ORIGINAL RESEARCH

Estimation of Gingival Crevicular Blood as Noninvasive Method to Determine the Blood Glucose Level: A Comparative Study

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Abstract

Aim: The current study's aim was to assess gingival crevicular blood as a noninvasive method to measure blood glucose levels.

Materials and methods: The current study comprised a total of 50 patients who had been diagnosed with chronic periodontitis and age was ≥30 years old. The study's procedures were carried out after receiving informed consent. For finger capillary blood collection method, a sterile lancet was used to prick the finger and a drop of blood was taken, for gingival crevicular blood collection method, blood was taken from the gingival margin of the chosen site, and for venous blood collection method with the aid of a disposable syringe, a venous blood sample was taken from the patient's antecubital fossa for determining blood glucose levels. One-way analysis of variance (ANOVA) was used to examine the differences between the three methodologies' significance, and Karl Pearson's correlation (*r*) was used to determine their correlation.

Results: The maximum glucose level was found in venous blood (187.78 ± 18.23), followed by finger capillary blood (181.88 ± 21.67) and gingival crevicular blood (169.04 ± 11.24). And there was no significant difference between the different blood collection methods ($p > 0.05$). The positive significant correlation was found between gingival crevicular blood and finger capillary blood ($r = 0.912$, $p < 0.001$). Correlation with gingival crevicular blood and venous blood showed a positive correlation ($r = 0.898$, $p < 0.001$). Correlation between venous blood and finger capillary blood also showed a strong positive correlation ($r = 0.988$, $p < 0.001$).

Conclusion: In conclusion, the findings of the current study suggest that blood drawn from the gingival crevicular during a clinical examination may be a great source for glucometric analysis. The gingival crevicular blood may show to be a promising technique for routine dental office screening for diabetes mellitus in periodontal patients, even if capillary/venous blood samples used for diabetes mellitus screening are the gold standard.

Clinical significance: Oral health is crucial for the early detection of many systemic disorders. As a result, dentists are crucial in the screening for systemic disorders. One of the prevalent chronic disorders is diabetes. Any systemic disease that is detected early enough can avoid long-term problems.

Keywords: Diabetes mellitus, Finger-prick blood, Gingival crevicular blood, Venous blood.

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Introduction

The most prevalent epidemic disease in the world is diabetes mellitus (DM). It is diverse and shares decreased lipid and carbohydrate metabolism along with poor glucose tolerance. The healthcare system is significantly impacted by diabetes mellitus. The prevalence of diabetes is rising worldwide, especially in India.[1]

About four million fatalities were directly or indirectly attributable to diabetes or high blood sugar in 2017, which was the year that diabetes accounted for 10.7% of all deaths in adults between the ages of 20 and 79. It is expected to overtake heart disease as the sixth biggest cause of death by 2030, making it the chronic ailment with the fastest global growth.[2]

According to epidemiological research, patients with periodontitis were twice as likely to have diabetes as those with healthy gums. Periodontal disease has been labeled as the "sixth complication of diabetes" due to the increased prevalence and severity of the condition in diabetic patients, particularly those with poor metabolic control.[3]

In ordinary dental practice, a noninvasive method of blood glucose estimates is frequently required because dental clinicians frequently encounter patients with diabetes. Although there are many blood glucose estimate tests available, including the

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traditional laboratory blood glucose estimation, the estimation of glycated hemoglobin, and the oral glucose tolerance test, the majority of them require lengthy, intrusive procedures.[4]

Diabetic individuals frequently use glucometers to check their blood sugar levels at home. During diagnostic procedures in individuals with periodontal disease, a lot of extravasated blood is generated. Compared with a finger puncture with a sharp lancet, routine probing during a periodontal checkup is less frightening for the practitioner.[5] These tools might actually make it possible to test blood leaking from the gingival fissures of patients with periodontal disease painlessly during routine periodontal examinations. They might also serve as a straightforward and reasonably priced in-office screening tool for any patient who may be diabetic. When employing a portable glucose self-monitoring device, gingival blood obtained through probing may make an ideal source for glucometric analysis.[6]

As a result, diagnosing diabetes in the dental office typically involves looking at the patient's medical history, their symptoms, and a traditional laboratory test that might not accurately reflect their current blood glucose level. Therefore, a rapid, chairside, noninvasive diagnostic technique is required in dentistry practice to assess blood glucose levels in periodontal patients with diabetes mellitus. Therefore, the aim of the current investigation was to estimate gingival crevicular blood as a noninvasive method compared with finger capillary blood collection method and venous blood collection method to measure blood glucose levels.

Materials and Methods

Patient's Selection Criteria

The present study was conducted at Kalinga Institute of Dental Sciences, Bhubaneswar, India, and the study period was 2021–2022. The study comprised 50 patients with chronic periodontitis, age ≥30 years old, patients having untreated moderate (3–4 mm of clinical attachment loss)-to-severe periodontitis (>5 clinical attachment loss). Diabetic patients under medication (oral drugs and controlled) were included in the present study. Patients with an abnormally low or high hematocrit, such as those with anemia, polycythemia vera, dialysis, hepatic, severe cardiovascular, immunologic, hematological, renal, or other organ disorders, sites with suppuration, patients who needed antibiotic premedication for periodontal examinations, and had received antibiotic therapy within the previous 6 months were excluded from the study. Each subject was informed about the protocol of the study. Institutional approval was obtained, and informed consent was taken from all the participants. All blood sample collection was done randomly.

Methods for Determination of Blood Glucose Level

Gingival Crevicular Blood Collection Method

The test site was isolated with cotton roll and air-dried with a three-way syringe in order to estimate blood glucose level utilizing gingival crevicular blood. On the test strip, blood was taken from the gingival margin of the chosen site. Clinical examination sites that bleed easily were chosen. Gingival probing was carried out using Williams' periodontal probe (QulixTM). When enough blood was collected, it was placed straight on the glucometer's test strip. The glucometer device (Accu-Chek, Roche Diagnostics, Germany) was turned on after proper sample collection on the test strip, and GCB glucose levels were captured. The glucometer gives blood glucose value in about 5 seconds. The value was noted as mg/dl gingival crevicular blood glucose (GCBG) value.

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Table 1: Evaluation of the mean blood glucose levels in three different blood collection methods

Methods of blood collection	*Mean ± SD (mg/dL)*	*Standard error*
Gingival crevicular blood	169.04 ± 11.24	11.02
Finger capillary blood	181.88 ± 21.67	14.36
Venous blood	187.78 ± 18.23	13.22

Finger Capillary Blood Collection Method

An immediate blood sample was taken from the patient's finger after the gingival crevicular blood was collected. Spirit was applied to the fingertip's delicate surface and allowed to evaporate. A sterile lancet was used to prick the finger, and a drop of blood was then applied to a test strip on the self-monitoring equipment.

Venous Blood Collection Method

About 3–4 inches (7.5–10 cm) above the venipuncture site, a tourniquet was tied around the patient's arm. With the index finger, the vein was gently tapped to promote dilatation. In a circular motion, the region was cleaned with spirit. With the aid of a disposable syringe, a venous blood sample was taken from the patient's antecubital fossa. In a plane bulb, 2 mL of blood was collected and examined. The technique used to estimate glucose was: GOD = POD method (combined action of glucose oxidase and peroxidase) readings were taken. And all the three tests were conducted by a single investigator.

Statistical Analysis

The statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) Version 20.0. Each clinical parameter's mean and standard deviation were computed. One-way analysis of variance (ANOVA) was used to examine the differences between the three methodologies' significance, and Karl Pearson's correlation (*r*) was used to determine their correlation. Additionally, *p*-values below 0.05 were regarded as statistically significant.

Results

The present study comprised of 50 patients (27 males and 23 females). And the mean age was 43.04 ± 8.12 years. Table 1 shows the mean blood glucose levels in three different blood collection methods. The mean gingival crevicular blood glucose level was 169.04 ± 11.24, finger capillary blood glucose level was 181.88 ± 21.67, and venous blood glucose level was 187.78 ± 18.23.

Table 2 depicts the comparison of the mean blood glucose levels in three different blood collection methods. The maximum glucose level was found in venous blood (187.78 ± 18.23), followed by finger capillary blood (181.88 ± 21.67) and gingival crevicular blood (169.04 ± 11.24). And there was no significant difference between the different blood collection methods ($p > 0.05$).

The Pearson's correlation coefficient between the different groups was assessed in Table 3. The positive significant correlation

Table 2: Comparison of the mean blood glucose levels in three different blood collection methods

Methods of blood collection	*Mean ± SD (mg/dL)*	*F-value*	*p-value*
Gingival crevicular blood	169.04 ± 11.24	18.724	0.736
Finger capillary blood	181.88 ± 21.67		
Venous blood	187.78 ± 18.23		

Table 3: Evaluation of Pearson's correlation coefficient between the different groups

Methods of blood collection	*r-value*	*p-value*
Gingival crevicular blood v/s finger capillary blood	0.912	0.001
Gingival crevicular blood v/s venous blood	0.898	0.001
Venous blood v/s finger capillary blood	0.988	0.001

was found between gingival crevicular blood and finger capillary blood ($r = 0.912$, $p < 0.001$). Correlation with gingival crevicular blood and venous blood showed a positive correlation ($r = 0.898$, $p < 0.001$). Correlation between venous blood and finger capillary blood also showed a strong positive correlation ($r = 0.988$, $p < 0.001$).

The inference of the present study indicates that gingival crevicular blood collection estimate could be employed as a reliable, efficient method for determining, monitoring, and/or screening for diabetes mellitus in periodontal populations using a noninvasive chair-side method.

Discussion

Diabetes mellitus is a clinically and genetically diverse set of diseases that impact the proteins' and carbohydrates' metabolites. Hyperglycemia results from inadequate insulin secretion brought on by impaired pancreatic B cells and/or insulin resistance in the liver and muscle.[7]

Periodontitis and diabetes mellitus appear to interact in both directions. It is reasonable to predict that a growing proportion of patients with undiagnosed diabetes and periodontitis will be seen by dental professionals, particularly periodontists. By getting a diagnosis of diabetes early on, long-term problems that cause significant morbidity and mortality in diabetic people can be avoided. Screening for diabetes should start at a younger age and be repeated every 3 years in persons without risk factors and earlier and more often in those with risk factors for diabetes.[8,9]

In the diabetic population with periodontitis, Datta and Devraj[10] and Strauss et al.[11] proposed that gingival crevicular blood might be employed as an easily tolerated, noninvasive source for blood glucose determination. In a study, Kaur et al.[12] found favorable associations between capillary blood glucose levels and crevicular blood, indicating that this blood may be a useful indicator of prospective diabetic patients during routine periodontal examinations.

Gingival blood glucose levels collected during routine periodontal examination may be an excellent source of blood, safe, easy to perform, and comfortable to the patient. According to Kost et al.,[9] significant work has been put into developing noninvasive, painless technologies to detect blood glucose. Due to the little volume of blood (3 mL) required for the analysis, Klonoff[13] indicated that even in cases of very little gingival crevicular bleeding, a glucose test is still possible with the use of a self-monitoring device. Furthermore, compared with a finger puncture, the method presented is more comfortable and less frightening for the patient.

The interdental gingival papilla-prick method with test strips was utilized to screen the patients with high gingival blood glucose by Stein and Nebbia,[14] who were among the first to describe a chair-side method of diabetic screening with gingival blood. In order to take a blood sample from the gingiva, Beikler et al.[15] recommended using the test strip from a glucometer directly. Debnath et al.[4] and Shetty et al.[16] recommended using the crevicular, which leaks blood from the gingival crevice, to estimate blood glucose levels during routine periodontal examinations.

Venous plasma glucose is the gold standard method for determining blood glucose levels in diabetic patients because it has the highest level of diagnostic accuracy. It must be compared to the other two noninvasive methods in order to assess how well they correlate with one another. Partheeban et al.[17] used venous blood glucose levels as the gold standard in their study and discovered strong positive correlations between these three methods in diabetic and nondiabetic patients. The sensitivity and specificity of fasting plasma glucose were 93% and 100% in both of their groups, respectively. The ADA suggested that blood glucose monitoring devices have prediction errors that are 15% or less than the laboratory norm; nevertheless, clinically, an analytical precision of up to 20% is considered acceptable.[18]

The present study's limitation includes, although using gingival blood as a chair-side test to monitor patients is painless, safe, and takes less time, we cannot rule out the possibility of gingival blood becoming contaminated with supragingival and subgingival calculus and plaque. Additionally, individuals who attend dental offices without fasting may reduce the need for gingival blood tests to check for diabetes mellitus. It is also necessary to compare gingival blood with more precise measurements like hemoglobin A1c, and longitudinal follow-up is necessary to assess the long-term outcome in connection to periodontal health with a larger sample size.

Conclusion

In conclusion, the findings of the current study suggest that blood drawn from the gingival crevicular during a clinical examination may be a great source for glucometric analysis. The gingival crevicular blood may show to be a promising technique for routine dental office screening for diabetes mellitus in periodontal patients, even if capillary/venous blood samples used for diabetes mellitus screening are the gold standard.

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