Original Article ISSN (O):2395-2822; ISSN (P):2395-2814

Effective and Affordable Method of Screening for Diabetes Mellitus Using Gingival Crevicular Blood

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Received: April 2019
Accepted: April 2019

ABSTRACT

Background: The increasing prevalence of obesity and physical inactivity due to population growth, aging, urbanization has prompted the rise in the incidence of diabetes mellitus (DM). Diabetes has emerged as a major healthcare problem in India. About half of the diabetic patients are undiagnosed, as diabetes mellitus is asymptomatic in its early stages. Diabetes and periodontitis interact in a bidirectional manner. Therefore, there is a need to screen patients for diabetes in dental clinics. Glucometers are reliable, rapid, and commonly used for blood glucose determination in diabetes screening. Routine oral examination of patients with periodontal inflammation with or without diabetes produce ample bleeding, which can be used in glucometers for screening DM. Therefore, the main aim of this study is to assess if gingival crevicular blood (GCB) is as efficient as capillary finger prick technique in estimating the glycemic status. **Methods:** A total of 48 patients participated in the clinical study. All of them were seeking dental check-up or treatment at Department of Periodontology, Government Dental College, Jammu. Probing was done until a sufficient amount of blood appeared in the gingival crevice. Accu -Check Instant S Meter, Roche Diabetes Care India Pvt Ltd. **Results:** The Gingival crevicular blood(GCB), Capillary finger prick blood (CFB) glucose value ranged between 82 and 299 mg/dl with mean value being 145.25±38.12 and the CFB glucose value ranged between 83 and 289 with a mean value of 138.88±51.243. Pearson's correlation coefficient showed a positive correla¬tion between GCB and CFB. **Conclusion:** It is be concluded that GCB may serve as a potential source for screening of blood glucose during routine periodontal examination in populations with an unknown history of DM. Thus, with minimal cost and time investment dental professionals can play a critical role in diagnosis of DM.

Keywords: Diabetes Mellitus, Gingival Crevicular.

INTRODUCTION

Diabetes mellitus (DM) is clinically and genetically heterogeneous group of disorders affecting the metabolites of carbohydrates and proteins, and resulting from defects in insulin secretion, action, or both.[1,2] The increasing prevalence of obesity and physical inactivity due to population growth, aging, urbanization has prompted the rise in the incidence of diabetes mellitus (DM). The preva¬lence of DM for all age groups worldwide was estimated to be 2.8% in 2000 and 4.4% in 2030.[3] The countries with the largest number of people with DM will be India, China, and the United States by 2030. It is estimated that every fifth person with DM will be an Indian.[4] Because of these sheer numbers, the economic burden due to diabetes in India is among the highest in the world.[4]

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Diabetes has emerged as a major healthcare problem in India. About half of the diabetic patients are undiagnosed, as diabetes mellitus (DM) is asymptomatic in its early stages.[5] It is a complex metabolic disorder.[6] DM significantly impacts the periodontium producing a number of effects including change in subgingival microbiota, gingival crevicular fluid glucose levels, periodontal vasculature, host response (neutrophil chemotaxis defects), and collagen metabolism.[6] In fact, periodontitis is considered as the sixth complication of DM.[7]

About half of diabetic pa¬tients are undiagnosed, as DM is asymptomatic in its early stage and can remain undiagnosed for many years.[5] Screening for type 2 DM would alone lead to earlier recognition of cases, with the potential to intervene earlier in the disease course. Early diagnosis may prevent long term complications.[5] Diabetes is fast gaining the status of a potential epidemic in India with >62 million individuals with diabetes currently diagnosed with the disease.[8] However, most of these cases usually remain undetected at early stage increasing

the potential complications of diabetes mellitus in later stages.[8]

Diabetes and periodontitis interact in a bidirectional manner.[9] Therefore, there is a need to screen patients for diabetes in dental clinics. Glucometers are reliable, rapid, and commonly used for blood glucose determination in diabetes screening. Development of an intraoral blood sampling technique could make such tests even more suitable for use by dental practitioners. Since the dental clinicians are often encountered with patients with diabetes in day-to-day practice, a noninvasive manner of blood glucose estimations are often necessary in routine dental practice. Although various blood glucose estimation test are available such as conventional laboratory blood glucose estimation, glycated hemoglobin estimation, and oral glucose tolerance test, most of them are complex, time taking, and invasive procedures.[10] Hence, the screening for diabetes in the dental office is usually accomplished through analysis of patient's history, symptoms, and the conventional laboratory methods that may not reflect their current blood glucose status.[11]

Community screening is not a cost-effective approach to screening for DM . It may best be performed in primary care as part of a review of a patient's health.[12] Routine oral examination of patients with periodontal inflammation with or without diabetes produce ample bleeding, which can be used in glucometers for screening DM.[13] Therefore, the main aim of this study is to assess if gingival crevicular blood (GCB) is as efficient as capillary finger prick technique in estimating the glycemic status. Blood glucose levels as measured in capillary fingerstick (standard method) and gingival crevice blood in subjects with gingivitis or periodontitis were used for this comparison.

MATERIALS & METHODS

The study population was recruited from patients visiting the Department of Periodontology, Government Dental College, Jammu. A total of 48 patients (age range, 32 to 68 years) with gingivitis or periodontitis, at least one site with positive bleeding on probing (BOP), were randomly selected for the study. 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. Consent forms were duly signed by the participants. The protocol was reviewed and approved by the institutional ethics and research committee.

A total of 48 patients participated in the clinical study. All of them were seeking dental check-up or treatment at Department of Periodontology, Government Dental College, Jammu. The patients presented with increased probing depth and attachment loss, periodontitis. The usual exclusion criteria for blood glucose determination applied. After briefing on the procedures and potential risks and benefits, patients gave their written consent for participation. All of the patients were aware of suffering from diabetes, 4 had type 1, and 8 type 2 diabetes mellitus. Periodontal examination included measurement of probing depth, attachment level, and bleeding on probing. A site with more profuse bleeding was chosen for collecting the gingival crevice blood (GCB) sample. The area was isolated with cotton rolls to prevent saliva contamination and dried with compressed air. Probing was repeated until a sufficient amount of blood appeared in the gingival crevice. Accu -Check Instant S Meter, Roche Diabetes Care India Pvt Ltd. was used according to the manufacturer's recommendations. Unlike common amperometric strips, the strip uses an osmium-based mediator that reacts at a very low electrochemical potential. The device requires only a droplet of 0.3 µl for accurate determination of blood glucose and is particularly recommended for off-finger glucose testing. Immediately before measuring glucose levels in GCB, a capillary fingerstick blood (CFB) sample was drawn from the right index finger using a disposable sterile lancet.

GCB was estimated using a glucometer, after isolating the area with cotton roll to reduce the contamination of the sample with saliva, the site with maximum bleeding on probing was selected, and sample was collected by directly placing the glucometer with the detection strip in the bleeding site. Capillary finger prick blood (CFB) was tested with glucometer by pricking the finger with a lancet.

RESULTS

A descriptive statistical analysis has been carried out in the present study. Results of continuous measurements are presented as mean±standard deviation (SD) (min–max) and results of categorical measurements are presented as number (%). 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. A total of 48 participants were included in the study in the age group 30–70 years with a mean age being 46.69 ± 7.8, and the mean probing pocket depth was 5.47 ± 0.4 [Table 1]. The Gingival crevicular blood(GCB), Capillary finger prick blood (CFB) glucose value ranged between 82 and 299 mg/dl with mean value being 145.25±38.12 and the CFB glucose value ranged between 83 and 289 with a mean value of 138.88±51.243 [Table 2].

Pearson's correlation coefficient showed a positive correlation between GCB and CFB [Table 3]. The linear relationship between GCB and CFB was

drawn graphically in a scatter plot. A r-value of 0.977 shows a very strong correlation between CFB and GCB, which was statistically highly significant (P<0.0001).

Table 1: Mean age and probing pocket depth of the selected population.

	n	Maximum	Minimum	Mean±SD
Age	48	68	32	46.69 ± 7.8
Probing pocket depth	48	8	4	5.47 ± 0.4
SD: Standard deviation				

Table 2: Mean Glucose (mg/dl) in gingival crevicular blood and capillary finger prick blood

Variable	n	Range	Mean±SD
GCB Glucose (mg/dl)	48	82-299	145.25±38.12
CFB glucose (mg/dl)	48	83-289	138.88±51.243
GCB: Gingival crevicular blood, CFB: Capillary finger prick blood, SD: Standard deviation			

Table 3. Pearson's correlation between, Gingival crevicular blood (GCB), Capillary finger prick blood (CFB) glucose

Glucose (mg/dL)	Pearson's correlation	P-value
CFB vs. GCB	0.977	<0.0001*

DISCUSSION

The American Academy of Periodontology recently stated in a position paper on diabetes and periodontal disease: "Glucometers are commonly used by diabetic patients for home monitoring of their blood glucose levels using a single drop of blood from a fingerstick. This procedure is of interest to the dental practitioner since it is simple, relatively inexpensive, and of sufficient accuracy to serve as an inoffice screening device for patients suspected to have diabetes, and to monitor blood sugar levels of known diabetics".[14]

Diabetes mellitus now has become a major burden on the all health-care facilities throughout the world. According to the WHO, an estimated 347 million people in the world had diabetes in 2008, and India had 69.2 million people living with diabetes (8.7%) as per the 2015 data. Of these, it remained undiagnosed in >36 million people.[8] DM is a complex metabolic disorder. Periodontitis is considered as the sixth complication of DM.[7] Data has shown that the prevalence of the DM is greater among individuals with periodontitis than healthy individuals. Adequate blood is extravasated from the gingival crevice during routine oral examination in dental clinics. With regard to the significance of early detection of DM and the need for an easy and quick method for screening for DM, we planned to use this extravasated blood from the gingival crevice for estimation of the blood glucose level using SMD.

Periodontal inflammation with or without the complicating factor of diabetes mellitus is known to produce ample extravasated blood during diagnostic procedures.[15] This excess amount of crevicular blood oozed during periodontal diagnostic procedure might be used as an excellent, alternative, chair-side, and noninvasive source of blood glucose estimation using Glucometer in periodontal patients. It could also be used for screening of diabetes mellitus in suspected population having periodontal disease. Although conventional laboratory blood glucose measurement is still considered to be the gold standard in diagnosing the diabetes mellitus or determining the blood glucose status, self-monitoring glucose device (Glucometer) Often provides a rapid, chair-side, less traumatic mode of determining blood glucose status in the patients.[16]

The results of the present study are in agreement with the study conducted by Shetty et al.[17] The present study included both diabetic and nondiabetics patients, and the results obtained in this study is similar to the study conducted by Parker et al.[18] and Beikler et al.[19] where they said a strong correlation was observed between blood glucose measured in GCB and CFB when diabetic and nondiabetic patients with moderate-to-advance periodontitis were examined. Strauss et al. reported that GCB samples are suitable to screen for DM in individuals with sufficient BOP.[20] However, they failed to give results in individuals with little or no BOP. Sarlati et al.[21] reported that GCB is useful for testing blood glucose during routine periodontal examination in subjects with DM and periodontitis, but not in those without DM. The present study reiterates the results by Parker et al.[22] nd Beikler et al. : a strong correlation was observed between blood glucose measured in GCB and CFB when diabetic and nondiabetic patients with moderate to advanced periodontitis were examined.[19] Khader et al. reported that GCB can be an acceptable source for measuring the blood glucose level.[23] In contrast to the above study, Muller and Behbehani failed to obtain any correlation between GCB and CFB.[24]

However, most of the recently developed glucometer devices require very small amount of blood (2–3 μl blood as low as 1 μl), and the results were usually obtained within 5 s.[2] Hence, Glucometer could be used for monitoring the blood glucose during treatment or as a screening tool, but confirmation should only be based on venous plasma glucose estimation in the laboratory.[16]

ADA recommended that the prediction error of blood glucose monitoring devices falls within 15% of laboratory standard; however, clinically, analytic precision to 20% is considered acceptable.[2] The results of the present study revealed a higher correlation between GCB and CFB with a smaller sample size. A large study sample should be able to demonstrate robustness in the correlation between GCB and CFB.

From the above discussion, it can be concluded that GCB may serve as a potential source for screening of blood glucose during routine periodontal examination in populations with an unknown history of DM. This study sheds light on the screening of individuals not suspected of DM, using GCB blood samples. Thus, with minimal cost and time investment for patients and clinicians, dental professionals can play a critical role in supporting their patients' overall health. The technique is safe, easy to perform, and comfortable for the patient.

CONCLUSION

With the alarming rise of diabetes mellitus as global epidemic disease and its association with periodontal disease and other systemic complications, GCBG estimation through Glucometer could be used as a reliable, effective. Noninvasive, chair‐side mode of estimating, monitoring, and/or screening diabetes mellitus in periodontal populations.

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How to cite this article: Kumar A, Khairat RA, Kotwal B. Effective and Affordable Method of Screening for Diabetes Mellitus Using Gingival Crevicular Blood. Ann. Int. Med. Den. Res. 2019; 5(3):DE24-DE27.

Source of Support: Nil, **Conflict of Interest:** None declared