Original Research Article

Correlation between levels of sulcular and capillary blood glucose in screening of diabetes mellitus in chronic periodontitis patient in Chittoor District

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Abstract

Introduction: There is a high prevalence of type 2 diabetes mellitus (DM) in the UAE. Recent national guidelines advise screening for undiagnosed diabetes in all adults aged ≥ 30 years. Diabetes mellitus remains undiagnosed in approximately 50% of the patients suffering from the disease. Importantly, the prevalence of diabetes in periodontitis patients is twice as high when compared to healthy subjects. Hence, a large number of patients with periodontitis may have undiagnosed diabetes mellitus.

Aim of the study: This study assessed the feasibility of identifying undiagnosed diabetes and prediabetes using gingival crevicular blood in patients with periodontitis.

Material and methods: This comparative study was conducted at twenty healthy controls (Group I) and twenty known diabetics (Group II) were recruited (for 6 months). Gingival crevicular blood and capillary finger blood glucose concentration obtained during the routine periodontal examination were analyzed by an Accu–Chek® Performa self-monitoring device. Diurnal effects were controlled.

Results: The mean age for Group I was 39.5 years (9.8) and for Group II it was 45.5 (10.2) with no significant difference by age between the two groups. The mean duration of diabetes in Group II was 5.7 (3.2) years. Mean blood glucose concentration from gingiva and finger within each group were not significantly different. Mean finger blood glucose concentration in Group II was significantly higher at 172(47) mg/dL than for Group I, 115.1(17) mg/dL ($t=5.03$, $p<0.001$). Similarly, mean gingival blood glucose was significantly higher in Group II compared to Group I, 173.2 (47.7) mg/dL and 116.3 (16.7) mg/dL respectively ($p<0.001$). There was a very strong correlation between mean blood glucose from

finger capillaries and gingiva (0.996; p<0.001) within each group irrespective of gender, age, periodontitis, and duration of diabetes. The duration of diabetes was highly predictive for both gingival and finger blood glucose concentration (p<0.001). Within Group I, 5 of the 20 patients were identified as pre-diabetic with a blood glucose concentration above 140 mg/dL.

Conclusions: Gingival crevicular blood glucose can be measured with the Accu-Chek® performa safelyand easily to screen for the diabetic status of patients with bleeding on probing.

Key words

Gingival crevicular blood, Gingival crevicular fluid, Probing depth.

Introduction

The epidemic of type-two diabetes mellitus (T2DM) is evident globally, shortening lives and straining the financial resources of health care systems [1]. Diabetes mellitus is defined as a metabolic disorder of multiple etiology characterized by chronic hyperglycemia with disturbances of carbohydrate, protein, and fat metabolism resulting from defects in insulin secretion, insulin action, or both [2]. T2DM was formerly called non-insulin-dependent, or adult-onset which results from the body's ineffective use of insulin. T2DM affects the majority of people with diabetes around the world and is largely the result of excess body weight and physical inactivity [3]. Symptoms may be similar to those of type 1 diabetes but are often less marked. As a result, the disease may be diagnosed several years after onset, once complications have already arisen. Until recently, this type of diabetes was seen only in adults but it is now also occurring with increased frequency in children [4]. Dentists are uniquely placed to increase public awareness of T2DM and in the early detection of prediabetes. Because of the close relationship between diabetes and periodontitis, it can be assumed that dental practitioners are extremely likely to encounter many patients having both diabetes mellitus and periodontitis. A high number of patients with periodontitis may have undiagnosed diabetes. The early diagnosis of diabetes might help to prevent or reduce its long-term complications which are responsible for the high morbidity and mortality of diabetic patients [5].While finger capillary blood glucose measurement is a common screening tool, dental practitioners, may find gingival blood more convenient as a blood sample that can be obtained during routine scaling. The strip system may provide a simple, quick, and reliable method to measure glucose concentration and identify prediabetes using gingival blood [6].

Materials and methods

This comparative study was conducted at twenty healthy controls (Group I) and twenty known diabetics (Group II) were recruited (for 6 months). A convenience sample of 40 adult patients (30-70 years) was invited to participate. 20 of them were healthy controls with no relevant medical history (Group I) and 20 were known diabetics (Group II) all were recruited gingival crevicular blood and capillary finger blood glucose concentration obtained during the routine periodontal examination were analyzed by an Accu–Chek® performa self-monitoring device. Diurnal effects were controlled.

Inclusion criteria: Patients with moderate to severe chronic periodontitis. At least one tooth in the maxillary anterior region showing bleeding upon probing.

Exclusion criteria: Patients requiring premedication or prophylactic drug regime, suffering from other systemic infection or diseases except for diabetes, A periodontal pocket with suppuration, Subjects on medication that interferes with coagulation (e.g., anti-coagulants), Subjects taking supplemental vitamin C (ascorbic acid) that could interfere with the glucose test strip oxidation reaction.

Gingival crevicular blood glucose concentration (GCB) measurement: The site selected was the gingiva around the upper anterior teeth as access is ideal. Supra and subgingival scaling were done at the selected donor site before GCB measurement to remove food debris and plaque. Contamination with saliva was minimized by using gauze and cotton rolls placed in the upper labial sulcus. A UNC-15 periodontal probe was gently passed along the gingival sulcus to induce bleeding then the glucometer strip was placed in contact with the blood. The gingival crevicular blood glucose (GCB) concentration was recorded using an Accu–Chek Performa self-monitoring device (Roche Diabetes Care GmbH, Snadhofer Strasse 116, 68305 Mannheim, Germany). It took an additional two minutes of the patient time without any disturbance to the planned clinical treatment. Capillary finger-stick blood glucose level (CFB) measurement:- The soft surface of the fingertip was wiped with surgical spirit and the spirit was allowed to evaporate. The surface of the finger was then punctured with a sterile lancet and the blood drop was allowed to be drawn into the test area of the strip. The capillary blood glucose concentration was recorded using an Accu–Chek Performa self-monitoring device (Roche Diabetes Care GmbH, Snadhofer Strasse 116, 68305 Mannheim, Germany). Both samples from each individual were taken at the same visit. The time of collecting blood from both sources was determined between 2:00 to 4:00 pm to control diurnal variation. The result from the Accu–Chek Perform self-monitoring device was used to compare gingival crevicular blood glucose concentration and Capillary finger blood glucose concentration. No blood samples were transferred to anylaboratory outside the clinical room.

Statistical analysis

The collected data were transferred to computer spreadsheets and analyzed using the computerized Statistical Package for Social Sciences (SPSS, version 20, Chicago, SPSS Inc). Descriptive statistics were performed for the general description of the data. Chi-square and Exact Fisher test were performed to examine differences between categorical data and t-test was carried out to compare continuous variable. The level of statistical significance was set at 5%. A *p*-value of < 0.05 was considered significant in all statistical analyses. Linear regression was used to explain the correlation between gingival crevicular blood glucose concentration and Capillary finger blood glucose concentration.

Results

The study sample included a total of forty patients, 20 were healthy controls with no relevant medical history (Group I) and 20 were known diabetics (Group II). The overall mean age (SD) was 42.5years (10.3).

The mean age for Group I was 39.5years (9.8) and for Group II 45.5years (10.2). No significant difference was found between the two groups. Regarding the periodontal diagnosis, in the group, I, 13 (65%) had been diagnosed with chronic moderate periodontitis while 7 (35%) with chronic severe periodontitis. In Group II, 11(55%) had been diagnosed with chronic moderate periodontitis and 9 (45%) with chronic severe periodontitis t-test 1.88, P=0.068, NSS (**Table – 1**).

Table - 1: Gender and mean ages of groups I & II.

	Gender		**Age in years**
	Male	**Female**	**Mean (SD)**
Group I	11	9	39.5 (9.8)
Group II	14	6	45.5 (10.2)

Table - 2: Duration of diabetes and periodontitis diagnosis.

	Periodontal diagnosis	**N**	**Mean (SD)**
Diabetes duration	Moderate	11	5.54 (2.436)
	Severe	9	5.86 (3.976)

The overall mean duration of diabetes in group II subjects was 5.7 years (3.2). The mean diabetes duration in patients with moderate periodontitis was 5.54 years (2.44) while in patients with severe periodontitis 5.86years (3.98). Duration of

diabetes with the severity of Periodontal diseases was not significantly correlated. The Shapiro-Wilk test confirmed that the data was normally distributed hence parametric tests were applied (**Table – 2**).

Table - 3: Mean of capillary finder blood glucose concentration and gingival crevicular concentration in group I & II.

	Mean (SD)	
	Capillary finger blood glucose mg/dL*	**Capillary finger blood glucose mg/dL***
Group I	115.10 (16.97)	116.30 (16.67)
Group II	172.10 (47.04)	173.15(47.71)

The mean capillary finger blood glucose concentration and gingival crevicular blood glucose concentration were 115.10 (16.97) mg/dL and 116.30 (16.67) mg/dL for group I, respectively while in group II it was 172.10 (47.04) mg/dL and 173.15 (47.71) mg/dL, respectively. Comparison of mean figure blood glucose concentration between Group I and Group II was highly significant (t=5.031, p<0.001). Similarly, the mean gingival crevicular blood glucose was also significantly different between the groups (t=5.098, p<0.001). There was a strong correlation between mean blood glucose from capillary fingers and gingiva (0.996; p<0.001) within each group. The correlation between the glucose level from capillary finger and gingival crevicular blood has a strong linear relationship regardless of gender, age, periodontal diagnosis (either moderate or severe), and duration of diabetes within this sample. A further linear regression model with gingival crevicular blood glucose as the dependent variable and diabetes duration, age, and gender as predictive variables was carried out. Diabetes duration was highly predictive for gingival crevicular blood glucose concentration (p<0.001) as per **Table - 3**.

Discussion

In the current study, venous blood was not tested as the simple screening was the study's aim with follow-up use of venous blood if there was any concern when referred to a diabetic center. While venous blood samples used for diabetes mellitus screening are the gold standard, gingival crevicular blood may prove to be a more practical approach for routine dental office screening for diabetes mellitus in periodontal patients [8]. Giving the current understanding of the close relationship between diabetes and root caries it has been suggested that diabetes risk assessment should include gingival crevicular blood glucose measurement in patients with root caries [9]. In the current study, gingival crevicular blood glucose showed a slightly higher mean value than finger-prick capillary blood glucose, in contrast with another study with the opposite result. This was believed to be due to contamination of gingival crevicular fluid diluting the glucose concentration producing lower measurements in gingival crevicular blood [10]. The method of collecting gingival crevicular blood is critical because the glucose concentration may be altered if there is any contamination from saliva and oral debris. For this reason, Correa FO, et al. used capillary tubes to collect gingival crevicular blood instead of wiping blood directly from the gingiva [11]. In the current study, efforts were made to minimize the contamination by removing all plaque and food debris, and by applying cotton rolls in the labial vestibule and were able to minimize saliva contamination by following this protocol. The result shows slightly higher glucose concentration in gingival crevicular blood which confirms that we can use test strips directly without any need for other instruments. Moreover, in this study diurnal variation was controlled by testing glucose concentration from both sites at a specific period between 2:00 – 4:00 pm. Diurnal variation forms an important part of the diabetes literature because of its impact on diabetes diagnosis and medication time [12]. Darby IA, et al. observed the impact of diurnal variation in fasting plasma glucose in patients examined in the afternoon. They concluded that if current diabetes diagnostic criteria are applied to patients seen in the afternoon, approximately half of all cases of undiagnosed diabetes in these patients will be

missed. In the present study, random blood glucose concentration was measured, not fasting blood glucose, but diurnal variation should be controlled. In the current study, we found that Diabetes duration was highly predictive for gingival crevicular blood glucose concentration ($p<0.001$). There was no significant correlation found between the severity of periodontal diseases and the duration of diabetes mellitus in our study. This might be because all study subjects in Group II had controlled diabetes [13]. Duarte PM, et al. also found 3 patients showed potential diabetes. These two studies used a venous blood source for glucose measurement in a laboratory glucose analyzer to compare it with capillary finger and gingival crevicular blood concentration level. In the current study, we relied on both capillary finger and gingival crevicular blood to measure blood glucose level and were able to identify subjects with undiagnosed prediabetes. Thus, periodontal diseases may be considered as a predictor of undiagnosed T2DM and prediabetes [14]. In the present study, non-diabetics were found to have a high glucose concentration and were diagnosed as prediabetic patients. It is a bonus to identify patients at this stage as their diabetic status is reversible. It is important to reward behavior as soon after the accomplishment as possible [15]. Even if without weight loss, what was done correctly should be identified and the patient should be congratulated. With this approach and with the possible need for medication, prediabetes can be managed simply by decreasing the risk of mortality and morbidity associated with T2DM. This study has shown the potential for the use of a simple, intra-oral, screening tool in identifying undiagnosed diabetes and prediabetes and its acceptance could potentially lead to the screening of all dental patients who exhibit bleeding on probing [16].

Conclusion

A strong and statistically significant correlation (0.996; $p<0.001$) was found between capillary finger blood glucose concentration and gingival crevicular blood glucose concentration. Gingival crevicular blood can be used as a blood source for geometric analysis and will allow for a non-invasive method to screen blood glucose concentration in the dental office. Gingival crevicular blood glucose can be measured with the Accu-Chek® Performa safely and easily to screen for diabetic status in patients with bleeding on probing.

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