Original Research Article

Estimation of gingival blood glucose using a sensitive self-monitoring device in periodontitis patients

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Abstract

Background: Diabetes Mellitus is a complex disease with varying degree of systemic and oral complications. The prognosis is quite favorable if a disease is diagnosed in early stages. Since a large number of patients seek dental treatment routinely, screening procedures for early detection of subclinical cases can help in diagnosis of asymptomatic diabetes.

Aim: The present study was undertaken to evaluate if gingival crevicular blood can be used for the estimation of blood glucose levels in periodontitis patients.

Material and Methods: A prospective study was carried out comprising 150 patients Group A comprised of 75 subjects with gingivitis and group B comprised of 75 subjects with periodontitis. For gingival crevicular blood glucose (GCBG) level estimation, the blood was drawn onto the glucometer strip after gently probing the gingival sulcus and the readings were recorded. At the same time, blood

was also collected from the index finger onto the glucometer strip for the capillary finger-prick blood glucose (CFBG) sample. Both the values were compared and statistical analysis of data was performed.

Results: The mean GCBGL and CFBGL in group A was 98.43 mg/dl ± 18.62 and 103.48 mg/dl ± 13.90 respectively, while in group B it was 136.37 mg/dl ± 36.95 and 141.62 mg/dl ± 51.84, respectively. There was no statistically significant difference ($p > 0.05$) between the two values in both the groups.

Conclusion: It can be concluded that GCBG levels are positively correlated with CFBG levels. Therefore, clearly indicating that gingival crevicular blood collected during diagnostic periodontal examination may be an excellent source of blood sample for glucometric analysis.

Key words

Capillary finger-prick blood glucose, Gingival crevicular blood glucose, Periodontitis.

Introduction

Diabetes Mellitus (DM) is a complex disease with varying degree of systemic and oral complications, depending on the extent of metabolic control, presence of infection, and underlying demographic variables. It is emerging as a global epidemic, whose complications impact significantly on quality of life, longevity and healthcare costs [1].

The major proportion of this disease is seen occurring in developing countries of the world where the disorder predominantly affects young adults in the economically productive age group. Also there is consensus that the South Asia region will include three of the top ten countries in the world (India, Pakistan and Bangladesh) in terms of the estimated absolute number of people with diabetes [2].

The onset of DM is preceded by inflammation, which leads to pancreatic beta-cell dysfunction and apoptosis, as well as impacting on the development of insulin resistance and ultimately DM. It is logical that co-morbidities that contribute to systemic inflammation are likely to increase the risk of developing disease, and impact on control and the development of diabetes mellitus complications, ultimately affecting diabetes-associated morbidity and mortality [3].

Several distinct types of DM are caused by a complex interaction of genetics and environmental factors. Depending on the etiology of the DM, factors contributing to hyperglycemia include reduced insulin secretion, decreased glucose utilization, and increased glucose production. The metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ system that impose a tremendous burden on the individual with DM and on the health care system [4].

There is a greater likelihood of a favourable prognosis when a disease is diagnosed in its early stages. Since a large number of patients seek dental treatment routinely for gingivitis and periodontitis, screening procedures for early detection of subclinical cases can help in diagnosis of asymptomatic diabetes. Hence, present study was undertaken to evaluate if gingival crevicular blood can be used for estimation of blood glucose levels in periodontitis patients.

Materials and methods

A prospective study was carried out in the Department of Periodontology and Implantology in collaboration with the Department of Biochemistry, Vananchal Dental College and Hospital, Garhwa, Jharkhand. The study design was reviewed and approved by the ethical committee of the institute.

The study sample comprised of 150 patients in the age group of 25-70 years. All 150 patients were evaluated for clinical and biochemical parameters and divided into 2 groups. Group A (Gingivitis) comprised of 75 subjects with clinical sign of gingival inflammation, bleeding on probing present without clinical attachment loss. Group B (Periodontitis) comprised of 75 subjects with presence of debris and calculus, clinical signs of gingival inflammation, bleeding on probing present, probing pocket depth of >4 mm and clinical attachment loss of >3 mm.

Inclusion Criteria consisted of subjects with chronic generalized gingivitis, chronic generalized periodontitis (>30% of sites) with a clinical attachment loss of 3 mm or more, periodontally untreated patients with either non-surgical or surgical periodontal therapy with at least 4 teeth per quadrant i.e. minimum 16 teeth present.

Individuals who were suffering from any acute or chronic systemic condition, including viral, fungal or bacterial infections, or had recent trauma or tooth extractions were excluded. Other exclusion criteria was patients with history of tobacco, smoking or alcohol abuse; those who had taken a course of anti-inflammatory or antimicrobial therapy within the previous 3 months, history of any minor or major trauma, any oral or general surgical procedure, which could have resulted in blood loss in past 1 year and pregnant and lactating women.

The selected patients were asked to rinse with chlorhexidine mouthwash, before the gingival crevicular blood glucose (GCBG) level estimation. The upper anterior segment was isolated with cotton roll to prevent saliva contamination and dried with compressed air. To obtain a clean sample, bleeding was induced by UNC-15 probe until a sufficient quantity of blood (2 to 3 µl) was present to be gathered as a sample. The extravasated blood through the gingival sulcus was made to fall directly onto the strip. The monitoring device {Elegance CT-X11 (Convergent technologies ltd. Taiwan)} was loaded with the active test strip (impregnated per cm with glucose dye oxidoreductase 0.7µ) and a drop (2µl) of blood was transferred on to the test strip. The testing time was about 10 seconds. The value displayed on the monitor was recorded.

Immediately following the collection of the sample, capillary finger-prick blood glucose (CFBG) sample was drawn from one of the patient's finger. The pad of the finger was wiped with spirit, allowed to dry, and then punctured with a sterile lancet. Capillary blood sample was drawn by the same collecting device and transferred on to the test strip pre-loaded in the glucometer. This was done to avoid bias. CFBGL readings were recorded. Afterwards pressure was applied with sterile cotton dipped in spirit to stop bleeding from punctured site. When the blood glucose levels were found to be >140 mg/dl patient was asked to get further investigations done.

The data was collected and entered into Microsoft excel spreadsheet. Statistical analysis of data was performed with a software program, SPSS (Statistical Package for Social Science) version 22 (SPSS Inc. Chicago, IL, USA) for windows software programme. Statistical analysis was carried out using Student t-test with level of significance $p< 0.05$.

Results

Table - 1 shows the gender and age-wise distribution of the subjects. A total of 150 subjects were divided in two groups; 75 subjects of Group A (chronic generalized gingivitis) (31 males and 44 females), 75 subjects of Group B (chronic generalized periodontitis) (40 males and 35 females) who underwent blood glucose analysis. The mean age for the study sample was 37.81± 6.66.

Table - 2 shows the mean and standard deviation value for GCBGL and CFBGL in gingivitis and periodontitits groups. The mean GCBGL in both

groups A and B (98.43 mg/dl ± 18.62 and 136.37 mg/dl ± 36.95, respectively) were slightly lower than the mean CFBGL in both groups (103.48 mg/dl ± 13.90 and 141.62 mg/dl ± 51.84, respectively). There was no statistically significant difference (p> 0.05) observed between the two values in both the groups.

Table - 1: Demographic Distribution of Group A and Group B Subjects.

Groups	Age (Mean± Std. Deviation)	Males	Females
Group A	33.76 ±6.57	31(41.3%)	44(58.6%)
Group B	41. 87 ±6.76	40(53.3%)	35 (46.6%)

Table - 2: GCBG and CFBG values in the Gingivitis (A) and Periodontitis (B) Groups.

Variable	Group A		Group B	
	Mean	Std. Deviation	Mean	Std. Deviation
GCBG (mg/dl)	98.43	18.62	136.37	36.95
CFBG (mg/dl)	103.48	13.90	141.62	51.84
p-value	p>0.05 Non-Significant		p>0.05 Non-Significant	

Discussion

Diabetes is a complex metabolic and an extremely important disease from a periodontal standpoint. The extensive literature on this subject and the overall impressions of clinicians show that periodontal disease in patients with diabetes follows no consistent or distinct pattern. Therefore, it may not always be possible for the clinician to correctly diagnose diabetes merely based on clinical features of periodontal disease, although periodontal disease was recognized as the sixth complication of diabetes by the American Diabetes Association. In addition, the prevalence of diabetes is more than twice as high in patients with periodontitis compared to in periodontally healthy patients. Thus, a high number of patients with periodontitis may have undiagnosed diabetes [5].

Ardakani MR, et al. and Almas, et al. stated that severity of periodontal disease is directly associated with the blood glucose level. The subjects of their study were type 2 DM patients. They observed that subjects with severe periodontitis also exhibited higher blood glucose levels [6, 7].

Successful resolution of periodontal inflammation involves the stabilization of blood glucose. Therefore, multiple measurements of a diabetic patient's blood glucose allow the periodontists to better assess the patients diabetic control as treatment progresses and this can be achieved by constant monitoring of blood glucose. The regular methods employed for evaluation of blood sugar is traumatic experience for the patient.

Hence, considerable effort has been made in the past years for the development of painless and non-invasive method to collect blood samples for measurement of blood glucose.

As early as 1969, Stein and Nebbia used the interdental gingival papilla prick method with test strips to screen patients with high gingival blood glucose, followed by Tsutsui, et al. to the more recent studies of Beikler, et al. and Khader, et al. who attempted to prove that extravasated blood from the gingival crevice due to inflammation can provide an acceptable source for measuring blood glucose [8-11].

These studies were based on the fact that periodontal inflammation with or without the complicating factor of diabetes mellitus is known to produce ample extravasated blood during diagnostic procedures, and hence, no extra technique like finger puncture is necessary to obtain blood for glucose analysis.

To assess the results of the aforesaid studies the present study was conducted over a total of 150 gingivitis and periodontitis patients, who visited the outpatient department (OPD) of Department of Periodontology and Implantology. Both the male and female subjects were considered for study because both may become diabetic. Patients within age range of 25-60 years were included for the study as this age range generally presents with chronic periodontitis and can maintain proper study protocol. Patients with history of local and/ or systemic antibiotic therapy within the last three months were excluded to rule out any effect of antibiotics.

Disease severities requiring periodontal therapy other than scaling and root planning were also excluded for ethical reasons and to minimize the risk to the patient. Smoking may act as confounding factors and is a potential risk factor for periodontitis hence smokers were also excluded from the study. An elegance CT-X11 glucometer was used in the present study because it requires less than 1 µl blood and the reagent strips have been shown to be fairly reliable and accurate for clinical use. Only 5 seconds are needed to obtain a glucose reading.

Our study shows that mean GCBGL and CFBGL in group A was 98.43 mg/dl ± 18.62 and 103.48 mg/dl ± 13.90 respectively, while in group B it was 136.37 mg/dl ± 36.95 and 141.62 mg/dl ± 51.84, respectively. There was no statistically significant difference ($p > 0.05$) observed between the two values in both the groups and they were positively correlated.

The results of the present study were found to be similar to the above studies. Likewise, Mealey BL also found positive correlation and suggested that the diabetic patients may be encouraged to bring their glucometer to dental appointments so that blood glucose can be immediately assessed when needed [12].

However, few studies also found dissimilar results. Muller and Behbehani failed to provide any evidence for the usefulness of GCB for testing blood glucose during a routine periodontal examination. In their study, investigators compared two methods of blood glucose determination and concluded that gingival crevice blood could not be recommended for measuring blood glucose levels [13].

A potential reason for possible discrepancies with these studies may be dilution of blood oozing from the sulcus after probing by gingival crevicular fluid as well as the incongruity in methodology and instruments used.

Although not a test to diagnose diabetes, such screening is an important first step in identifying individuals for whom follow-up tests regarding possible diabetes are warranted. The present study investigated and compared the GCBG and CFBG levels and evaluated whether the GCBGL can be used reliably to estimate blood glucose in chronic periodontitis patients.

Thus patients should not be overlooked in the absence of positive history of diabetes and so screening for diabetes with gingival blood glucose monitoring holds definite promise in periodontitis patients.

Conclusion

It is concluded from the present study that gingival crevicular blood glucose (GCBG) levels are positively correlated with the capillary finger-prick blood glucose (CFBG) levels. Therefore, clearly pointing out that gingival crevicular blood collected during diagnostic periodontal examination may be an excellent source of blood for glucometric analysis, for early detection of diabetes in a population

comprised of patients predominantly having gingival and periodontal diseases.

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