this study was to determine association between salivary and serum glucose in Diabetes mellitus.

Material and Method: This cross sectional study was conducted on 384 diabetic patients who were registered for fasting serum glucose detection in laboratory of IBNE-SENA EMERGENCY HOSPITAL. In this study 269 were female and 115 were male. Glucose in serum and saliva was determined by Glucose oxidase-peroxidase method by semiautomatic analyzer. For detecting association bivariate correlation and linear regression was performed.

Results: In this study mean age was 50 ± 0.6 years, Mean fasting salivary glucose and mean fasting serum glucose were 28.19 ± 0.3 and 149.39 ± 3.04 mg/dl respectively. Totally 56.3% of samples had serum glucose equal and higher than 126mg/dl. Difference of mean salivary glucose according to age and gender were not significant. In 56.3 % of samples salivary glucose had association with serum glucose but this association was just significant when serum glucose was equal to 126mg/dl or more than it.

Conclusion: Fasting Serum glucose more than threshold indicate positive correlation with fasting salivary glucose and according to linear correlation that was found serum glucose could be predictable when fasting salivary glucose was determined but there was no correlation with gender and age.

Key words: Diabetes mellitus, saliva, salivary glucose

Introduction

Diabetes mellitus is a metabolic disorder that results from deficiency or resistance of target tissue to insulin. The main cause of mortality is complication of diabetes. Therefore for prevention of complication it is better to control the serum glucose regularly, but it is an invasive technique and comparison it with urinary glucose is not valuable because of variability in renal threshold (1).

Saliva as a biological fluid has similar biochemical composition as serum, beside this saliva collection is safe, easy and less expensive, therefore recent studies introduce it as diagnostic factor for many diseases (1) as in diabetes mellitus changes in composition and function of saliva has been reported (2). It should be mentioned that two types of saliva, saliva from certain ducts

and whole saliva can be studied. Whole saliva which is needed for investigating systemic disease can be collected as stimulated saliva and unstimulated saliva (3).

Glucose diffuse through vessels to gingival cervical fluid and finally reaches to salivary ducts through which reaches to oral cavity and become component of saliva(4).Different studies shows a positive correlation between fasting serum glucose and salivary glucose in diabetics . Following other studies this research explains the correlation between fasting serum glucose and fasting unstimulated salivary glucose.

Methods and Materials

This is an analytical cross sectional study conducted on 27 July 2017 up to 25 Oct 2017 in laboratory of IBNE-SENA EMERGENCY HOSPITAL after acceptance by KABUL UNIVERSITY OF MEDICAL SCIENCES RESEARCH COMMITTEE. Serum and saliva was collected by using convenience sampling method from 384 diabetic patients who registered for determination of fasting blood concentration.

Inclusion and Exclusion criteria: Patients who were pregnant, 18 years old and younger than 18 years, exposed to radiotherapy of neck and face in recent one month, patients who had oral cavity problems and systemic diseases and smokers were not included in this study. Diabetic patients who were not included in exclusion criteria were considered under investigation.

Blood collection and analysis: blood was taken from diabetic patients in fasting state and setting position from 8 up to 10 am. Totally 2.5 ml of venous blood was taken by syringe and transferred to EDTA containing tubes. Samples were centrifuged at 3500rpm for 5 minutes (Centrifuge H-26F, Koksuan corporation, Tokyo-Japan). Immediately the glucose determined by glucose oxidase peroxidase method (Randox Kit) in semi-Auto analyzer (Microlab300, Merck).

Saliva collection and analysis: Fasting unstimulated saliva was collected by spitting method in setting position. Totally one milliliter saliva was collected in a sterilized test tube during two minutes, immediately centrifuged in 3500 rpm for five minutes(H-26F,Koksuan corporation, Tokyo-Japan) and glucose was determined by glucose oxidase peroxidase method in semi-auto analyzer(Microlab300,Merk).

Principle of assay: Glucose was detected by enzymatic method (glucose oxidase peroxidase). In presence of glucose reagent the enzyme convert glucose to gluconic acid and hydrogen peroxide. The later product formed a reddish compound quinoneimine, as in indicator in presence of 4-aminoantipyrine and phenol. The intensity of color formed was determined by semi auto analyzer and proportional to glucose concentration in mg/dl.

Data analysis: Data was analyzed in SPSS version 21 with CI=95% and $\alpha=0.05$ concerned. Descriptive statistic was presented with mean as (mean± S.E error), standard deviation, minimum and maximum range. Normal distribution test was performed. Differences of salivary glucose mean were analyzed in different gender and four different categories of age with ANOVA test. Difference of salivary glucose was observed in patients with serum glucose ≥ 126 mg/dl and less than 126 mg/dg. For determination of correlation between saliva and serum glucose bivariate correlation and linear regression analysis was performed.

Results: In this study 384 diabetic patients were included with 269(70.1%) female and 115(29.9%) male. Mean salivary glucose was 28.19±0.3 with 11-56 mg/dl ranges. Mean serum glucose was 149.39±3.04 and ranges between 67-328mg/dl. Mean age were 50±0.6 and ranges between 20-82 year.

Mean salivary glucose in females and males was 28.34±0.45 and 27.84±0.64mg/dl respectively but statistically was not significant (p=0.54). Mean salivary glucose was determined in different age group (Table 1) difference of mean in these group were not significant (P=0.638).

Table 1: Mean salivary glucose in different age classes.

Age Groups (Year)	Fasting Salivary Glucose						
	Mean	N	Std. Deviation	Minimum	Maximum	Std. Error of Mean	% of Total N
=<40	28.0093	107	7.24178	18.00	56.00	.70009	27.9%
41-50	28.9406	101	7.78052	11.00	50.00	.77419	26.3%
51-60	27.6864	118	7.13209	16.00	50.00	.65656	30.7%
>60	28.2586	58	6.90172	19.00	51.00	.90624	15.1%
Total	28.1927	384	7.29278	11.00	56.00	.37216	100.0%
P Value	0.638						

Percentage of patients with serum glucose ≥ 126mg/dl and less than 126 mg/dl were shown in Figure 1.

Fasting Serum Glucose ☐ <126 mg/dl ■ >=126mg/dl
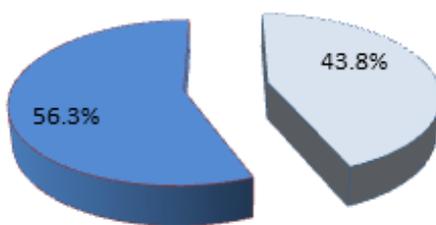
**Figure 1**.Percentage of patients having serum glucose more than 126mg/dl.

Descriptive statistic of serum and salivary glucose for these two categories was shown in Table.2. Mean differences of salivary glucose in these two categories were significant (p=0.00).

 Table.2. Descriptive statistic of serum and salivary glucose according to serum glucose concentration

Fasting Serum Glucose	N	Minimum	Maximum	Mean	Std. Deviation

		Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
<126mg/dl	Salivary glucose	168	11.00	40.00	24.3988	.34731	4.50168
	Serum glucose	168	67.00	125.00	98.0060	1.20578	15.62874
	Valid N (list wise)	168					
≥126mg/dl	Salivary glucose	216	16.00	56.00	31.1435	.52267	7.6816
	Serum glucose	216	126.00	328.00	189.3657	3.49188	51.31998
	Valid N (list wise)	216					

Pearson correlation test shows a positive correlation(r=0.608, P=0.00) between serum glucose and salivary glucose (Figure.2) but this correlation was not observed in patients with serum glucose less than 126mg/dl (p=0.54) just it was observed in patients with serum glucose ≥126mg/dl (p=0.00). According to Linear regression equation that was shown in Figure.2 if salivary glucose is known serum glucose can be estimated with the following formula.

Salivary glucose=17.22+0.07xserum glucose)
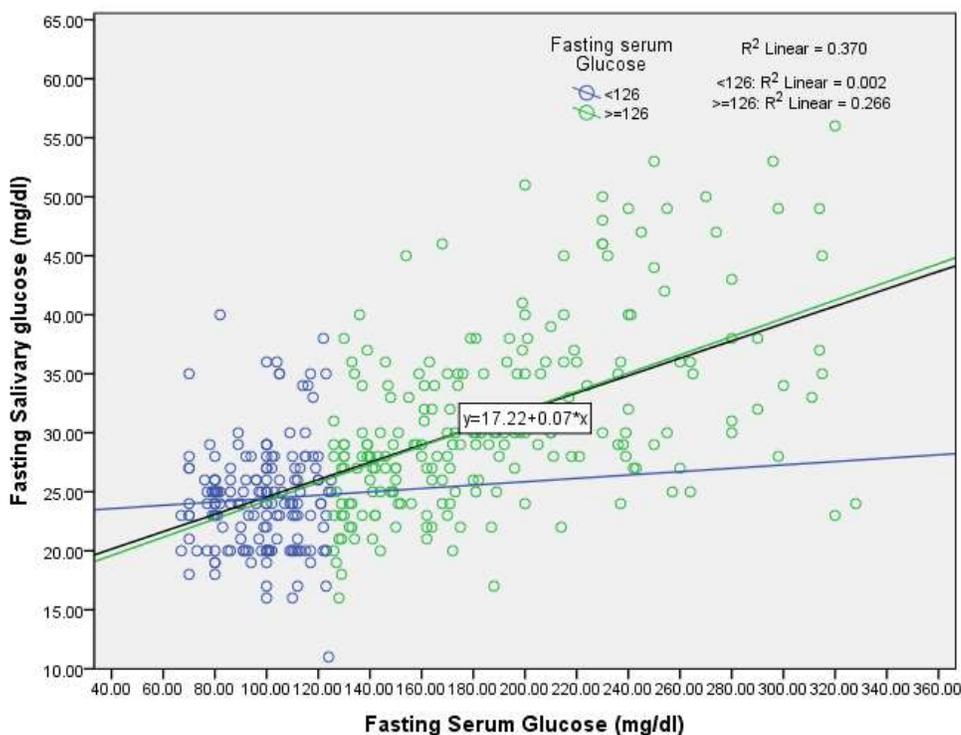
Figure. 2. Shows correlation between Fasting serum glucose and Fasting salivary glucose

Discussion: Diabetic complication as a main cause of morbidity and mortality in diabetic patients become a major health problem and increase massively (5). It was estimated that, in the year of 2030 there will be 552 million diabetic patients. According to these reasons a non-invasive and easy techniques as determination of salivary glucose should be concerned for diagnosis of diabetes (6). This study as other researches was performed to investigate the correlation of salivary glucose and serum glucose and to the best our Knowledge this is the first study in Afghanistan that investigates the salivary glucose in diabetic patients. Study of J. Max Goodson (8) and Bhumika J Patel et al (7) shows an increase of salivary glucose in diabetics rather than normal individuals. In addition Amit Ladgotra et al (9) reported significant correlation of salivary glucose with serum glucose in diabetics but not in normal individuals. Several other studies show increase of salivary glucose level in diabetics, that is because of production of advanced glycosylation end products (AGEs) which causes modification of collagen and matrix proteins and results in basal membrane dysfunction and increase of vascular permeability, therefore more glucose is secreted to saliva, but it should be mentioned that several other factors are involved(7). Studies of Arati S. Panchbhai et al (2) and Preethi Balan et al (5) shows high level of glucose in saliva of uncontrolled diabetic patients than controlled patients that is because of glucose leakage to saliva when the level is higher than threshold (5,2). In this study salivary glucose was only correlated with serum glucose when the level of serum glucose was higher than threshold. It should be mention that as Seyyed omid Mahdavi et al (10) and KUMAR et al (11) studies, this correlation was not significantly depended to gender and age.

Finally it can be concluded that salivary glucose level has diagnostic value in diabetic patients, but for more exact results this investigation should be observed in larger sample size or in a case control studies.

Conclusion: salivary glucose is increases when the serum glucose become higher than threshold and in this circumstances serum glucose level can be estimated if salivary glucose level was known. Correlation between serum glucose and salivary glucose was not dependent to age and gender.

Conflict of interest: the authors declare that there is no conflict of interest.

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