



Assessment of blood glucose levels in diabetic patients with periodontitis: A three-way method using gingival crevicular, capillary, and venous blood

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Abstract

Background: To test the feasibility of using gingival crevice blood collected during routine periodontal examination and to estimate the blood glucose levels using glucometer (Accu-Chek Active).

Materials and Methods: A total of 50 patients with a history diabetes mellitus and with chronic periodontitis were selected. From all, the patients fasting venous blood glucose was estimated. Blood oozing from gingival tissues during periodontal examination was collected on the strip of the glucose self-monitoring device (Accu-Chek). Then, the finger stick capillary blood was collected, and glucose levels were estimated using glucometer.

Results: The comparison between venous capillary and gingival crevicular showed a strong correlation with a $P < 0.001$.

Conclusion: The data from this study have shown that gingival crevicular blood collected during the periodontal examination may be used to analyse blood glucose levels in diabetic patients.

Introduction

Periodontitis is a chronic inflammatory disease caused by (multifactorial) microbial plaque with an important role of systemic diseases that weaken the body's immune system.

Diabetes mellitus (DM) encompasses a heterogeneous group of disorders characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both, with several major complications affecting both the quality and length of life.^[1]

Among the various systemic factors that are thought to play a role in the initiation and progression of periodontal disease, DM has shown to exhibit a bidirectional relationship.^[2] This interrelationship between DM and periodontitis has been studied for many years emphasizing their role in periodontal disease. Predictions show that 70% of those affected belong to the developing countries and diabetes is fast gaining the status of a potential epidemic in India with more than 62 million diabetic individuals currently diagnosed with the disease.^[3]

The prevalence of DM is more than twice as high in patients with periodontitis when compared to periodontally healthy subjects. The periodontists are extremely likely to encounter

growing number of undiagnosed diabetics with periodontal disease due to the increasing figure of diabetics and the close interrelationship between diabetes and periodontitis.

The early detection of the systemic conditions like DM is making considerable progress in reducing the progression of these chronic diseases, with the large number of patients seeking dental treatment each year dentist plays an important role as a health team member in identifying undiagnosed asymptomatic patients with diabetes, which might help in the early detection of subclinical diseases may considerably slow the progression of chronic diseases like diabetes, thus incorporating various chair side detecting procedures into the routine clinical practice may provide the clinician with a better chance of diagnosing a previously undetected disease.

The traditional laboratory methods that are used for diagnosing and screening diabetes are relatively time-consuming and require elaborate equipment and are invasive. A normal consequence of the routine examination of the periodontal tissues is the sulcular bleeding which is a result of tissue inflammation in both diabetic and non-diabetic patients.

Hence, considerable effort has been made in the past few years to develop painless and non-invasive and rapid methods

to measure blood glucose, and the introduction of glucose self-monitoring device allowed clinicians to assess blood glucose methods at the chair side and also provided diabetic patients with a simple method for rapid daily monitoring of blood glucose levels at home.

The monitoring of blood glucose levels using glucometers are in common use by the diabetic patients.^[4] This procedure or method being simple, reliable in terms of accuracy and also being relatively inexpensive serves as an in-office screening device for patients suspected to have diabetes as well as monitor the blood sugar levels of patients with diabetes.

Since periodontal inflammation, with or without the complicating factor of DM, is known to produce ample extravasated blood during routine probing of a patient as a part of periodontal examination^[5] and is more familiar to the practitioner and less traumatic compared to a finger puncture with a sharp lancet, these glucose self-monitoring devices may actually allow for painless testing of blood oozing from the gingival crevices of patients which are simple and relatively inexpensive in-office screening aids. They can also be used to monitor blood glucose levels in known diabetics.^[6]

Hence, this study was aimed at assessing the reliability of a glucose self-monitoring device for testing gingival crevicular blood in comparison with the finger stick capillary blood glucose and standard laboratory venous blood glucose measurement in diabetic patients.

Materials and Methods

A total of 50 patients with chronic periodontitis and Type II DM were screened and included in the study. Inclusion criteria were as follows - age between 35 and 75 years old, diagnosis of chronic periodontitis with attachment loss of ≥4 mm in more than 30% of sites and at least 10 teeth in the mouth. The patients were examined and periodontal status was recorded.

Patients with any of the following conditions were excluded from the study: Polycythemia vera, anemia, dialysis; intake of substances that interfere with the coagulation system, heparin; severe cardiovascular, hepatic, immunologic, renal, hematological, or other organ disorders. The study was proceeded after obtaining ethical clearance from the college ethical committee. Periodontal parameters were assessed at 6 sites of every tooth which included probing pocket depth and clinical attachment level measured with a calibrated probe (UNC 15 HUFRIDEY). Bleeding on probing was assessed and a site with more profuse bleeding was selected for collecting the gingival crevicular blood.

Sample collection

Venous blood collection

From all, the subjects included in the study venous blood glucose was collected after 8-12 h of fasting, from the antecubital fossa using a disposable syringe and the fasting venous blood glucose was estimated in the laboratory.

Capillary blood collection

Capillary blood was collected from one of the patient’s fingers. The soft surface of the finger was wiped with spirit and then punctured with a sterile auto lancet device. The first drop was discarded and the subsequent drop of blood was used for glucose measurement. The glucometer strip was held at the bleeding site until glucose measurement was displayed on the glucometer.

Gingival crevicular blood collection

A site with more profuse bleeding was chosen for gingival crevicular blood after the periodontal examination was done using Williams periodontal probe, and the sites were air dried to prevent contamination with saliva. The blood oozing from the periodontal pocket was collected with a micropipette and was then transferred to the glucometer strip, and the reading was noted [Figure 1].

Results

A study population included a total of 50 patients with type II DM aged between 36 and 73 years with a mean age of 56.6 years of which 16 were females and 34 were males.

The venous blood glucose levels ranged between 92 and 231 mg/dl with a mean value of 129.1 mg/dl. The capillary blood glucose values had a minimum of 101 mg/dl with a maximum of 239 mg/dl and the mean value was 135.86 mg/dl, whereas the gingival crevicular blood showed a mean 123.56 mg/dl



Figure 1: Collection of gingival crevicular blood

Table 1: Comparison of blood glucose levels among three methods used in the study

Clinical parameters	Sample size	Mean±SD
FBS	50	129.10±28.08
CBG	50	135.86±27.30
FBS	50	129.10±28.08
GCBS	50	123.56±28.29
CBG	50	135.86±27.30
GCBS	50	123.56±28.29

FBS: Fasting blood sugar, CBG: Capillary blood gas, GCBS: Gingival crevice blood sugar, SD: Standard deviation

with the minimum and maximum values of 88 and 225 mg/dl, respectively [Table 1].

Post-hoc analysis for multiple comparisons among the groups has given a $P = 0.44$ between venous blood gas and capillary blood gas (CBG) which is insignificant and between CBG and gingival crevicular blood glucose (GCBG) is insignificant with a $P = 0.07$ [Table 2]. Comparison of blood glucose levels among the groups has shown a $F = 2.44$ [Table 3].

Discussion

The periodontists are likely to encounter an increasing number of undiagnosed patients with diabetes, wherein the early diagnosis of diabetes might help to prevent its long-term complications that are responsible for high morbidity and mortality of diabetic patients.^[7]

As per the recommendations of the AAD, the diabetic screening should start at an age of 45 years and should be repeated once in 3 years for those patients without risk factors, which should be made more often in those with risk factors for diabetes.

A thorough meta-analysis by Papapanou demonstrated that a majority of studies which included nearly 3500 diabetic adults evidenced a more severe periodontal destruction in diabetic adults than in adults without diabetics.^[8]

As the periodontal treatment is a long-term one that would often continue for years a single blood glucose test would not be sufficient for periodontal management and moreover consultation with diabetic physician would routinely yield a single blood glucose test result.

As per Collin in 1998, the impairment of the metabolic control in non-insulin-dependent diabetes mellitus seems to be associated with advanced periodontitis and therefore requiring a regular periodontal surveillance.

Hence, the multiple measurements of the blood glucose levels in a patient would help the periodontist assess the patient's diabetic control during the treatment progression.

In this study, 50 known patients with diabetes were included and in all the patients fasting venous, capillary, and GCBG measurements were estimated. On comparison between venous, capillary and gingival crevicular glucose values a strong correlation was seen which was statistically highly significant. The results of this study are in agreement with the studies conducted by Parker *et al.* in 1993 who examined patients with diabetes and unknown periodontal status, a very strong correlation was observed between gingival crevicular, capillary and venous blood glucose measurements.^[9]

Studies conducted by Beiker *et al.*, Müller and Behbehani consisted of non-diabetic patients^[10,11] and the results of this study were also comparable to these studies except that they did not compare GCBG and capillary blood glucose to fasting venous blood glucose. This is a much stronger relationship than reported by Tsutsui *et al.* ($r = 0.782$).^[12]

Strauss *et al.* in their study reported that gingival crevicular samples are suitable to screen for diabetes in individuals with sufficient bleeding on probing.^[13] Sarlati *et al.* stated in patients with diabetes this method revealed sufficient agreement.^[14] Hence, they concluded that gingival crevicular blood can be used for testing blood glucose level during the periodontal examination in diabetic periodontal patients but not in non-diabetics.

Meti *et al.* (2003) compared GCBG with capillary blood glucose and they have found a highly significant correlation with a $P < 0.001$.^[15]

Ponni *et al.* (2013) in their study of 100 patients (50 diabetic and 50 non-diabetic) with chronic periodontitis have stated that the comparison between gingival crevicular fluid, finger prick and venous blood showed a strong correlation with a $r = 0.99$ ($P < 0.001$).^[16]

In a study by Gupta *et al.* (2012) with 50 patients the comparison between the three blood glucose levels had shown a strong correlation and wherein they concluded that gingival crevice blood collected during periodontal examination can be an excellent source of blood for glucometric analysis.^[17]

All these studies aim to develop a safe, rapid and non-invasive approach to screen diabetes, which is a major problem especially in periodontal management. With a successful resolution of periodontal inflammation involving the stabilization of blood glucose, multiple measurements of a diabetic patient's blood glucose allows the periodontist to better assess the patient's diabetic control as treatment progress. All the studies attempted so far in the literature proved that extravasated blood from the gingival crevice due to inflammation can provide an acceptable source for measuring blood glucose in diabetic patients.

Table 2: Multiple comparisons

		Blood glucose levels				
(I) groups	(J) groups	Mean difference (I-J)	Standard error	Significance	95% Confidence interval	
				Tukey HSD	Lower bound	Upper bound
VBG	CBG	-6.76000	5.57704	0.448	-19.9647	6.4447
	GCBG	5.54000	5.57704	0.582	-7.6647	18.7447
CBG	GCBG	12.30000	5.57704	0.074	-0.9047	25.5047

VBG: Venous blood gas, CBG: Capillary blood gas, GCBG: Gingival crevicular blood glucose, HSD: Honest significant difference

Table 3: ANOVA

	Blood glucose levels				
	Sum of squares	df	Mean square	F	Significance
Between groups	3794.653	2	1897.327	2.440	0.091
Within groups	114304.840	147	777.584		
Total	118099.493	149			

Conclusion

The results of this study indicate that gingival crevicular blood collected during the diagnostic periodontal examination may be an excellent source of blood for glucometric analysis. In

addition, the technique described is safe, easy to perform and comfortable for the patient and might, therefore, help to increase the frequency of diabetes screening in dental offices.

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