

ORIGINAL ARTICLE

Association of salivary glucose, specific gravity, pH and flow rate with HbA1c in patients with Type 2 Diabetes Mellitus - A case-control study

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Abstract

Background: Diabetes mellitus is emerging chronic disease affecting people worldwide. Currently, diagnosis of diabetes mellitus for screening and monitoring blood glucose levels includes invasive technique which involve painful pricks and unnecessary discomfort to the patients. Hence, Saliva is used as a non-invasive tool in monitoring glycaemic status in diabetes patients.

Methodology: A total of 60 subjects, 30 in Group I (Type 2 diabetes mellitus) and 30 in Group II (control) aged between 40-60 years were participated in the study. Serum sample in the fasting state was collected from both patient and the control to check the HbA1c (HPLC method) and FPG (GOD POD method). Unstimulated saliva sample was collected from both patient and control to estimate the salivary glucose, specific gravity, pH and flow rate.

Results: Serum and salivary glucose, HbA1c, salivary pH, specific gravity and flow rate were significantly higher in T2DM subjects compared to control groups. Salivary glucose and salivary pH were significantly associated with HbA1c, and salivary specific gravity and salivary flow rate is weakly correlated with glycaemic status of T2DM subjects.

Conclusion: The salivary glucose levels thus closely reflect blood glucose levels and can be used as a non-invasive diagnostic tool to monitor glycaemic status in diabetic subjects.

Key words: - *Type 2 Diabetes Mellitus, Salivary glucose, HbA1c, Salivary pH, Specific gravity, Flow rate, Glycaemic Control.*

Introduction: -

Diabetes mellitus is a major disorder characterized by the metabolic dysfunction of carbohydrates, lipids and proteins. There are two major types of diabetes: - T1DM, the β -cells of pancreas are destroyed by the autoimmune mechanism. T2DM is mainly of insulin resistance and impaired insulin secretion [1]. A dramatic increase was seen in the incidence of Type 2 Diabetes Mellitus (T2DM) worldwide, especially Indian subcontinent which is the second largest country with T2DM. [2] The International Diabetes Federation (IDF), reports total number of people in India with diabetes is 65.1 million in 2013, estimated that it would rise to 72% by 2035. [3] T2DM is a chronic disease, characterized by hyperglycemia and combination of insulin resistance, declining insulin production, and eventual pancreatic beta-cell failure [4].

Currently, diagnostic procedure of Diabetes Mellitus, we generally use collection of blood or urine samples causing discomfort to the patients, less frequently saliva, sweat and tear. Both involve painful pricks and unnecessary discomfort to the patients. Patients do also have risk of infection. [5] Recently, few studies found that saliva could be a potential sample for screening / monitoring the glycemic status, in cases with T2DM. [6,7] The concentration of many analytes in saliva, correlates their respective serum concentration.[8] Good evidence suggests that salivary glucose levels can be used as an important non-invasive indicator of the blood glucose levels.[9] Moreover, collection of saliva is more convenient for frequent collection, cost effective, low infection risk and could be well acceptable by both patients and clinicians.[10,11]

Saliva mainly contains inorganic substances like Na^+ , K^+ , Mg^{2+} , Ca^{2+} , Cl^- , HCO_3^- , HPO_3^{2-} and organic substances mainly glucose, lipids like cholesterol, mono/di-acyl glycerol of fatty acid, amino acids, non-protein compounds like uric acid, bilirubin, creatinine, etc., [12, 13] Saliva is already a useful sample for diagnosis and monitoring of certain metabolic diseases. [14]

With this background, keeping the necessity of frequent sampling in cases with T2DM and feasibility of collection of saliva, the present study was planned to determine the role of saliva as a tool for the self-monitoring of glycemic control by the patients and to evaluate an association among FPG, HbA1c, salivary glucose levels, specific gravity, pH and flow rate of saliva in patient with T2DM.

Subjects and Methodology: -

The Study was conducted in Department of Biochemistry in collaboration with Department of General Medicine [Mahatma Gandhi Medical College and Research Institute, Pillayarkuppam, Puducherry 607402].

Male and female subjects with T2DM between the ages 30 to 60 years with no established complications was included in our study after obtaining a written informed consent.

Patients with other specific types of diabetes, any known organ dysfunction, Smokers and chronic alcoholics, Subjects with infection of oral cavity, Caries of tooth or any other oral pathology were not selected.

3 ml of venous blood sample in the fasting state was collected from both patient and the control to check the HbA1c and FPG. Unstimulated saliva sample was collected from both patient and control to estimate the salivary glucose, specific gravity, pH and flow rate.

Collection of saliva

Procedure was explained and salivary samples was collected during fasting. Water can be consumed 1 hour prior to the test. The subjects were asked to rinse their mouth and made to sit comfortably, and then unstimulated salivary samples were collected in sterile graduated container every minute for 10 min [spit technique] [10]

Salivary flow rate: Salivary samples was collected, and the volume was measured gravimetrically. The weight of saliva sample (g) is equated to volume (mL), since the specific gravity of saliva is 1.0. Salivary flow rate was expressed as mL/min (V). [15]

Salivary pH: Saliva will be put on pH paper, and then pH is determined using pH meter. [15]

Statistical Analysis

All data were expressed as mean ± standard deviation. Student ‘t’ test or Mann Whitney U test was used to compare the data between the two groups. A p value <0.05 was considered as the level of significance for all statistical purposes. Pearson’s / spearman’s correlation and regression analysis was done to find the association between salivary glucose concentration, specific gravity, pH, flow rate and HbA1c in patients with T2DM. SPSS version: 16 for windows was used for all statistical analysis.

Results

The study groups consisted of 60 subjects, 30 in Group I (Type 2 diabetes mellitus) and 30 in Group II (control). In both the groups, 50% of subjects were males and 50% females. The mean age of the study group was 51 ± 11 years. For each patient fasting blood glucose, salivary glucose, salivary pH, salivary specific gravity and flow rate levels were determined.

Table 1: Comparison of biochemical variables between the cases and control groups

Parameters	Controls (n=30)	Cases (n=30)	p value
Salivary glucose (mg/dl)	4.80±1.60	6.50±2.33	0.002*
Fasting plasma glucose (mg/dl)	121.13±20.31	154.63±45.76	0.002*
HbA1c (%)	6.93±1.11	8.23±1.75	0.003*
Salivary pH	6.96±0.39	7.80±0.40	0.000†
Salivary specific gravity (g/mL)	2.23±0.62	0.95±0.15	0.000†
Salivary flow rate (ml/min)	0.39±0.09	0.20±0.06	0.000†

*p value < 0.01 indicates statistically significant, † p value < 0.001 indicates highly significant
All biochemical parameters were significantly higher in T2DM subjects compared to control groups.

Table 2: Association of salivary glucose, pH, specific gravity and flow rate with glycemic control (HbA1c)

Parameter	HbA1c	
Salivary glucose (mg/dl)	r=0.63	p=0.009*
Salivary pH	r=0.56	p =0.330
Salivary specific gravity (g/mL)	r=0.20	p < 0.001 [†]
Salivary flow rate (ml/min)	r=0.21	p < 0.001 [†]

*p value < 0.01 indicates statistically significant, † p value < 0.001 indicates highly significant

The association of HbA1c with salivary glucose, salivary pH, salivary specific gravity and salivary flow rate was evaluated. Salivary glucose and salivary pH were significantly associated with HbA1c and salivary specific gravity and salivary flow rate is weakly correlated with glycemic status of T2DM subjects.

Discussion

Diabetes Mellitus, a metabolic syndrome characterized by a relative or absolute deficiency of insulin secretion and/or attendant resistance to the metabolic action of insulin on target tissues.[16] Early screening of type 2 diabetes mellitus is important in predicting both micro and macro complications associated with diabetes, which can lower the incidence of this disease worldwide.[17] Current technique in estimation of glucose levels involves painful pricks, anxiety and trauma. Hence, an alternative diagnostic tool for T2DM arises. [6]

Saliva is recently emerging as an alternative of blood for several diagnostic purposes. As a diagnostic fluid, has some distinctive advantages over serum, which can be collected noninvasively and provide cost effective approach for screening purposes.[18]

Our study aims to compare the levels of serum and salivary glucose, specific gravity, pH and flow rate in patients with T2DM and their association with glycemic status and to assess if salivary glucose level can be used as a non-invasive means of diagnosing and monitoring diabetes mellitus. The present study confirms the results of previous investigators who reported the levels of both serum and salivary glucose were significantly higher in T2DM patients as compared to control group. [8,10,19]

Decreased salivary flow rate in diabetic subjects has been reported by various studies. Similarly, we also found the levels of flow rate were significantly diminished in patients with T2DM compared to control group. [20,21] The levels of salivary specific gravity were significantly decreased in diabetic patients.

The salivary pH shows significantly increased with T2DM patients compared with controls. This finding of our study is contrast to the previous studies which states that lower salivary pH in diabetic patients compared to control groups. [22]

There was no significant correlation between salivary specific gravity and salivary flow rate with glycemic status in patients with Type 2 diabetes which disagrees with previous studies. A significant positive correlation was seen between salivary glucose, serum glucose and salivary pH levels with glycemic status in Type 2 diabetes patients. [23] Also evidence shows that salivary and serum glucose significantly correlates with glycemic control in T2DM patients [8, 24]

Hence, saliva offers an alternative diagnostic fluid to serum that can be analysed for diagnosing and monitoring diabetes mellitus and to predict various complications associated with diabetes.

Conclusion

The salivary glucose levels thus closely reflect blood glucose levels and can be used as a non-invasive diagnostic tool to monitor glycemic status in diabetic subjects.

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Conflict of Interest: The authors declare that there is no conflict of interest in the study.

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