Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2021;11:2:135-140.

Effect of Nonsurgical Therapy on Gingival Crevicular Blood Glucose Level and Capillary Blood Glucose Level in Chronic Periodontitis Patients: A Clinico-Biochemical Study

Aishwarya Saxena[1*] Umesh Parmar[2] Shilpi Verma[3] Ankit M. Patel[4] Nagmani Kumar[5] Aastha[6]

[1]Assistant Professor, Department of Periodontology, Buddha Institute of Dental Science and Hospital, Patna, Bihar, India.
[2]Private Consultant, Department of Prosthodontics, Rajkot, Gujarat, India.
[2]Private Consultant, Department of Prosthodontics, Patna, Bihar, India.
[4]BDS, Dental Assistant, 16 Ferris Road, Edison, NJ 08817 USA.
[5]Private Consultant, Patna, Bihar, India.
[6]Private Consultant, Patna, Bihar, India.

ABSTRACT

Background: Diabetes is known to have many medical complications and periodontal disease has been considered as the sixth complication of diabetes. A patient with periodontitis may have undiagnosed diabetes which may complicate treatment. Gingival crevicular blood from routine periodontal probing may be a source of blood for glucose measurements at chair side for non-invasive quick determination.

Material and methods: 40 patients with periodontitis and positive bleeding on probing were chosen. Blood samples from two sites-capillary i.e., fingertip and gingival wall were analyzed using a glucose self-monitoring device at baseline and following SRP. Clinical parameters like Gingival Index (GI), Plaque Index (PI)and probing pocket depth (PPD) were assessed pre and post SRP and analyzed.

Results: Correlations between CBGL and GCBGL at baseline and following SRP were well established. SRP resulted in significant difference in all the clinical parameters assessed.

Conclusion: SRP caused reduction in PI, GI and PPD but it had no effect on the GCBGL and CBGL. However, strong correlation was established between GBGL and CBGL during periodontitis and following SRP. Hence, gingival blood can be used as a sample for evaluation of systemic glucose level in dental clinic.

Keywords: Diabetes mellitus, Gingival crevicular blood glucose level, Capillary blood glucose level, Glucometer, Periodontitis.

INTRODUCTION

Health has been defined by WHO as a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity. This concept symbolizes the aspiration of the people and represents an overall objective or goal toward which esc and every nation should strive (1). The burden of chronic diseases is increasing in developing countries and the most common chronic diseases i.e. cardiovascular disease, chronic obstructive pulmonary disease and type 2 diabetes are linked by common and predictable biological risk factors(2).

Periodontal disease is basically a chronic inflammatory process that extends deep into the tissue which support the teeth causing loss of connective tissue and alveolar bone (3). It has been said that the mouth is the mirror of systemic health.

Received: Oct. 23, 2020**: Accepted**: Dec. 7, 2020
*__Correspondence Dr. Aishwarya Saxena.__
Department of Periodontology, Buddha Institute of Dental Science and Hospital, Patna, Bihar, India.
Email: asaksena99@gmail.com

pISSN 2278-0076
eISSN 2321-9270

The diseases which affect the mouth such as periodontal disease can have an effect on the rest of the body. The concept linking systemic disease and periodontitis can be traced back to the beginning of recorded history and medicine(4).The association between severe periodontal disease and diabetes mellitus is the most consistent(5).It is widely documented that people with diabetes have a higher risk of periodontal disease(3)and periodontal disease has been considered as the 6th complication of diabetes(6).For successful periodontal treatment to be carried out stabilization of blood glucose to a near normal range is necessary. Dentist rely on lab test which may not be accurate. So, a sensitive, specific and simple method should be searched for so that monitoring of blood glucose during office visit can be done[7,8].

Gingival crevicular fluid may be an excellent source of blood for glucometric analysis [9,10] using the technology of portable glucose monitors [10] as routine probing during a periodontal examination generates ample amount of blood. Therefore the intention of the study was to compare patients gingival crevicular blood glucose level (GBGL) and finger puncture capillary blood glucose (CBGL) measurements using a self-monitor so as to determine whether blood oozing from gingival tissues during routine periodontal examination can be used for evaluating glucose levels and whether GBGL and CBGL corelates with the periodontal condition in health as well as disease.

AIMS AND OBJECTIVES

1) Corelate the gingival crevicular blood glucose with capillary blood glucose in subjects suffering from periodontitis.

2) Corelate the gingival crevicular blood glucose level with the capillary blood glucose level after SRP.

3) Evaluate the effect of SRP on the glucose level in the gingival crevicular blood and capillary blood glucose level.

MATERIAL AND METHODS

A perspective, interventional, comparative, biochemical study was done on a population of individuals having periodontitis. The study aimed at comparing a single group of subjects with pretreatment and post treatment evaluation. The study was conducted in compliance with the ethical principles for medical research involving human subjects of the Helsinki Declaration, as revised in 2000.

A total no of 40 patients were selected (20 males and 20 females, aged 25 to 65 years) for the comparison of gingival and capillary blood glucose level. A signed consent was taken from the patient. Patients with history of diabetes were also included for the study, on the basis of history and medical records furnished by the patients among the entire sample.

Inclusion Criteria:

Subjects with moderate chronic generalized periodontitis were selected keeping in mind-

1.Patients aged between 25 and 65 yrs.
2.Periodontal pocket depth<5 mm, involving 5 or more tooth.
3.Loss of attachment<4mm,present in 5 or more tooth.

Exclusion Criteria

Subjects were excluded if they presented:

1.With specific conditions like pregnancy, concurrent infections, history of concomitant cardiovascular disease and those who were on long term medications.

2.History of systemic antibiotic administration within the last 3 months.

3.Periodontal treatment 6 months prior to study.

CLINICAL PARAMETERS FOR ASSESSMENT

Following clinical parameters were recorded for patient evaluation

1.Plaque index (PI), (Silness and Loe 1964)
2.Gingival index (GI), (Loe and Silness 1963)
3.Periodontal Probing Depth (PPD)
4.Capillary blood glucose level (CBGL) and
5.Gingival crevicular blood glucose level (GBGL).

Procedure:

Site and Tooth Selection:

To estimate gingival blood glucose level blood was collected from the gingiva of the tooth showing GI score of 2 or more. Another factor kept in mind during site selection was to avoid all those sites where purulent discharge was evident. To keep the process simple, tooth in upper anterior arch which fulfilled the criteria was selected.

Estimation of gingival crevicular blood glucose level (GBGL)

Selected patients were asked to rinse with chlorhexidine mouthwash before the collection of GCBGL was initiated. The upper anterior segment was isolated with cotton roll to prevent saliva contamination and dried with compressed air. To obtain a clean sample bleeding was induced by UNC-15 probe until a sufficient quantity of blood (2 to 3 micro) lt was present to gather as a sample. The extravasated blood was collected by plastic pipette/dropper used by doctors of homeopathic medicine to dispense the medicine. The Accucheck Active Glucometer (Roche Diagnostics, Germany) monitoring device was loaded with the active test strip (impregnated per cm with glucose dye oxidoreductase0.7 micron) and a drop (2micro lt.) of blood was transferred on to the test strip. The testing time was about 10 seconds. The value displayed on the monitor was recorded. This reading was taken as the baseline reading.

Periodontal Procedure

After recording all the clinical parameters conventional non-surgical therapy was instituted for the management of periodontal disease. It involved one stage full mouth scaling and root planning without any prescription of antibiotics and mouthwash. Scaling and root planning were performed using ultrasonic device and curettes (Gracey curettes). Patients were instructed on oral hygiene method and recalled after one and a half month.

The similar procedure was followed after SRP with a gap of one and a half months to obtain GCBGL reading. The only point of difference was in the method of collection of gingival crevicular blood. Here explorer was used to induce bleeding as the same was difficult to obtain from healthy gingiva.

Estimation of capillary blood glucose level (CBGL)

CBGL sample was drawn from patients one of the fingers. The pad of the finger was wiped with alcohol, allowed to dry and then punctured with a sterile lancet. Capillary blood sample was drawn by the same collecting device and transferred onto the test strip preloaded in the glucometer. CBGL readings were recorded.

RESULTS

Forty patients were screened according to the exclusion/inclusion criteria. A master chart containing the physical variants, pre- and post-treatment values of the clinical parameters of all the participants was prepared. Out of 40 subjects, males were 20 (50%, Table-1) and females were 20 (50%, Table-1). The participants were in the age range of 25-65years. Males were within the range of 35-60 years, with mean age of 34.94±sdyears. Females were within the range of 25-65, mean age 40±sd.

Table 1: Demographic presentation of subjects.

Variable	Age Range(years)	Mean (year)	%percentage population
Male	35-60	34.90	50%
Female	25-65	40.00	50%

Table 2: Presentation of clinical parameters PI; GI; PPD and glucose measurement in gingival and finger-stick puncture blood.

Variable	Baseline Mean ± SD	Post-treatment Mean ± SD	Differences of mean	Student t - test	'p' value
PI	1.62±.39	0.88±.88	0.8532	13.82	.001*
GI	1.78±.41	.88±.30	1.024	14.681	.001*
PPD	3.50±.98	2.54±.71	0.9682500	11.002	.001*
CBGL	131.13±60.18	133.50±57.86	5.42	-.616	.541**
GBGL	118.33±51.36	121.53±50.69	4.03	-.895	.376**

'p'<0.05-Significant (*); 'p' >0.05-Non-significant (**)

PI-Plaque Index; GI-Gingival Index; PPD- Probing pocket depth; CBGL-Capillary blood glucose level; GBGL-Gingival blood glucose level.

Periodontal Parameters:

Plaque index- The mean plaque index was 1.62±.39 at baseline which declined to .88±.88, 1½ months after, the periodontal therapy (Table-2). The mean difference was 0.8532. The mean percentage reduction in the plaque index was 52.66% It was statistically significant ($p<0.05$)

Gingival index- Following treatment GI dropped from 1.78±.41 at baseline to .88±.30 after 1½ months following phase 1 therapy. The mean difference was 1.024. The mean percentage reduction in the gingival index was 57.53% from baseline to 1½ months after periodontal therapy, which was statistically significant ($p<0.05$), (Table-2).

Probing pocket depth- Following the non-surgical periodontal therapy, the mean value declined to 2.54±.71 which was 3.50±.98 at baseline (Table-2), the difference in mean value was 0.9682500. The mean percentage reduction was 27.11% and was statistically significant.

Table 3: Pearson- co- efficient co-relation test applied to establish 'r' between periodontal parameters and CBGL, GBGL at baseline and 1½ month following phase-1 therapy.

	PI Pre	PI Post	GI Pre	GI Post
CBGL Pre	0.280329	0.205808	0.112716	0.108014
CBGL Post	0.300865	0.175494	0.164879	0.094457
GBGL Pre	0.357767	0.23485	0.186241	0.121649
GBGL Post	0.330145	0.156752	0.198297	0.050524

Correlation between GBGL, CBGL and periodontal parameters PI, GI and PPD in the total sample, were analyzed with "Pearson correlation coefficient. Weak correlation between CBGL, GBGL and PI, GI and PPD. (Table-3) in total samples was found at the base line and 1½ month following non-surgical therapy.

Table 4: Pearson- co- efficient co-relation test applied to establish 'r' between CBGL and GBGL at baseline.

Variable	Mean ± SD	'r'	't'	'p' value
CBGL	131.13±60.18	.975	26.07	≤.001
GBGL	118.33±51.36			

The mean gingival blood glucose (GBGL) levels and Capillary blood glucose (CBGL) derived from all samples were 118.33±51.36 mg/dl and 131.13±60.18 mg/dl respectively at the baseline. No significant difference between GBGL and CBGL when compared to age and sex group were found. Correlation between GBGL and CBGL in the total sample, were analyzed with "Pearson correlation coefficient" using the SPSS version 15 (statistical and data analysis). Highly significant correlation between CBGL and GBGL (r=0.975) (Table-3), in total samples was found at the base line. Correlation was significant at $p<0.01$.

Table 5: Pearson- co- efficient co-relation test applied to establish 'r' between CBGL and GBGL following phase-1 therapy.

Variable	Mean ± SD	'r'	't'	'p' value
CBGL	133.50±57.86	.965	22.76	≤.001
GBGL	122.53±50.69			

Following periodontal treatment, the GBGL and the CBGL values were 121.53±50.69 and 133.50±57.86 mg dl^{-1} respectively. Correlation coefficient between GBGL and CBGL when analyzed, were found to be highly significant (r=0.965) (Table-4). Correlation is significant at $p<0.01$.

DISCUSSION

Recent studies have amply proved the association between oral and systemic health and this may be bidirectional relationship for some conditions. This is particularly true for the association between periodontal disease and diabetes mellitus[11].At present there is strong evidence to suggest that the incidence and severity is influenced in part by diabetes mellitus and the level of blood glucose control[12].

Regular method employed for evaluation of blood sugar is traumatic and a tiring experience. Hence considerable effort is being made in the past years for the development of painless and noninvasive method to measure the blood glucose. All the studies, started from 1969 by Stein et al.[13]and Tsutsui et al .[14] to the more recent studies of Beikler et al.[15] and Khader et al.[16] attempted to prove that extravasated blood from the gingival crevice due to inflammation can provide an acceptable source for

measuring blood glucose. These studies are based on the fact that periodontal inflammation with or without the complicating factor of diabetes mellitus is known to produce ample extravasated blood during diagnostic procedures and hence no extra procedure like finger puncture is necessary to obtain blood for glucose analysis[17]. Hence the present study is designed to evaluate and compare between GBGL and CBGL and whether the GBGL can be used reliably to estimate blood glucose in chronic periodontitis patients. Patients with age group range of 25-65 years were recruited in the study. Clinical parameters namely PI, GI, PPD were recorded both before and after the treatment. Analysis of our data showed significant reduction in the scores of PI and GI post treatment when compared with the baseline. The mean PI and GI at baseline were 1.62+/-.39and 1.78+/-.41 which following phase 1 therapy reduced to .88+.88 and .88+/-.30 respectively. Changes were statistically significant($p<0.5$). The overall mean percentage reductions were 52.66% for PI and 57.53%for GI.PPD is a crucial and mandatory procedure in diagnosing periodontitis and evaluating the success of periodontal therapy. In our study mean probing depth at baseline was 3.50+/-.98 which reduced to 2.54+/-.71 post treatment after SRP. Statistically significant reduction in PPD was observed($p<0.001$).We observed a 27.11%reduction in PPD which corroborated with the finding of study by Rodriguez et al(48).This clinical trial provided the evidence that statistically strong correlation exists between GBGL and CBGL The mean CBG level was 131.13+/-60.18 mg/dl and GBG was 118.33+/-51.36 mg/dl at the base line and following treatment the mean values were 133.50+/-57.86mg/dl and 121.53+/-50.69mg/dl respectively. Highly significant correlations ($r=0.975, p<0.05$)at baseline and following phase 1 therapy ($r=.965$) were established. Estimations of sulcular blood glucose levels were previously conducted and showed correlations with capillary blood glucose levels thereby suggesting that testing sulcular blood may be a valuable tool in identifying potential patients with diabetes It is seen that glucose measurements in GCB were generally lower than those in finger prick samples. This might partly be explained by contamination of crevice blood with gingival exudates, in particular in tiny samples[18]. Other point to be noted is high values of GBG and CBG following treatment than what was recorded at the baseline. One of the probable explanations could be that during inflammation the residing as well as inflammatory cells are in hyperactive stage, consuming more glucose for their activity. This also implies that there was no effect of periodontal treatment on blood glucose level from either source. This study shows that measurement of blood glucose level from gingival blood gives an impression of systemic glucose level. It is an easy, quick chair side method. There were few limitations of the study i.e., small sample size, contamination of gingival blood during collection and difficulty in procurement of blood for estimation of blood glucose from healthy gingiva.

CONCLUSION

The dentists can also participate in the routine screening of the patients for the diagnosis of the glycemic level which can prove to be extremely beneficial. When comparing glucose measurements in GBG with those in CBG samples no systematic trend of change of variation of the differences with higher measurements was noted. The determination of glucose in plasma or urine or in whole blood shows the level at the specific time of sampling but this value can change within a few minutes due to various factors including diet, physical activity or/and medications. Testing crevicular blood glucose levels with self-monitoring device is sensitive since it can provide results with minimal of blood within few seconds. Subjects can reliably be screened for glycemic state by measuring glucose levels in gingival crevicular blood since probing and sample collection takes a very little time and there is no discomfort to the patient. It might therefore help to increase the frequency of diabetes control in the dental office as the study finds a strong correlation between CBGL and GBGL in health and disease. However, no effect of periodontal treatment was observed on blood glucose level from either source.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

REFERENCES

1. Clark C.M, Lee D.A. Prevention and treatment of complications of diabetes. The New England Journal of Medicine 1991; 332:1210-17.

2. Poul E Peterson and Hiroshi Ogawa. The global burden of periodontal disease: towards integration with chronic disease prevention and control. Periodontology 2000 2012; 60: 15-39.

3. Martha E Nunn. Understanding the etiology of periodontitis an overview of periodontitis risk factors. Periodontology 2000 2003; 32:11-23.

4. O'Reilly PG & Claffey, W.M. a history of oral sepsis as a cause of disease. Periodontology 2000 2000; 23: 13-18.

5. Raul I Garcia, Michellem, Henshaw & Elizabeth A. Krall. Relationship between periodontal disease and systemic health. Periodontology 2000 2001; 25: 21–36

6. Loe H. Periodontal disease: the sixth complication of diabetes mellitus. Diabetes care 1993; 16:329-34.

7. Hadden, W. C. & Harris, M. I. Prevalence of diagnosed diabetes, undiagnosed diabetes, and impaired glucose tolerance in adults 20–74 years of age. Vital Health Stat. 1987; 237: 1–55.

8. Klonoff, D. C. (1997) Non-invasive blood glucose monitoring. Diabetes Care 20, 433–437.

9. Shiela M. Strauss, Alla J. Wheeler, Stefanie L. Russell, Anya Brodsky, Robert M. Davidson, Rima Gluzman, Lin Li, Roberto Galao Malo, Bram Salis, Robert Schoor, and Krassimira Tzvetkova. The Potential Use of Gingival Crevicular Blood for Measuring Glucose to Screen for Diabetes: An Examination Based on Characteristics of the Blood Collection Site. J Periodontol 2009; 80:907-914.

10. Sarlati Fatemeh Pakmehr E, Khoshru K, Akhondi N; Gingival crevicular blood for assessment of blood glucose levels. J periodontol implant dent 2010; 2(1): 17-24

11. Tara B. Taiyeb-Ali, Renukanth P. Cheta Raman & Rathna D. Vaithilingam. Relationship between periodontal disease and diabetes mellitus: an Asian perspective. Periodontology 2000, Vol. 56, 2011, 258–268.

12. Nishimura F, Takahashi K, Kurihara M, Takashiba S, Mura-yam Y. Periodontal disease as a complication of diabetes mellitus. Ann Periodontol 1998; 3:20-9

13. Stein GM, Nebbia AA. A chair-side method of diabetes screening with gingival blood. Oral Surg Oral Med Oral Pathol 1969; 27:607-12.

14. Tsutsui P, Rich SK, Schonfeld SE. Reliability of intraoral blood for diabetes screening. J Oral Med 1985; 40:62-6.

15. Beikler T, Kuczek A, Petersilka G, Flemmig TF. In-dental-office screening for diabetes mellitus using gingival crevicular blood. J Clin Periodontol 2002; 29:216-8.

16. Khader Y, Al-Zubi B, Judeh A, Rayyan M. Screening for type 2 diabetes mellitus using gingival crevicular blood. Int J Dent Hyg 2006; 4:179-82.

17. Ervasti T, Knuuttila M, Pohjamo L, Haukipuro K: Relation between control of diabetes and gingival bleeding. J Periodontol 1985; 56:154–157.

18. Bland JM, Altman DG (1999) Measuring agreement in method comparison studies. Stat Methods Med Res 8:135–160.