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SCREENING OF ELEVATED GLUCOSE LEVELS USING NOVEL, SENSITIVE SELF-MONITORING DEVICE

Dental Science

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ABSTRACT

Blood glucose levels of patient are an important concern for the successful periodontal therapy and stabilization of blood glucose to a near normal range is very important consideration for surgical as well as non- surgical therapy. Sixty patients in the age group of 35-65 years of either sex with type II diabetes mellitus and periodontal disease were selected. Venous blood was used as a control group, whereas finger- prick blood and gingival crevicular blood constituted the study groups I and II respectively. Blood samples were tested in glucometer to check the blood glucose level. The values obtained by glucometer exhibited significant correlations among each other, but the blood glucose values obtained using venous bloodsamples were higher than that of finger prick blood samples followed by gingival blood samples. Hence gingiva can be used as an alternative site to check blood glucose and gingival wound healing is definitely better than finger prick healing.

KEYWORDS

Glucose levels, Periodontitis, Glucometer.

INTRODUCTION

World health organization (WHO, 1948) defines health in the permeable of its constitution as “a state of complete physical, mental and social well- being and merely an absence of disease and infirmity.” The most common chronic diseases like cardiovascular diseases, chronic obstructive pulmonary disease and diabetes type II are linked by common and predictable biological risk factors[1] and account for about 40% of the global burden of disease and by year 2020, their contribution is expected to rise 60%. Among all these chronic diseases, the incidence of diabetes mellitus has been increasing rapidly.

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both.[2,3] Incidence of diabetes in India is estimated to be 20.2 per 1000 persons and prevalence rate is 12.1 % in adults.Diabetes mellitus is associated with a wide range of complications, such as retinopathy, nephropathy, neuropathy, micro- and macrovasculardisease, altered wound healing,[4]In the early 1990s periodontitis was sometimes referred to as the 'sixth complication of diabetes,[5,6] and in 2003 theAmerican Diabetes Association acknowledged that periodontal disease is often found in people with diabetes.Despite the association between periodontitis and uncontrolled blood glucose, dental practitioners do not routinely screen periodontal patients for diabetes. However, Strauss et al.[7] has estimated that 93.4 percent of patients with periodontitis should qualify for diabetes screening.

Considering the close association of elevated blood glucose levels and the severity of periodontitis, periodontist and other dental practitioners are uniquely positioned to monitor blood glucose levels or other biomarkers to detect undiagnosed diabetic and pre-diabetic patients to prevent long term complications.[8]The successful periodontal therapy in diabetic patients must include the stabilization of blood glucose to a near normal range.[9]

Over the past several years, several methods have been developed to measure glucose level in biological fluids, but the search for more specific, sensitive, non – invasive and simple method is still going on. Since centuries, the clinicians are sending venous blood, or urine samples for determining glucose levels to clinical biochemistry laboratories.

In 1998, the World Health Organisation adopted the diagnostic parameters for diabetes established by the American Diabetes Association for measuring the fasting blood glucose which is considered to be the gold standard for diagnosing diabetes patients, butthese methods are time consuming, painful and require elaborative equipment. So, the advent of blood glucose monitors allows the clinician to assess blood glucose at the chair side in which results are obtained instantaneously, incontrast to laboratory method, which helps the clinician to decide if further confirmatory tests are required to diagnose diabetes or to proceed for the further periodontal treatment. Monitoring their blood glucose during their office visit may be a better alternative,[10]preferably it should be a chair side technique and estimate the sugar level at the time of treatment.

Self-monitoring devices provide a simple method for rapid monitoring of the glucose level in blood by utilizing a blood sample from the finger but requiring a needle puncture of the skin to obtain a drop of blood. With regard to the development of painless and non-invasive methods to measure blood glucose, considerable effort has been made in the past few years. However, until now, no such methods are in routine clinical practice. To overcome all these drawbacks, the oozing blood from the gingival crevice during periodontal probing thus may allow a non-invasive or minimally invasive monitoring of blood glucose.Also, the results are obtained instantaneously which helps the clinician to decide if further confirmatory tests arerequired to diagnose diabetes.

It is possible that gingival crevicular blood may be an excellent source of blood for glucometric analysis.[7] Using the technology of portable glucose monitors as routine probing during a periodontal examination generates ample amount of blood and is less traumatic compared to finger-puncture with a sharp lancet, these devices may actually allow for painless testing of blood oozing from gingival crevices of patients with periodontal problem during routine periodontal examination and could be simple and relatively inexpensive in – office screening device for any patient suspected to have diabetes. They can also be used to examine the blood glucose levels in known diabetes.

Hence the present study was being conducted to compare the efficacy of glucose level among venous, finger prick and gingival blood samples in type II diabetic patients with periodontal disease in Himachal ethnic population.

MATERIALS AND METHOD

The present study populaceincorporated patients with type II diabetes mellitus with periodontal diseases from the Out Patients Department of Periodontology, Himachal Dental College, Himachal Pradesh. Ethical authorization was taken from institutional ethics committee (IEC). Patients were explained about the procedure to be performed and an informed consent was taken. 60 periodontal patients of age group 35-65 years of either sex with type II diabetes mellitus were included. Detailed medical and dental history of all the patients was taken.Patients having indication for antibiotic prophylaxis, severe systemic diseases for instance cardiovascular, renal, hepatic, immunologic, or hematological disorders or any medication inquisitivethrough the coagulation system and current treatment for anemia, polycythemia, gout, dialysis, or any other disorder that can cause an abnormally high or low hematocrit were excluded.

The procedure included 3 groups: 1 control group and 2 test groups. In the patients having Type II diabetes mellitus with periodontal disease blood samples were taken from three sites; venous site, finger site and gingival crevicular site. Blood sample taken from venous site was included in control group and blood sample taken from finger and gingival crevice was taken as experimental group I and II respectively.

DESCRIPTION OF THE PROCEDURE:

CONTROL GROUP

Venous blood sample was drawn from the patient's antecubital fossa with the help of disposable syringe. A tourniquet was tied around the patient's arm about 3" to 4" (7.5cm to 10 cm) above the venipuncture site. The vein was tapped with index finger to encourage dilation and the area was disinfected with an alcohol wipe with a circular motion. One drop of venous blood from disposable syringe was transferred on the test stripwhich was pre-loaded in the glucometerand the results were obtained within 10 seconds.

TEST GROUP I:

The finger tip of the fourth finger on the left hand was wiped with surgical spirit and was permitted to dry and then punctured with a sterile lancet. The first drop of blood was wiped away, and the second drop was used. Blood sample was drawn on the test strip which was pre-loaded in the glucometer and finger prick blood glucose level(FPBGL) readings was recorded at the same time.

TEST GROUP II:

Patients were asked to rinse with Chlorhexidine mouthwash before the collection of gingival crevicular blood glucose level. The site with more inflammation was selected and thenisolated with the help of cotton rolls. Bleeding was induced by UNC-15 periodontal probe until a sufficient quantity of blood (2-3µl) was collected by glass pipette. The Glucometer monitoring device was loaded with the active test strip. The blood drop from pipette was transported to test strip of glucometer and the results were recorded.

The values recorded from all the three methods put for statistical analysis.

STATISTICAL ANALYSIS:

Mean values and standard deviation of all the three groups was calculated. To compare the mean values of gingival blood glucose levels and capillary blood glucose levels between the test groups and control group, Student's independent t-test and Karl Pearson's product–moment correlation were used. For all the comparisons, P-value of0.05 or less was intended for statistical significance.

Table 1 shows intergroup comparison of 60 patients of test group I and control group (Graph I).

For test group I, the mean value was found to 214.17 ± 81.91 and for control group, the mean value was 213.42±84.33.

The t value was 0.048 and the p value was 0.481which was found to be statistically non – significant ($p \leq 0.05$).

Table 2 shows intergroup comparison of 60 patients of test group II and control group (Graph II).

For test group II, the mean value was found to 213.57± 80.41 and for control group, the mean value was 213.42±84.33.

The t value was 0.009and the p value was 0.496which was found to be statistically non-significant ($p \leq 0.05$).

Table 3 shows intergroup comparison of 60 patients of test group I and test group II (Graph III).

For test group I, the mean value was found to 214.17 ± 81.91 and for test group II, the mean value was 213.57± 80.41.

The t value was 0.039 and the p value was 0.484 which was found to be statistically non-significant ($p \leq 0.05$).

RESULTS:

As P-value of 0.05 or less was taken to see the significant results. It was observed that the result was not statistically significant between control group and test group I, control group and test group II and between test group I and test group II.

Next the Pearson correlation coefficient Rwas counted to measure the strength and course of the relationship among two variables. The R value between control group and test group I was 0.989, the R value between control group and test group II was 0.988 and the R value between two test groups was 0.998 and it shows a strongly positive co-relation which means that high X variable scores go with high Y variable and vice versa.

The present study was undertaken in the Department of Periodontology, Himachal Dental College, Sundernagar, Distt. Mandi (H.P.)to diagnose the efficacy of gingival crevicular blood, venous blood and finger- prick blood for assessment of blood glucose levels in type II diabetic patients.

The study included 60 patients within the age group of 35-65 years of either sex for the proposed study were selected.

All the patients divided into three groups: control group, test group I and test group II and readings were recorded.

Control group: venous blood
Test group I: finger-prick blood
Test group II: Gingival crevicular blood

Periodontal examination was performed for assessment of clinical parameters and all patients were subjected to the following parameters.

1. Gingival index (GI)
2. Clinical attachment loss (CAL)

The data thus collected was subjected to statistical analysis. The results thus obtained are shown in table 1-4 and graphs I-III.

The following results were observed:-

1. COMPARISON OF TEST GP I AND CONTROL GROUP

Table 1 shows intergroup comparison of 60 patients of test group I and control group (Graph I).

For test group I, the mean value was found to 214.17 ± 81.91and for control group, the mean value was 213.42±84.33.

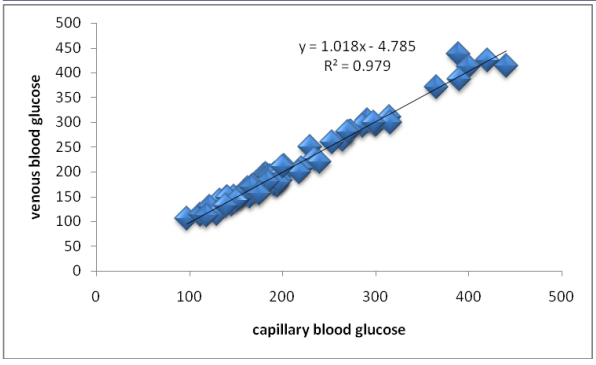
The t value was 0.048 and the p value was 0.481which was found to be statistically non – significant ($p \leq 0.05$).

TABLE 1: INTER GROUP COMPARISON OF TEST GP I AND CONTROL GROUP

SD- Standard Deviation, P<0.001- Highly Significant (HS), P≤0.05 Significant, P≥0.05- Non-significant (NS)

Graph I: Regression line and scatter plot of linear relationship between test group I (capillary blood glucose level) and control group (venous blood glucose level)

	MEAN ±S.D.	t-VALUE	p- VALUE	SIGNIFICANCE
TEST GROUP I CONTROL GROUP	214.17±81.91 213.42±84.33	0.048	0.481	NS



2. COMPARISON OF TEST GP II AND CONTROL GROUP

Table 2 shows intergroup comparison of 60 patients of test group II and control group (Graph II).

For test group II, the mean value was found to 213.57± 80.41 and for control group, the mean value was 213.42±84.33.

The t value was 0.009and the p value was 0.496which was found to be statistically non-significant (p≤0.05).

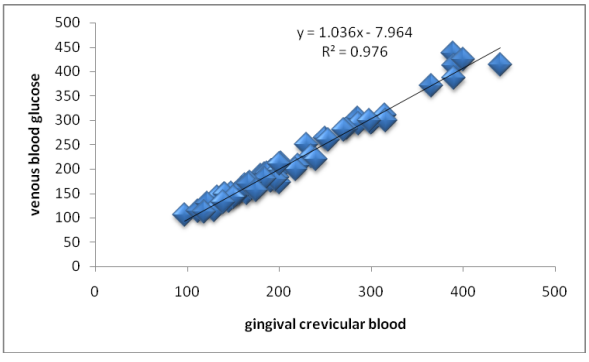
TABLE 2: COMPARISON OF TEST GP II AND CONTROL GROUP

SD- Standard Deviation, P<0.001- Highly Significant (HS), P≤0.05 Significant, P≥0.05- Non-

	MEAN ±S.D.	t- VALUE	p- VALUE	SIGNIFICANCE
TEST GROUP II CONTROL GROUP	213.57±80.41 213.42±84.33	0.009	0.496	NS

significant (NS)

Graph II: Regression line and scatter plot of linear relationship between test group II (gingival blood glucose level) and control group (venous blood glucose level)



3. COMPARISON OF TEST GP I AND TEST GROUP II

Table 3 shows intergroup comparison of 60 patients of test group I and test group II (Graph III).

For test group I, the mean value was found to 214.17 ± 81.91 and for test group II, the mean value was 213.57± 80.41.

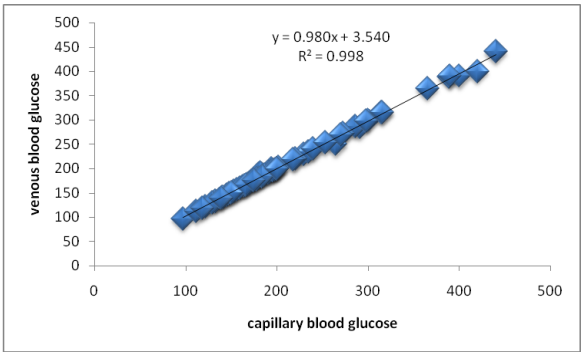
The t value was 0.039and the p value was 0.484which was found to be statistically non-significant (p≤0.05).

TABLE 3: COMPARISON OF TEST GP I AND TEST GROUP II

	MEAN ± S.D.	t- VALUE	p- VALUE	SIGNIFICANCE
TEST GROUP I TEST GROUP II	214.17 ± 81.91 213.57± 80.41	0.039	0.484	NS

SD- Standard Deviation, P<0.001- Highly Significant (HS), P≤0.05 Significant, P≥0.05- Non-significant (NS)

Graph III: Regression line and scatter plot of linear relationship between test group I (capillary blood glucose level) and test group II (gingival blood glucose level)



4. Karl Pearson's product–moment correlation (R) for all groups

The Pearson correlation coefficient R was counted to measure the strength and direction of the relationship between two variables. The R value between control group and test group I was 0.989, the R value between control group and test group II was 0.988and the R value between two test groups was 0.998 and it shows a strongly positive co-relation (Table 4).

Table 4: Karl Pearson's product–moment correlation (R) for all groups

	Correlation (R)
Control group and test group I	0.989
Control group and test group II	0.988
Test group I and test group II	0.998

Shows a strongly positive co-relation.

DISCUSSION:

Diabetes Mellitus is a complex metabolic disorder characterized by hyperglycemia resulting from defect in insulin secretion, insulin action, or both.[3]In 1997, the International Expert Committee classified diabetes into Type 1, Type 2, other specific type, and gestational DM. In India, DM is one of the major diseases of concern as the incidence rate of DM is increasing at an alarming rate.[11] Diabetes mellitus and periodontitis seem to interact in a bidirectional manner.[12] Patients with diabetes mellitus have more possibility for periodontal disease and vice a versa.[13]Use of gingival crevicular blood for detection of blood sugar level has been documented in literature as far back as 1969.[14] In the present study, a high correlation and a marked relationship was found between GCB and FPB which is in accordance with the earlier studies done by Shetty N, Shetty S, Parker and Strauss.[7]Muller and Behbehani failed to provide any evidence for the usefulness of GCB for testing blood glucose during a routine periodontal examination.[15]

Khader et al[16] suggested that GCB can provide an acceptable source of measuring blood glucose level, but the technique to obtain an acceptable blood sample from gingival crevices is not always feasible, which would limit its application as a clinical practice. The strong correlation obtained in the present study on comparison between the various blood glucose measurements indicates the feasibility of using gingival crevicular blood as an alternative to the Finger prick blood in accordance to the previous studies. On analysis of our study, finger prick capillary blood glucose showed a slightly higher mean value than gingival crevicular blood glucose mean value, this may be due to contamination of gingival crevicular fluid which dilutes the glucose concentration producing lower measurements in gingival crevicular blood.

From the present study, it was concluded that GCB can be used as a diagnostic tool for measuring blood glucose level in diabetic patients. Though GCB collection has some limitations, if we collect GCB with caution during periodontal diagnostic examination it will be an excellent source of blood for glucometric analysis in future.

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