

# Salivary Glucose Estimation: A Noninvasive Diagnostic Method

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## ABSTRACT

**Background:** There is a shocking rise in number of people with diabetes mellitus over these years. Oral physicians are more likely to come in contact with a significant number of patients with diabetes mellitus. Due to the lack of early diagnosis and treatment, diabetes is a major cause of death worldwide. Thus, there arises a need for a noninvasive and painless technique to detect glucose levels. The aim of this study is to estimate the glucose levels in saliva and correlate it with serum glucose.

**Materials and Methods:** The study was conducted in the Outpatient Department of diabetes research center Bikaner. Forty patients' serum and saliva were collected and the levels were estimated using the glucose oxidase-peroxidase method.

**Results:** Highly significant *P* value (*P* = 0.00) was obtained between the serum blood glucose and salivary glucose level. A distinct difference was observed in the salivary glucose between the control and diabetic group.

**Conclusion:** Diabetes mellitus is a worldwide extensive

disease. As the salivary collection is easy and noninvasive, in this study, an attempt has been made to diagnose diabetes mellitus by estimating the salivary glucose level in comparison with serum blood glucose level.

**Keywords:** Diabetes Mellitus, Glucose Oxidase-Peroxidase, Noninvasive, Salivary Glucose Level, Serum Glucose Level.

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## INTRODUCTION

Diabetes mellitus is a group of complex multisystem metabolic disorders characterized by relative or absolute insufficiency of insulin secretion and concomitant resistance to metabolic action of insulin on target tissues. India is the diabetic capital of the world. Over 62 million have now been diagnosed with diabetes mellitus. Due to delay in the early diagnosis and fear of the disease and investigation, it has become the major cause of death. The usual method of investigation is by venipuncture, which makes some patients to hesitate. Saliva offers some distinctive advantages. The whole saliva can be collected in a noninvasive way by the individuals with limited training. Diagnosis of disease through the analysis of saliva is potentially valuable for children and older adults as collection of the fluid is associated with fewer compliance problems as compared with the collection of blood. One of the best two ways to collect the whole saliva is by the draining method in which saliva is allowed to drip off the lower lip, and the other is by spitting method in which the subject spits saliva into a test tube. Saliva moreover contains glucose, amino acids, lipids like cholesterol, and mono/diglycerides of fatty acid saliva may be useful for the diagnosis of hereditary disorders, autoimmune diseases, malignant and infectious diseases, and

endocrine disorders, as well as in the assessment of therapeutic levels of drugs and the monitoring of illicit drug use.<sup>1</sup> The aim of the present study is to compare the salivary glucose level with serum blood glucose level in individuals with diabetic mellitus and nondiabetic individuals, and the objective of the study is to assess the validity of saliva in diagnosing diabetes mellitus.

## MATERIALS AND METHODS

The study was conducted in the Outpatient Department of diabetes research center Bikaner S.P.Medical College Bikaner following the inclusion criteria, where the patients with diabetes where considered as case, and nondiabetic were considered as control, and the exclusion criteria are pregnant females, patients with habit of smoking and chewing tobacco, and patients suffering from systemic ailment. After patients were detailed about the study protocol, a written consent was obtained. Patients were advised to report 1½ h after breakfast for serum and saliva collection. The later was collected by making the patients to rinse his/her mouth with water and were insisted to open mouth for 5 min without swallowing, and about 1 mL of saliva was collected in a sterile container by the suction method.

**Table 1: Serum and salivary glucose level of diabetic patients**

Serum blood glucose level (mg/dl)	Salivary glucose level (mg/dl)
158	1.4
168	4.5
169	2.3
170	4.9
175	1.7
185	5
185	7.9
186	1
198	2.9
208	9.6
210	1.5
220	1.6
225	1.1
226	6.9
229	2.6
233	0.5
312	2.6
320	3.6
397	8.7
403	4.3

**Table 2: The serum and salivary glucose level of control group**

Serum blood glucose level (mg/dl)	Salivary glucose level (mg/dl)
88	0.4
89	0.4
92	0.2
92	0.1
96	0.3
96	0.2
96	0.6
97	0.2
98	0.6
98	1.8
99	0.3
99	0.6
99	0.6
102	0.6
102	0.4
102	0.4
103	0.3
104	0.1
107	0.5
110	0.3

**Table 3: Correlation between serum and salivary glucose level**

	Group	N	Mean	SD	t	Significant
Serum blood	1	20	288.75	72.3172	8.304	0.00
Glucose level	2	20	98.450	5.614		
Salivary	1	20	3.650	2.7211	5.189	0.00
Glucose level	2	20	0.455	0.3605		

## RESULTS

A total of 40 patients were selected. Of which 20 were diabetic and 20 were the control group. In diabetes mellitus, out of 20 patients, 9 of them had the serum glucose level of 150–200 mg/dL, 7 had a level of 200–250 mg/dL, and 4 with a level of 300–400 mg/dl and in control group out of 20 patients 13 patients had the serum glucose level below 100 mg/dl and 7 of them with the level of 100–110 mg/dl. Data obtained from 40 patients was subjected to statistical analysis using *t*-test and it is shown in Table 3. There is high statistical significance between the serum blood glucose level and salivary glucose level ( $P = 0.00$ ). A distinct difference was observed in the salivary glucose between the control and diabetic group. The salivary glucose level for control was between 0.1 and 0.7 mg/dl and for diabetic; the level was between 1.0 and 9.6 mg/dl. However, the salivary glucose levels were highly inconsistent with respect to the serum blood glucose levels, i.e., the salivary glucose levels were not consistent with the severity of diabetes.

## DISCUSSION

Diabetes mellitus is a worldwide extensive disease for which various diagnostic devices are now available. However, among the available methods, blood glucose test is taken as the gold standard for diagnosing diabetes, but blood collection is an invasive method.<sup>2</sup> Saliva is a wonderful marker of early disease detection that leads to more effective diagnosis and treatment or monitor systemic illness, such as diabetes mellitus.<sup>3</sup> The salivary composition may also correspond to the systemic state of the patient rather than the oral health state.<sup>4</sup> Kortuem<sup>5</sup> was the first who noticed the correlation between serum glucose level and salivary glucose level in 1944, followed by Shannon et al.<sup>6</sup> in 1960 and Englander et al.<sup>7</sup> in 1963 and Campbell<sup>8</sup> in 1965. In this study, the salivary glucose concentrations correlated with the serum glucose level in patients with diabetes mellitus which was in accordance with the study done by Darwazeh et al.<sup>9</sup> Marchetti et al.<sup>10</sup> in their study suggested that the saliva contributes a simple, quick, and inexpensive method for screening of diabetic

autonomic neuropathy. It was observed that salivary glucose level increased with an increase in serum glucose level both in diabetic and nondiabetic in our study, which was in accordance with the findings of the Naik et al.<sup>11</sup> and Abikshyeet et al.<sup>12</sup> A study done by Agrawal et al. indicated that values observed regarding blood and salivary glucose levels were found distinctly different between normal and diabetic patients suggesting that saliva can be used as an index of diabetes mellitus which was similar to the study. In another study conducted Panchbhai<sup>13</sup> to assess the correlation of salivary glucose level with blood glucose level in people with diabetes mellitus showed a significant positive correlation of salivary glucose level. Glucose, a small molecule can easily diffuse through semipermeable membranes thus increasing the salivary glucose levels, which ultimately results in altered salivary glucose level and greater susceptibility to disease in the oral cavity. Unstimulated whole saliva has been used in the majority of diagnostic studies because generally there is a dilution of saliva, modulation in pH in stimulated saliva. Conversely, there are studies which have contradicted the correlation between salivary glucose level and serum glucose level because of the threshold mechanisms along the basement membrane which was justified by Shannon et al and Twetman et al.<sup>14</sup> Many researches also asserted that salivary concentrations seem to correlate with serum glucose concentration in patients with diabetes mellitus. In this study, glucose concentration in unstimulated whole saliva was analyzed. There was an increase in salivary glucose level when there was increase in serum glucose level. Hence, saliva can be used as a screening method in diagnosing diabetes mellitus.

#### Reason for Highly Inconsistent Levels of Salivary Glucose

1. In the mucous type of saliva, there is an increase in mucus content (mucopolysaccharide and glycoprotein)
2. In psychological and physical stress, there is an increase in salivary amylase level which results in increase in the breakdown of starch to glucose
3. Antimicrobial activity increases salivary hydrogen peroxide which leads to over estimation by GODPOD kit.

#### LIMITATIONS

Present study has a small sample size and the composition of saliva changes in different condition and as a result, there will be alteration in the salivary glucose level.

#### CONCLUSION

Frequent monitoring of glucose level is required to reduce its complication. The outcome of the present study showed distinct difference was observed between normal and diabetic patients suggesting that monitoring of salivary glucose level can be used as an index of diabetes mellitus. Further studies on large sample size should be done to ascertain the diagnostic valuability of salivary glucose level in the early diagnosis of diabetes mellitus.

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