Original Article

Estimation of Blood Glucose levels from GCF in patients with or without Diabetes Mellitus

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Abstract:

Background: Diabetes Mellitius is a common finding in medical history of patients receiving treatment for periodontal disease. The incidence of diabetes is on the rise worldwide. Virtually every dentist and especially the periodontist are likely to encounter an increasing number of undiagnosed diabetic patients. The conventional laboratory methods employed to detect blood glucose are time consuming and require elaborative equipments. The advent of blood glucose monitors allows the clinician to detect blood glucose at chair side. **Materials & Methods:** The use of gingival capillary blood as a marker for blood glucose estimation using glucometer against the conventional laboratory method has been assessed in 30 periodontitis patients, 50 diabetic and 50 non diabetic patients (control). **Results:** The significant correlation (r= 0.93, p<0.001) was found between gingival crevicular blood glucose levels and capillary finger stick blood glucose levels in diabetics and non- diabetics [Group B & C]. **Conclusion:** The result suggests that Gingival Crevicular blood is an efficient diagnostic tool for estimation of blood glucose levels in patients with or without diabetes mellitus. **Key Words:** Blood glucose, Diabetes mellitus, GCF, Periodontitis.

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Introduction

Diabetes mellitus is one of the most common chronic diseases that affects mankind and is associated with considerable morbidity and mortality. Diabetes mellitus affects more than 120 million people worldwide, and it is estimated that it will affect 220 million by the year 2020.[1]

The literature provides consistent evidence of greater prevalence and severity of periodontal disease in diabetics, both types 1 and 2. Periodontal diseases can have a significant impact on the metabolic state in diabetes. The presence of periodontitis increases the risk of worsening of glycemic control over time.[2] Periodontitis is

considered to be one of the pathognomic oral warning signs and is designated as the sixth complication of Diabetes mellitus.[3]

In 1998, the World Health Organization adopted the diagnostic parameters for diabetes established by the American Diabetes Association. Measuring the fasting blood glucose is considered to be the gold standard for diagnosing these patients.[4]

These conventional laboratory methods employed to detect blood glucose are time consuming, invasive 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 decide if further confirmatory tests are required to diagnose diabetes.

Recently there has been an increasing evidence of research carried out to use gingival crevicular blood in monitoring blood glucose levels. 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 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.[5]

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 Method
Patient Selection:
Patients reporting to the outpatient department of Oral medicine and Radiology, Swami Devi Dyal Dental College & General Hospital with Diabetic Centre age ranging 20 -70 from were selected for the study after obtaining informed consent. The patients were divided into 3 groups.

Group A: 30 patients, 13 males and 17 females with un-treated moderate to severe periodontitis.

Group B: 50 diabetic patients, 20 females and 30 males selected from a list of diabetic patients, monitored regularly at General Hospital with Diabetic Centre.

Group C: 50 non-diabetic patients, 32 females and 18 males randomly selected from individuals attending the Department of Oral medicine and Radiology, Swami Devi Dyal Dental College

The approval from the ethical committee of the institution was obtained regarding the study.

Inclusion criteria:
- Patients 20-70 years of age.
- Patients diagnosed with moderate to severe periodontitis with and without Diabetes Mellitus

Exclusion criteria:
- Any indication for antibiotic prophylaxis
- Any bleeding disorder
- Severe systemic diseases such as cardiovascular, renal, hepatic, immunologic, or hematological disorders.
- Any medication interfering with the coagulation system.

Clinical and Laboratory Assessments:
Data was collected by the same qualified examiner trained through standardized procedures for making the required measurements. The device was calibrated prior to the study. 30 patients with periodontitis [Group A] were examined intraorally for visual signs of periodontal inflammation. Areas with marked signs of

inflammation were probed by a Williams probe, inserted into the gingival sulcus, as is commonly done during a periodontal examination. When the probe was removed, the gingival crevice was observed for bleeding. Bleeding gingival sites were determined and two sites with profuse bleeding on probing with access for the glucose self-monitoring device were chosen for testing Gingival Crevicular Blood Glucose (GCBG). These areas were isolated with cotton rolls to prevent saliva contamination and dried with compressed air. Probing was repeated until sufficient amount of blood appears in the gingival crevice. The two selected areas were analyzed using the glucometer (ACCU-CHEK Active, Roche Diagnostics, USA), according to the manufacturer's instructions. The top edge of the reagent strip of glucometer is 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.

Fifty diabetic [Group B] and 50 non-diabetic [Group C] patients underwent routine laboratory measurement of fasting plasma glucose (FPG) levels. These patients after a meal were subjected to periodontal examination using the same method, and only one site with bleeding on probing was selected for testing GCBG. Immediately after measuring GCBG, capillary finger stick blood glucose (CFBG) was assessed using the same glucose self-monitoring device. The fingertip of fourth finger on the left hand was wiped with surgical spirit and was allowed to evaporate. The sample was drawn on the lateral surface of the fourth digit since it will have thinner epithelium and also it is a finger of lesser use. The hand is held down and the finger tip is gently massaged (but not squeezed) to obtain a round drop of blood. The first drop of blood was wiped away and the second drop was used. This may reduce the risk of an inaccurate result, should the

sample contain excess tissue fluid or alcohol used to clean the finger. The blood glucose levels of gingival crevicular blood (GCBG), finger stick blood (CFBG) and the venous blood (FPG) of all patients were documented.

Statistical Analysis:
The glucose values obtained from gingival capillary blood, finger-stick blood, and venous blood from laboratory method were analyzed using SPSS statistical package.

The correlation between blood glucose measurement pairs of patients with periodontitis was determined by calculating intra class correlation coefficient (ICC). In other two groups of the study, Pearson's rank correlation was used.

Results
1. Patients with periodontitis [Group A] include 13 males and 17 females with a mean age of 51.46 ± 12.20 years old. The paired GCBG samples of periodontitis patients revealed an intra class correlation coefficient of 0.98 (p=0.001).[Fig.1]
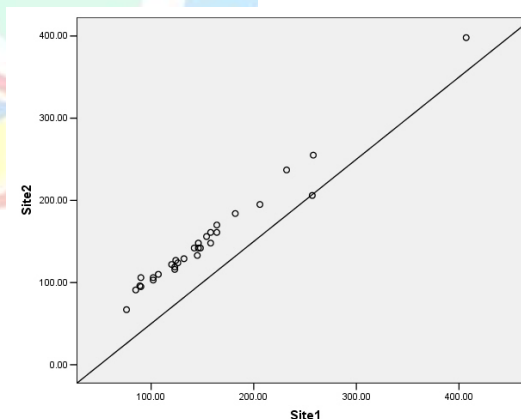
Figure 1: Scattered representation of paired GCBG values (mg/dl)

2. Diabetic patients [Group B] included 20 females and 30 males with a mean age of 50.38 ± 10.25 years old. Their mean blood level at fasting blood was 148.22 ± 42.04, capillary finger stick blood was 221.42 ± 66.14 and gingival crevicular blood was 207.14 ± 69.71. A statistically

significant correlation (p=0.001) was found between CFBG and FBG (r=0.798); GCBG and FBG (r=0.736) and GCBG and CFBG (r=0.949) .

3. Non- diabetic individuals (control group) [Group C] included 32 females and 18 males with a mean age of 48.34±13.99 years old. Their mean glucose level at fasting blood was 98.08±27.44, capillary finger stick blood was 135.22±49.88 and the gingival crevicular blood was 119.46±41.90. A statistically significant correlation (p=0.001) was found between CFBG and FBG (r=0.783); GCBG and FBG (r=0.784) and GCBG and CFBG (r=0.93).

Discussion

Diabetes has emerged as a major health problem in India. According to International Diabetes Federation every fifth diabetic in world would be an Indian by year 2025. It is important to appreciate that these disorders do not initiate periodontitis but they may predispose accelerate or otherwise fasten its progression. About one third of type 2 cases are undiagnosed and screening for undiagnosed type 2 DM is highly recommended.[6] The American Diabetes Association recommends that screening for diabetes should start at age 45 years and be repeated every 3 years in persons without risk factors, and earlier and more often in those with risk factors for diabetes. Moreover, testing at younger age or more frequently should be carried out in individuals who are (a) obese, (b) have a 1st-degree relative with diabetes, (c) are members of a high-risk ethnic population, (d) have delivered a baby weighing 4.05 kg or have been diagnosed with gestational diabetes mellitus, e) are hypertensive (>140/90), (f) have an HDL cholesterol level <35 mg/ dl and/or a triglyceride level >250 mg/ dl, (g) had on previous testing an impaired glucose tolerance or an impaired fasting glucose.[7]

The primary methods used to diagnose diabetes mellitus and monitor blood glucose levels have traditionally been fasting blood glucose, a combination of fasting blood glucose with a 2-hour test after glucose loading (2-hour post-prandial) and oral glucose tolerance test.[8]

These tests require fasting by the patient, tend to be highly dependent on patient compliance, and results usually will only be available at subsequent visit (second appointment). Thus, more than one appointment is usually needed to assess the glycemic status and make necessary therapeutic decisions. It may be more convenient for the dental surgeon to obtain blood sample from the gingival site. Stein and Nebbia [9] 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. Tsutsui *et al.*[10] reported the rubbing of blood onto the test strip from a blood-laden dental curette.

Rubbing or direct wiping of intra-oral blood on to the test strip will not produce a uniformly timed reaction and may damage the strip's chemical indicator surface.[11] Also, significant contamination may occur from saliva and oral debris present at the wiped gingival area or from plaque and crevicular fluid on the dental curette from its entry into the gingival sulcus. American Diabetes Association in their consensus statement on blood glucose monitoring (1987)[12] 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* [11] 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,*[13] 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. Estimation of Gingival Crevicular blood glucose level can be done as an in-office screening procedure. The advantages of this method are it is safe, reliable, easy to perform, inexpensive, comfortable for patients, non- invasive, painless and convenient for the dentist.

In this study, ACCU-CHEK Active, Roche Diagnostics, USA is the glucometer used to measure the glucose levels in the blood which oozes out during routine probing. Measuring blood glucose with a glucometer is very sensitive since it can provide results with 2-3µl of blood within 10 seconds. It is a less time consuming procedure and does not require any additional tools like sharp lancet for puncture.

The main controversial issue is the reliability of glucometer, as they may show large deviations. The results this study showed that there was a highly significant correlation (ICC: 0.98) between subsequent measurements of glucose concentrations in gingival crevicular blood samples of two sites of profuse bleeding on probing, and therefore, the device is reliable. [Group A- moderate to severe periodontitis]

In this study, significant correlation (r= 0.93, p<0.001) was found between gingival crevicular blood glucose levels and capillary finger stick blood glucose levels in diabetics and non- diabetics [Group B & C] Fasting blood glucose is always considered the gold standard. Considerable correlation (r=0.75, p<0.001) was found between levels of gingival crevicular blood glucose and fasting blood glucose both in diabetic patients and the normal population. [Group B & C] The results of our study are consistent with Beikler et al.[13], and Parker et al. [11] and Tsutsui et al.[10] In our study, sample was collected from the capillaries on 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. This method cannot be applied in cases where purulent exudates are found in pockets. This results in dilution of the blood sample and alteration of glucose levels.

Conclusion

Considering the correlation between gingival crevicular blood glucose and the other two standard methods for glucose estimation in diabetic and normal individuals, it is evident that the blood obtained during routine periodontal probing can be used for estimation of blood glucose levels. Hence, gingival crevicular blood is an efficient diagnostic tool for estimation of blood glucose levels in patients with or without diabetes mellitus. The technique described is safe, easy to perform, repeatable, comfortable for the patient, cost effective, and might therefore help to increase the frequency of diabetes screening in dental office.

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