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RESEARCH BRIEF

To evaluate the correlation between gingival crevicular blood glucose and capillary blood glucose to screen diabetes mellitus in the dental office

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Abstract

Background: Most of the Indian population goes undiagnosed for diabetes due to unawareness. This will lead to more serious and long-term complications of diabetes. Thus, there is a critical need to increase opportunities for diabetes screening and early diabetes detection. Research has explored the dental office as a strategic venue of opportunity for glucose testing, examining the possibility of using gingival crevicular fluid (GCF) for diabetes screening. **Aim:** The aim of this study is to evaluate the reliability of gingival crevicular blood (GCB) to screen the diabetes. **Methodology:** Thirty patients were randomly selected based on bleeding on probing and probing depth. GCB and capillary finger blood (CFB) glucose levels were calculated using glucometer from patients. Data for glucose levels were statistically analyzed. **Results:** The correlation between GCB and CFB was high. **Conclusion:** GCB can be used as the screening test for diabetes in the dental office. **Clinical Significance:** GCB blood glucose level detection can be used as chairside screening test for diabetes patients.

Keywords: Diabetes mellitus, gingival crevicular fluid, periodontitis

Introduction

Diabetes mellitus is one of the leading diseases that affect population worldwide, as well as in India, where 62.4 million population is affected with this disease[1] and every fifth diabetic person in the world is an Indian.[2] It is associated with a wide range of complications such as retinopathy, nephropathy, neuropathy, micro- and macrovascular disease, altered wound healing, and periodontitis.[3,4]

Periodontitis is a chronic disease that affects 70% of the global population.[5] As we know, periodontitis is the sixth most common complication of diabetes mellitus.[6] Persons with poorly controlled diabetes are nearly 3 times more likely to have severe periodontitis than those without diabetes.[7] Adjusted cumulative odds ratio for the progressive loss of alveolar bone is between 2.2 for well-controlled diabetics and up to more than 11 for patients with poor glycemic control have been reported for subjects suffering from type 2 diabetes mellitus.[8] Large number of patients suffering from periodontitis may have undiagnosed diabetes mellitus,[6] as periodontitis and diabetes go hand in hand.

The wellinformed dentist plays a key role in detecting diabetes.[9] If the dentist is aware of the correlation between periodontitis and diabetes, he/she can suspect the periodontitis patient as a diabetic. This helps in making patients more aware of their health, as a lot of cases of diabetes go undetected in India every year. Early treatment and secondary prevention efforts can help in preventing long-term complications of diabetes which are responsible to reduce the quality of life and increase the rate of mortality among the diabetic population.[10] The dental visit can be one of the great opportunities to screen diabetes especially in highrisk populations. Thus, there is a crucial need to increase opportunities for diabetes screening and early diabetes detection.[11]

Nowadays, glucometers have gained popularity among diabetic patients. As they are convenient devices to check blood glucose levels at home. Recently, more sensitive self-monitoring devices have been developed for testing small amounts (<2 μl) of blood. In general, the accuracy of these novel glucometers has been reliable.[12] Glucometers are sufficiently accurate, simple, and relatively inexpensive. The glucometer could be a beneficial

device for screening any patient suspected to have diabetes in the dental office.[13]

Therefore, in addition to, looking after the oral health of people with diabetes, dentists also play a key role in screening for disease in the general population.[14] Hence, the aim of the present study was to evaluate whether gingival crevicular blood (GCB) can be used to screen for diabetes during regular periodontal examination in periodontitis patients, and the objectives were to estimate and correlate the capillary blood glucose level using blood drawn by finger method and GCB during routine periodontal examination and to know if GCB is equally effective in blood glucose estimation using glucometer.

Materials and Methods

Ethical clearance was obtained from the Institutional Ethical Committee. Thirty patients visiting the Department of Periodontology, Pandit Deendayal Upadhyay Dental College, Solapur, were randomly selected. Informed consent was taken from all participants. The duration of the study was 1 week. Patients aged 35 years and above with untreated Moderate to severe periodontitis with adequate bleeding on probing (BOP) were included in the study. Known diabetes patients were not involved. Participants with any other systemic diseases, under any medication, and suppuration in the anterior teeth were excluded from the study.

Full mouth periodontal examination of the patient was done. Maxillary anterior teeth having BOP are selected as it provides better access for the collection of GCB.

The glucometer used in this study was commercially available which is known as Dr. Morepen Gluco One (Morepen Industries, New Delhi, India). It follows the enzyme electrode principle. The blood glucose mixes with the enzyme glucose oxidase present on the test strip and are converted to gluconolactone which generates DC electrical current. The strength of this current is directly proportional to the amount of glucose. The electrodes incorporated in the test strip measure the charge and give a digital reading on screen.[15]

The unit has a meter and dry reagent test strips used for capillary blood glucose testing by diabetic patients or by healthcare professionals. These reagent test strips are calibrated to report plasma glucose values.

First, the test strip is inserted into the test port of the glucometer. After that, a symbol of blinking drop appears on the monitor. This suggests that the meter is ready to use. After keeping the glucometer ready, the intraoral site was isolated using cotton rolls and then dried by compressed air. Bleeding was induced using the periodontal probe. Blood oozing from the site was used as a sample to check glucose level [Figure 1].

Then, the reagent strip inserted in glucometer was placed in opposition to the bleeding sites in an isolated area. The white window on the strip should be filled completely with blood. Blood is automatically drawn into the strip by capillary action. The glucose level from GCB provided within 5 s was noted down. Then, glucometer is turned off. The test strip is removed and disposed.

The next strip was inserted in glucometer to measure the blood glucose level from the capillary finger. The blood sample was drawn from the fourth finger. The pad of finger was wiped with alcohol followed by drying. After making the pad sterile, it was punctured using a disposable sterile lancet [Figure 2]. A sufficient amount of blood allowed oozing out and the blood drop placed on the test strip of a glucometer [Figure 3]. The reading was obtained and noted down.

Data were tabulated and submitted to the statistician.

Results

The Pearson's correlation coefficient was assessed to evaluate the correlation between GCB glucose (GCBG) and capillary finger blood glucose (CFBG). The range for GCB glucose (GCBG) varies from 85 to 156 mg/dl and that of CFBG varies from 87 to 156 mg/dl. The mean values of GCBG and CFBG are 130.4 and 130.6, respectively [Table 1 and Graph 1]. The Pearson Correlation test value (r) is 0.981 which is statistically significant

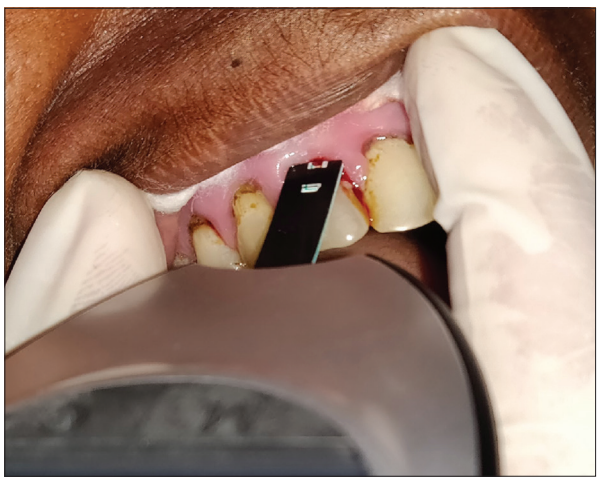


Figure 1: Blood sample collected from intraoral site

Figure 2: Puncturing of sterile finger pad using a sterile lancet

[Table 1]. The results showed a strong correlation (r = 0.981, $P < 0.01$) between GCBG and CFBG glucose. Twenty-one participants show CFBG level more than 120 mg/dl, while 23 participants show GCBG level more than 120 mg/dl.

Discussion

Diabetes mellitus is one of the most common metabolic disorders not only in India but also worldwide. India is the diabetes capital of the world, with 41 million Indians having diabetes; every fifth diabetic in the world is an Indian.[2] The prevalence of diabetes in India ranges from 5% to 17% means 69.1 million people are suffering from this.[16] Although this number is rapidly increasing, half of these cases go undiagnosed.

There are certain systemic conditions, considered as relative risk factors for periodontal diseases. Diabetes mellitus is one of the most important conditions having influence on periodontal health. Considering the bidirectional relationship between periodontitis and diabetes,[17-19] dentists have great opportunities to screen diabetes.

Diabetes increases inflammation in the periodontal tissues. Hyperglycemia can result in the activation of pathways that increase inflammation, oxidative stress, and apoptosis. For example, gingival crevicular fluid (GCF) levels of prostaglandin E2 and interleukin 1 (IL-1β) are higher in Type 1 diabetic patients with either gingivitis or periodontitis compared with those in non-diabetic individuals with the same level of periodontal disease. Whereas among Type 2 diabetic patients, those with hemoglobin A1c (HbA1c) >8% had a significantly higher GCF IL-1β level compared with patients with HbA1c <8%, and both HbA1c and random glucose were independent predictors of an elevated GCF IL-1β level.[20-22]

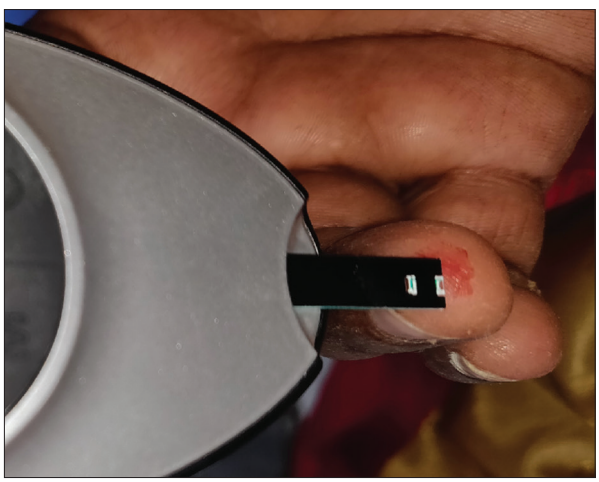


Figure 3: Blood sample collected from finger pad

To measure blood glucose levels at home, glucometers are frequently used. Because the glucometer is very easy, quick, and sufficiently accurate to check blood sugar level at home. A drop of blood is required to measure the blood sugar level and gives results within seconds. Hence, this can be used in the dental office to screen the patients suspected to have diabetes.[23,24]

Within the past few years, a lot of efforts have been taken to make the measurement of blood glucose level painless and noninvasive. BOP is one of the symptoms of periodontitis. Hence, this blood can be used as the source of blood to detect the blood sugar level instead of a finger prick. As periodontal inflammation with or without the complicating factor of diabetes mellitus is known to produce ample extravasation of blood during the diagnostic periodontal examination, no extra procedure, for example, finger puncture with a sharp lancet is necessary to obtain blood for glucometric analysis;[6] hence no extra prick.

In the current study, readings from GCB are compared with the readings with the CFB and verified by correlating with it. The accuracy of the readings was verified by correlating glucose readings obtained using the patients GCB with those obtained through a traditional finger stick sample from the patient. This shows that GCB can be used to check the blood glucose level instead of CFB.

In literature, Beikler *et al.*[3] and Strauss *et al.*[11] have found a correlation between GCB and CFB. The results of the present study are in agreement with the studies conducted by Müller and Behbehani,[25] Parker *et al.*,[26] and Ashish *et al.*[27] In the present study, the correlation of these two readings is strong (r = 0.981) for patients with adequate BOP. This shows that GCB can be used for screening diabetes in a dental office which was in agreement with other studies.[28]

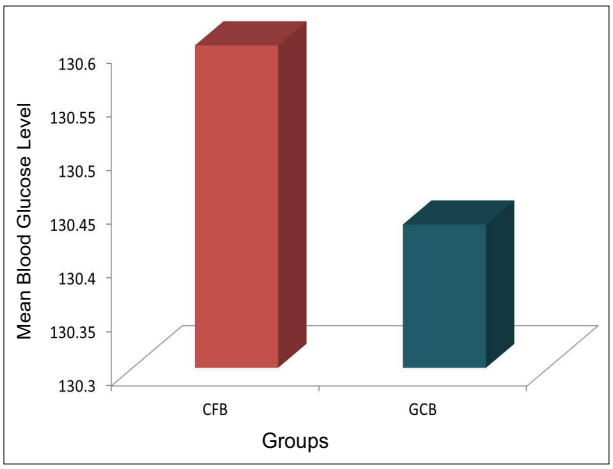
However, in contrast to the current study, Kandwal and Batra,[28] and Debnath *et al.*[29] reported that GCB cannot be used for screening blood glucose during a periodontal examination.

Dentists receive many patients suffering from periodontitis; hence, this dental visit can be used as an opportunity to screen for diabetes. Dental providers can perform the diabetes screening test using crevicular bleeding in periodontitis patients as BOP has ample amount of blood for glucose measurement. Therefore, researchers have used GCB from persons with periodontal disease.[30]

The procedure involving probing and GCB blood collection took very less time and did not show any discomfort by patients. Patients did not complain about any discomfort during the probing or while the sample was being drawn. While CFB

Table 1: Correlation between CFB and GCB using Pearson Correlation test

Groups	Mean	Standard deviation	Mean difference	95% confidence interval for difference		r	*P*
				Lower	Upper		
CFB	130.6000	17.88392	0.16667	-9.04758	9.38091	0.981	0.000
GCB	130.4333	17.77189					



Graph 1: Comparison between CFB glucose level and GCB glucose level. X-axis: Groups. Y-axis: Mean blood glucose level

screening can cause discomfort for the patient as it needs extra prick. When the dentist probes to collect the necessary data for the diagnosis of periodontal disease, simultaneously, diabetes screening can occur using a GCB sample. This makes use of a blood sample that would generally be swabbed away.

This procedure is less time consuming, safe, easy to perform, and acceptable by the patient. Therefore, this helps to increase the frequency of diabetes screening in dental offices. Although this is not a confirmatory test for diabetes, the suspected patients should undergo follow-up tests for the confirmation.

There are some limitations also in this study. We did not collect the venous blood, which considered as a gold standard to measure the glucose level. Furthermore, participants were just screened for diabetes and the confirmatory test was not done after screening. The sample size is less in the current study. Hence, further studies should include large sample size and also improvised method with more accuracy to measure and identify the GCB glucose using small blood for the early detection of diabetes mellitus.

Conclusion

This study suggested that there is a correlation between GCB glucose and CFBG and GCB can be used to screen the glucose level in the dental office itself. However, this cannot be used as an adjunct to standards aids.

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