Original Article

Detection of blood glucose level through gingival crevicular blood - A pilot study

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ABSTRACT

Background: Diabetes mellitus (DM) is one of the most important risk factors for destructive periodontitis. It is possible that gingival crevicular blood from routine periodontal probing may be a source of blood for glucose measurements.

Aim: To compare gingival crevicular blood and finger stick blood glucose measurements using a self-monitoring device.

Materials and Method: 30 patients with periodontitis and positive bleeding on probing were chosen. Blood samples of two sites were analyzed using a glucose self-monitoring device. Glucose levels in gingival crevicular blood (GCBG) and capillary finger prickblood (CFBG) samples were analyzed using the same device. The following clinical periodontal parameters were recorded: probing depth, gingival bleeding index, clinical attachment loss and periodontal disease index. The Statistical Analysis was carried out.

Results: Sufficiently large GCB volumes provided glucometer readings in all 30 cases (range between60 and 160 mg/dl). The CFB readings ranged between 60 and 166 mg/dl. Karl Pearson's product–moment correlation coefficient was calculated, which showed a positive correlation between the two measurements (r = 0.592) and p- value (0.001).

Conclusion: Gingival crevicular blood can be used for testing blood glucose during periodontal examination in patients with periodontal disease.

Keywords: Chronic periodontitis, Diabetes mellitus, Gingival crevicular blood, Capillary finger prick blood

INTRODUCTION

Diabetes mellitus is one of the most common chronic diseases that affects mankind and is associated with considerable morbidity and mortality. It is worldwide in distribution and the incidence is rising through-out the world. It is projected that 221 million people will have diabetes by the year 2010 [1]. In industrialized countries, a prevalence of 7% is reported, of which nearly half of the cases are undiagnosed. In other words, for every person known to have diabetes, there is someone else in whom the disease remains undiagnosed.

The countries with the largest number of people with diabetes will be in India, China and the United States by 2030 [2]. It is estimated that every fifth person with diabetes will be an Indian. Because of these sheer numbers, the economic burden due to diabetes in India is among the highest in the world.

Surveys showed that the prevalence of impaired glucose tolerance (IGT) is also high. It was reported that the prevalence of IGT in the Indian subcontinent is ≥ 8.7% in urban and ≥ 7.9% in rural areas. Because of this observation that ≥ 35% of those with IGT will develop full-blown diabetes in ~5 years, the sheer numbers of those with diabetes seems overwhelming.

The older age of the average periodontal patient increases the likelihood of thisunderlying disease. Periodontitis is now considered as the sixth complication of diabetes mellitus [3]. The epidemiological data regarding diabetes mellitus coupled with the possible two--way relationship between diabetes mellitus and periodontal disease suggests that virtually every dentist, especially the

periodontist, is likely to encounter an increasing number of undiagnosed diabetic patients.

Considerable effort has been made in the past few years to develop painless and non-invasive methods to measure blood glucose [4].Glucometers are commonly used by diabetic patients for self-monitoring of blood glucose levels at home. Since periodontal inflammation, with or without the complicating factor of diabetes mellitus, is known to produce ample extravasated blood during diagnostic procedures,and routine probing during a periodontal examination is more familiar to the practitioner and less traumatic [5] compared to a finger-puncture with a sharp lancet, these devices may actually allow for painless testing of blood oozing from the gingival crevices of patients with periodontal problem during routine periodontal examination and could be a simple and relatively inexpensive in-office screening device for any patient suspected to have diabetes. They can also be used to monitor blood glucose levels in known diabetics. The conventional laboratory methods that are employed to detect blood glucose are time consuming and require elaborative equipment. The advent of blood glucose monitors allows the clinician to assess blood glucose at the chair side. In contrast to laboratory method, results are obtained instantaneously, which helps the clinician to make decisions immediately. Very few studies have been conducted to assess the use of this chair side device to monitor blood glucose level. Earlier reports in this regard have suggested the use of gingival crevicular blood to assess blood glucose. The present study has been conducted to evaluate the use of gingival capillary blood as a marker for blood glucose estimation using glucometer against the conventional laboratory method.

MATERIALS AND METHODS

Sample size

The study population included 30 patients (15 gingivitis, 15 chronic periodontitis) who visited Department of Periodontology, and comprised of age range of 26 to 78 years. Exclusion criteria included the following: Any indication for antibiotic prophylaxis, any bleeding disorder, severe systemic disease such as cardiovascular, renal, hepatic, immunologic, or hematological disorders, and any medication interfering with the coagulation system

Clinical assessments

Patients with gingivitis and periodontitis were examined intraorally for visual signs of periodontal inflammation and various parameters (Plaque Index, Gingival Bleeding Index, Russell's periodontal index, probing pocket depth, Clinical Attachment level) were assessed. Areas with marked signs of inflammation were probed by a Williams periodontal probe, inserted into the gingival sulcus, as is commonly done during a periodontal examination.

Gingival crevicular blood sampling (GCB)

Gingiva in relation to maxillary anterior teeth was chosen for sample collection, as they offer ideal access. The site with more obvious visible changes of inflammation was selected as the test site. Isolation was done with cotton rolls and salivary contamination was prevented by using gauze squares and air-drying. The probe was inserted into the gingival sulcus to induce bleeding and then the glucometer is turned on by inserting the reagent strip into the test port. The top edge of the reagent strip of glucometer is then placed against the bleeding site. The blood is automatically drawn into reaction cell of the strip by capillary action, until the conformation window is full. Caution was taken to obtain the blood sample on the reagent strip by a clean catch without contacting gingiva / teeth.

Capillary Finger-Prick Blood sample (CFPB)

Samples for finger-capillary blood were taken preferably from the patient's non-dominant hand from the soft tissue surface of the index finger. The soft tissue surface of the finger was wiped with the surgical spirit and the finger was punctured with a sterile lancet and a drop of blood was allowed to form on the finger. The drop of blood was touched to the test end of the strip and held until the instrument gave a beep displaying the blood glucose measurements on the screen in mg/dl.

Statistical Analyses

Statistical analysis has been carried out in the present study using SPSS windows software. Significance has been assessed at a 5% level of significance. The Pearson's correlation has been used to find the correlation between the variables, and the significance of correlation has been obtained using the Student's *t-test.*

RESULTS

Patients with periodontitis included 15 subjects with a mean age of 35.5 ± 11.99 years, while patients with gingivitis also included 15 subjects with a mean age of 24.5 ± 10.54 years.

The GCB readings of the study participants ranged between 60 and 160 mg/dl with a mean ± SD 84.50±20.09 and their CFB readings ranged between 60 and 166 mg/dl with mean ± SD 93.53±21.71 (Table 1).

Table 1: Mean and Standard Deviation (SD) of gingival crevicular blood glucose and capillary finger prick blood glucose

Variable	Mean± SD
Gingival Crevicular Blood Glucose (mg/dl)	84.50±20.09
Capillary Finger prick Blood Glucose(mg/dl)	93.53±21.71

The Pearson's correlation for GCB and CFB samples was *r* value = 0.592 with a P value of 0.001 suggestive of a statistically significant correlation (Table 2).

Table 2: Pearson's correlation for gingival crevicular blood glucose and capillary finger prick blood glucose

Glucose (mg/dl)	Pearson's correlation	p-value
CFB vs. GCB	0.59**	0.001

CFB=Capillary finger blood; GCB= gingival crevicular blood; **=correlation significant at 0.01 level

When the correlation of CapillaryFinger- prick Blood Glucose (CFBG) and Gingival Crevicular Blood Glucose (GCBG) with the various clinical parameters was made, a statistically significant correlation was found between the probing pocket depth (r=0.956, p=0.01 and r=0.829, p= 0.04 respectively (Table 3).

Table 3: Pearson's correlation for various variables

Variables	Capillary finger prick Blood		Gingival crevicular blood	
	r	p	r	p
Plaque Index	-0.132	0.48	-0.211	0.263
Gingival Bleeding Index	0.195	0.30	0.132	0.486
Russell's Periodontal Index	0.599	0.40	-0.266	0.155
Probing Pocket Depth	0.956	0.01**	0.829	0.04*
Clinical Attachment Level	0.248	0.18	-0.130	0.49

r=Pearson's correlation value; *significant p≤0.05;
**Highly significant p≤0.01

DISCUSSION

India has nearly 33 million diabetic subjects today with an overall prevalence rate of 4.3%. Type 2 Diabetes Mellitus i.e. Non Insulin Dependent Diabetes Mellitus (NIDDM) constitutes nearly 90% of diabetic population in any country, with a prevalence of 2.4% in rural population and 11.6% in urban population. It has been estimated that about one third of type 2 cases are undiagnosed, and screening for undiagnosed type 2 Diabetes Mellitus is highly recommended.

Considerable efforts have been made in the past with regard to the development of painless and non-invasive methods to measure blood glucose. Since periodontal inflammation is known to produce ample extravasation of blood during routine diagnostic periodontal examination, no invasive procedure such as finger puncture with a sharp lancet is necessary to obtain blood for glucometric analysis. The technique of using GCB is less traumatic and less time consuming and does not cause any discomfort to the patient motivating the dental professionals to implement diabetes screening using a GCB sample and feel comfortable and confident in doing so. Furthermore, especially among older persons (a population at greater risk for diabetes), pocket depth ≥ 4 mm and/or excess bleeding on probing is common and increases with age, even exceeding 50 % in some samples [6].

Stein and Nebbia [7] were the first to describe a chair-side method of diabetic screening with gingival blood. They transferred blood onto the test strip by wiping blood directly from hemorrhagic gingival tissue. American Diabetes Association in their consensus statement on blood glucose monitoring (1987) [8] said that manual timing of the test strip reaction and the wiping of the test strip are significant sources of error when using glucose self monitors. To over-come these errors, Parker *et al,*[9] used a glucometer, which is self timing and requires no wiping. The use of plastic pipette is claimed to reduce contamination of the sample with saliva, plaque, and debris.

Beikler *et al* [10] suggested direct use of test strip of glucometer to collect blood sample from gingiva. In contrast to Parker's study, the sampling procedure used in this study was much easier to perform and less time consuming and required no additional tools to collect gingival crevicular blood.

The present study is primarily carried out with the objective of an early and simple diagnosis of diabetes mellitus in an unsuspecting periodontal population. Estimations of sulcular blood glucose levels were previously conducted and showed correlations with capillary blood glucose levels, thereby suggesting that testing sulcular blood may be a valuable tool in identifying potential patients with diabetes. It has been reported that the free glucose concentration in gingival fluid was influenced by local environmental factors such as the microflora and the liberation and activation of hydrolyzing enzymes. Thus, gingival crevicular blood after probing may not represent true capillary blood glucose measurement.

In our study, after proper isolation and drying of the site, sample was collected from the outer surface of the gingiva, thus eliminating the possibility of contamination with crevicular fluid. None of the subjects under study reported pain / discomfort and no complications have been reported after sampling by this method. The glucometer used is a self-timing, second-- generation monitor and is approved by Federation dentaire Internationale (FDI) for off-finger testing. It requires very low amount of blood (1 µl), thus allowing to perform the analysis even in cases with very mild gingival inflammation.

The correlation between gingival and finger- prick capillary blood was r = 0.59, *P* =0.001 which showed a positive relationship with the studies conducted by Tsutsui *et al.* r = 0.782, Beikler *et al.* r = 0.981.

The present study also found a positive correlation between probing pocket depth and the gingival crevicular blood and finger prick capillary blood.

CONCLUSION

This screening study clearly pointed out the importance of the early detection of diabetes in a population which comprised of patients predominantly having gingival and periodontal diseases. Thus developing a safe, rapid and non-invasive approach to screen diabetes, which is a major problem especially in periodontal management is necesary. The successful resolution of periodontal inflammation results in the stabilization of blood glucose. Therefore, multiple measurements of a diabetic patient's blood glucose allow the periodontist to better assess the patient's diabetic control as treatment progresses and success in the periodontal therapy with decreased gingival blood glucose level. On the basis of the results of the present study, gingival crevicular blood is a useful aid for testing blood glucose during routine periodontal therapy. Further, large sample size study can be undertaken.

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