Original Article

Assessment Of Bidirectional Relationship Between Diabetes And Chronic Periodontitis By Evaluating Blood Glucose Levels Using Sulcular And Venous Blood In Chronic Periodontitis After Non-Surgical Periodontal Therapy - A Cross Sectional Study

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Abstract

Background: Diabetes and chronic periodontitis (CP) act as bidirectional manner. Dental office DM screening could result in earlier treatment and possible minimization of serious complications.

Objective: objective of the present study was to compare the efficacy of blood glucose level using conventional venous blood (VB) and gingival sulcular blood (GSB) samples in CP patients having type II diabetes before and after non-surgical periodontal therapy (NSPT).

Material and methods: A total of 250 CP stage I/II patients with type II DM were divided into control (VB) and test (GSB) group. VB and GSB were evaluated for blood glucose level after NSPT at 3 months and compared with baseline.

Results: Mean blood glucose level at baseline for test group was 204.71 ± 82.51 and control group was 203.86 ± 87.78 mg/dl (p=0.41) which was statistically non-significant. Both the VB and GSB was effective to evaluate diabetic status. Blood glucose level before and 3 month after NSPT showed statistically significant difference (p=0.026) for test group and highly statistical significance (p=0.001) for control group. Karl Pearson's product–moment correlation (r) for 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 and test group was 0.98 at baseline and 0.99 at 3 months. It shows a strongly positive co-relation.

Conclusion: Diabetes and chronic periodontitis has a bi-directional relation. Periodontal therapy helps to maintain better blood glucose level. Successful periodontal maintenance is also dependent on diabetic status of the patient.

Introduction

Diabetes mellitus (DM) constitute one of the crucial chronic health issues faced by the community today [1]. Occurrence of DM in Indian subcontinent is on an abrupt rise and is considered to be 20.2 per 1000 persons with rate of recurrence of 12.1 % in adults [2]. Predictions also showed that in near future 70% of distressed will be a part of the emergent nations. Many times, patients require medical/dental treatments are unaware of their undiagnosed DM. Hence dentist may have an importance by taking part in the pursuit for unknown and symptomless DM patients.

By definition DM is a class of metabolic disorder distinguished by high blood sugar developing from inadequacy in insulin production, effect or both[3].It is connected with a wide scale of problems, such as retinal vascular disease, kidney diseases, brain disease, vascular disease and impaired healing [4]. In the early 1990s periodontal diseases was named as the 'sixth problem of DM [5]. Subsequently, in 2003 the American Diabetes Association accept that periodontitis is frequently seen in the population with DM.

Periodontal diseases are contemplated to be the inflammatory condition of teeth which leads to attachment loss and bone loss. Periodontal infection is very severe in poorly controlled diabetic people with advanced complications [1]. Diabetes and chronic periodontitis (CP) act as bidirectional manner. Cytokines expression in both the condition proves their reciprocal association. The mechanism related with CP seen in diabetic patients is aggregation of AGEs, which influence the phagocytic process of PMNS, enhancing the population of gram-negative anaerobes in sub gingival environment. This will result in the production of various chemicals that leads to reportion of supporting structure and This triggers secretion of various mediators that facilitate connective tissue destruction, bone resorption. Simultaneously CP brings out insulin resistance in tissues, which is responsible for AGEs accumulation [6].

Despite these known association between CP and uncontrolled DM, dental practitioners are largely ignorant in this aspect. Strauss et al. [7] has estimated that 93.4% of CP patients should evaluate for diabetes screening. Early diagnosis of DM however may help to prevent its long term complications. In 1998, the World Health Organisation adopted the diagnostic parameters for DM established by the American Diabetes Association for measuring the fasting blood glucose (FBG). FBG level is considered to be the gold standard for diagnosing diabetes. However, these methods are relatively time consuming, painful and require elaborative lab equipment.Monitoring blood glucose during dental visit may be a better alternative particularly in CP patients [8].Also this can be performed prior to any therapeutic intervention because blood glucose level may increase with stress. So, preferably a chair side technique estimating blood glucose before the commencement of treatmentcan help to make decisions immediately. Also this can help to decide if further confirmatory tests are required or to proceed for the further periodontal treatment.

Periodontal examination in CP comprises of careful probing of periodontal pockets which result in some amount of bleeding from the gingival sulcus. Instead of swabbing and disposing the gingival sulcular blood (GSB), this can be employed to assess blood glucose by glucometer. This allows a minimally invasive chair side monitoring of blood glucose level [9].

Hence, the present study was conducted to compare the efficacy of blood glucose level using conventional venous blood (VB) and GSB samples in CP patients having type II diabetes before and after non-surgical periodontal therapy (NSPT).

Materials and methods:

A total of 250 CP stage I/II patients with type IIDM were selected from the out patients department of periodontology. V Band GSB were used as control and test group respectively. Inclusion criteria for the study were – CP stage I/II patients with type II DM having blood FBS ≥126 mg/dl; patients under oral medication or insulin injection for DM;

age group between 30-65 years; probing pocket depth ≥4 mm, periodontal attachment loss ≥2 mm, CP patients require NSPT. ; Exclusion criteria were - any indication for antibiotic prophylaxis; severe systemic cardiovascular, renal, hepatic, immunologic, or haematological disorders; any medication interfering with the coagulation system; current treatment for anaemia, polycythemia, gout, dialysis, or any other disorder that can cause an abnormally high or low haematocrit; sites with suppuration, tooth mobility; pregnant and lactating mothers; CP cases indicative of surgical intervention.

Patient fulfilling the inclusion criteria were explained in details about the risk, benefits and possible outcome of the intervention and diagnostic tests. Those patients who agreed to participate voluntarily were signed a consent form. The approval for this study protocol was been obtained from the institutional ethical committee and review board.Selected subjects underwent a full diagnostic work up which included: detailed medical and dental history, routine blood investigations - bleeding time, clotting time, hepatitis B surface antigen for hepatitis, enzyme linked immune sorbent assay test for HIV and FBS.

NSPT including complete ultrasonic scaling, curettage, root planning, polishing and Chlorhexidine 0.2% irrigation were performed in all the participants. Thorough oral hygiene instructions were given following NSPT. Blood glucose level were estimated through VB and GSB at baseline prior to NSPT and at 3 months after therapy. Patients under oral medication or insulin injection for DM were instructed to follow the medications as per medical consultant throughout the study period. Additionally Gingival index (GI) [10] and clinical attachment level (CAL) were assessed at baseline and 3 months after NSPT to evaluate the outcome of periodontal therapy.

Estimation of VB glucose level in Control group: 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. The area was disinfected with an alcohol wipe in a circular motion. VB sample was drawn from the antecubital fossa with the help of disposable syringe. One drop of VB from disposable syringe was transferred onto the glass slide and the test strip pre-loaded in the glucometer was touched to the test end of the strip and readings were recorded. This method was performed at baseline and at 3 months.

Estimation of GSB glucose level: Patients were asked to rinse with 0.2% chlorhexidine mouthwash before the collection of GSB. The most inflamed site was selected and was freshly isolated with cotton rolls. Sites with suppuration were excluded from the study. Bleeding was induced by UNC-15 periodontal probe until a sufficient quantity of blood (2-3µl) is obtained. The Glucometer monitoring device was loaded with the active test strip and the test end of the strip was kept on to the bleeding site to obtain the blood sample on the test strip without contacting the gingival palatal tissues. The testing time was about 10 seconds. The value displayed on the monitor was recorded. Same method was performed at 3 months evaluation. Same gingival site was probed and gingival bleeding was initiated for assessment.

Glucometer was standardized by known sugar solution after every 10^{th} reading. The data thus collected was subjected to statistical analysis.

Statistical analysis: The data assimilated was subjected to statistical analysis using statistical package of social science (SPSS Version 16; SPSS Inc., Chicago, IL, USA) by applying specific statistical tests to find out the significance of the comparisons. Quantitative variables were compared using mean values and standard deviations. Descriptive data were presented as mean ± standard deviation (SD) and range values. Student's independent t-test and p values were calculated to compare the mean values between the test groups and control group. P-value of 0.05 or less was used for statistical significance. Karl Pearson's product–moment correlation was used. A value of correlation coefficient close to +1 was considered as a strong positive linear relationship and a value close to −1 was considered as a strong negative linear relationship, and a value close to 0 was considered as no linear relationship.

Results:

Mean blood glucose level at baseline for test group was 204.71 ± 82.51 and control group was 203.86 ± 87.78 mg/dl (p=0.41) which was statistically non-significant. Both the VB and GSB was effective to evaluate diabetic status (Table 1). Blood glucose level before and 3 month after NSPT showed statistically significant difference (p=0.026) for test group and highly statistical significance (p=0.001) for control group (Table 2).

Tables:

Table 1: Comparison of blood glucose levels in Test Group and Control Group at baseline and 3 month

	MEAN ± S.D.	t- VALUE	p- VALUE	SIGNIFICANCE
TEST GROUP	204.71 ± 82.51	0.22	0.41	NS
CONTROL GROUP	203.86 ± 87.78			

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

Table 2: Comparison of blood glucose levels in Test Group and Control Group at baseline and 3 month

	MEAN ± S.D.	t- VALUE	p- VALUE	SIGNIFICANCE
TEST GROUP	Baseline - 204.71 ± 82.51	2.345	0.026	S
	At 3 month – 190.21 ± 70.44			
CONTROL GROUP	Baseline - 203.86 ± 87.78	3.564	0.001	HS
	At 3 month – 188.25 ± 60.44			

Footnotes: SD- Standard Deviation, P< 0.001- Highly Significant (HS), P≤0.05 Significant, P≥0.05- significant (S)

Table 3: Karl Pearson's product–moment correlation (R) for all groups

		Correlation (R)
Baseline	Control Group and Test Group	0.98
3 month	Control Group and Test Group	0.99

Karl Pearson's product–moment correlation (r) for 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 and test group was 0.98 at baseline and 0.99 at 3 months. It shows a strongly positive co-relation (Table 3).

Discussion: Diabetes mellitus and Chronic periodontal diseases are both multifactorial with a high prevalence rate [3]. Insulin is the only blood glucose controlling hormone produced and released by the β-cells of the pancreatic islets of Langerhans. In 1997, the International Expert Committee classified diabetes into Type I and II, other specific type,

and gestational diabetes mellitus[11].In India, DM is one of the major diseases of concern as the incidence rate is increasing at an alarming rate.

CP is a destructive inflammation of the tooth-supporting tissues resulting from a complex plaque microorganisms organized as biofilm and interactions of host cells. Furthermore, genetic predispositions, systemic diseases, such as DM, personal behavior, such as smoking and oral hygiene, play an important role in the pathogenesis of CP. Systemic metabolic or cellular changes in DM also influence distant tissues/ organs, including the periodontium [12].

Past studies have proved that periodontal therapy exerts beneficial effects on the control of DM[13]. ADA recommends screening for DM from age ≥ 45 in every 3 years in persons without risk factors and more frequently in those with risk factor for DM[14].According to Collin HL et al advanced CP seems to be associated with the impairment of the metabolic control in patients with DM and a regular periodontal surveillance is therefore beneficial[15]. Various diagnostic tests like oral glucose tolerance test, fasting plasma glucose test, random blood glucose test, urine test, glycatedhaemoglobin are the complex tests used by physicians for definitive diagnosis.Screening for diabetes in the dental office is generally accomplished only through analysis of symptoms and patient history and often the only information available is in the form of a single past laboratory test that may not reflect their current blood glucose status.

Dental office DM screening could result in earlier treatment and possible minimization of serious complications. Development of an intra-oral blood sampling technique could make such tests even more suitable for use by dental practitioners.Glucose monitoring system needs only 3µl of blood and may actually allow for totally painless testing of blood oozing from the gingival sulcus of patients with gingivitis or periodontitis during routine periodontal examination[16, 17]. This might be of considerable interest to the dental practitioners since this is accurate, simple and relatively inexpensive and can be used as an in-office screening device for patients at supportive periodontal phases, suspected to have diabetes, or a way to monitor blood sugar levels in known diabetics.

Glucometers have employed the oxidation of glucose to glucono-lactone catalyzed by glucose oxidase. The first-generation devices relied on the same colorimetric reaction that is still used now a days in glucose test strips for urine. Besides glucose oxidase, the test kit contains a benzidine derivative, which is oxidized to a blue polymer by the hydrogen peroxide formed in the oxidation reaction. The disadvantage of this method was that the test strip had to be developed after a precise interval (the blood had to be washed away), and the meter needed to be calibrated frequently [18]. To overcome these drawbacks, second generation glucometers were formulated that worked by coulometric method. Test strips contain a capillary that sucks up a reproducible amount of blood and an enzyme electrode containing glucose oxidase. The enzyme is reoxidized with an excess of ferrocyanide ion. The total charge passing through the electrode is measured and is proportional to the concentration of glucose in the blood. The advantages of these glucometers are that they are time consuming and no additional tool is required for sample collection [19].

Beiklerin 2002)[16] evaluating the predictability of test strip glucose monitors have shown to fall within this range. The test strip reaction is time dependent and begins as soon as blood is applied. Reagent strips were also shown to be fairly reliable and accurate for clinical use. Mealey BL [20]suggested that the diabetic patients may be encouraged to bring their glucometers to dental appointments so that blood glucose can be instantly assessed when needed. Using the method described in this study, the dentist can rapidly evaluate blood glucose many times using the GSB. It is necessary as resolution of periodontal inflammation in patients suffering from DM is successful only if blood glucose levels are controlled along with the removal of bacterial etiology. As CP requires long-term treatment that often continues for years, a single blood glucose test will not be sufficient for periodontal management[21]. Consequently, the multiple measurements of a diabetic patient's blood glucose levels allow the periodontist to better assess the patient's diabetic control as the treatment progresses[22].

The glucometer used in the current study was a self-timing, second- generation monitor and is approved by federation dentaireinternationale (FDI) for off-finger testing. It requires very low amount of blood (1 µl), thus allowing to perform

the analysis even in cases with very mild gingival inflammation.The sampling procedure used in this study was much easier to perform and less time consuming and required no additional tools to collect GSB.The result is also supported by Beikleret al. [16] who suggested the direct use of test strip to collect the blood sample from gingiva.Stein and Nebbia[23] 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. Tsutsuiet al. [24] 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. American Diabetes Association in their consensus statement on blood glucose monitoring 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 [25]. In contrast to our study,Parker et al [26]used plastic pipette for sample collection and Prabhu et al [27] used capillary tube for sample collection.

Current study incorporated the minimally invasive method where the blood oozing out during routine periodontal examination was checked for diabetes. This is supported by Sibyl S et al.[28] and Wesley S[29] who induced bleeding by periodontal probing for evaluation of DM. More recently, Shetty et al. [30]studied a previously unsuspecting periodontal population for DM using the same method. Student's independent "t" test showed no significant difference between the test and the Control Group (Table 1).

Therefore, the results of present study indicate that the GSB collected during diagnostic periodontal examination may be an excellent source of blood for glucometric analysis. In addition, the technique described is safe, easy to perform and comfortable for the patient and might therefore help to increase the frequency of Diabetes screening in dental offices. The sampling procedure performed in the study is much easier and less time consuming since no additional tools are necessary to collect GSB.

Conclusion:

Diabetes and chronic periodontitis has a bi-directional relation. Periodontal therapy helps to maintain better blood glucose level. Successful periodontal maintenance is also dependent on diabetic status of the patient.

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