ejpmr, 2019,6(9), 414-419

SJIF Impact Factor 4.897

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

TO CHECK THE RELIABILITY OF GINGIVAL BLOOD GLUCOSE ESTIMATION FOR SCREENING OF DIABETES MELLITUS BY COMPARING IT WITH FINGER CAPILLARY BLOOD GLUCOSE ESTIMATION

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Article Received on 28/06/2019 **Article Revised on 18/07/2019** **Article Accepted on 08/08/2019**

ABSTRACT

Gingival crevicular blood collected during periodontal examination might be an alternative source for glucometric analysis, in patients exhibiting atleast one inflamed site with bleeding on probing for screening of Diabetes mellitus. A high degree of correlation in blood glucose estimation between Gingival Crevicular Blood & Finger Capillary Blood samples confirms the former to be another reliable source.

KEYWORDS: Reliability; Gingival blood glucose estimation; Finger capillary blood glucose estimation; Diabetes mellitus.

INTRODUCTION

Peridontium is a complex and highly specialized pressure sensing system consisting of four tissues (cementum, periodontal ligament, alveolar bone and junctional and sulcular epithelia) supporting the teeth.

Diabetes and periodontitis, seems to interact in a bidirectional manner.[1] The incidence and severity of periodontitis is influenced in part by DM and the level of blood glucose control.[2] Moreover, periodontal therapy might exert beneficial effects on diabetes control.[3]

The WHO predicts that diabetes in Asia alone will rise by 90% in the next 20 years.[4] It is one of the most frequent metabolic disorders with an estimated prevalence of 7% in industrialized countries, of which nearly half the cases are undiagnosed.[5] In addition, recent data indicates that the incidence of the Type II Diabetes, maybe increasing by up to 6% per year.[6]

It is estimated that among dental patients for every patient with known diabetes there is one with undiagnosed DM.[7] Among the various diagnostic tests available for diabetes, the oral glucose tolerance test and fasting plasma glucose test are more complex tests used for definitive diagnosis.[8]

The periodontists frequently manage diabetic patients using limited information about their blood glucose control.[9] It's the responsibility of dental practitioners to screen for undiagnosed cases which may influence dental treatment for the general well being of their patients.[10] Thus, monitoring their blood glucose during the office-visit may be a better alternative.[9] Periodontal inflammation with or without the complicating factor of diabetes mellitus is known to produce ample extravasated blood during diagnostic procedures.[11] Routine probing during periodontal examination is more familiar to the practitioner and less traumatic than a finger puncture. It is, thus, possible that gingival crevicular blood from probing may be an excellent source of blood for glucometric analysis using the technology of portable glucose monitors.[9]

This study is done to check the reliability of gingival blood glucose estimation for screening of diabetes mellitus by comparing it with finger capillary blood glucose estimation.

MATERIALS AND METHODS

A descriptive, cross-sectional study was conducted in the department of Periodontics for Oral Hygiene assessment & advised Oral Prophylaxis at Maharaja Ganga Singh Dental College Shri Ganganagar. Rajasthan. Participants were selected with no known history of diabetes of age group of 18-55 years and subjects with more than 14 teeth and not less than 7 teeth in each arch. Exclusion criteria were subjects under current or undergone periodontal treatment in last 3 months, smokers and alcoholics, arthritis (Rheumatoid & Osteoarthritis)

patients, pregnant or lactating females, patients with any known/ diagnosed form of immunosuppressive disease, post-menopausal women and subjects on any medications (antioxidants, anti-inflammatory drugs and antibiotics in the previous six months). The patients were asked to give their written consent before participation in the study. Data obtained were analyzed.

RESULTS

Subjects for this study were selected from the Out-Patient Department of Periodontics, M.G.S Dental College and Research Centre, Shri Ganganagar, Rajasthan.

The study included a total of 150 patients [90 (60%) males and 60 (40%) females], belonging to age group 18-55 Years. (Table.1).

Table 1: Demographic distribution of study population according to gender and age.

Age group (years)	Males Females Total
	n % n % n %
15-24	05 27.7 13 72.3 18 100
25-34	41 62.1 25 37.9 66 100 100
35-44	38 67.8 18 32.2 56 100 100
45-54	06 60 04 40 10 100
Total	90 60 90 40 150 100 100

The subjects were divided into two groups as Group 1 (patients with gingivitis) & Group 2 (patients with periodontitis) on the basis of the clinical parameters including Bleeding on Probing & Clinical Attachment Loss. The highest percentage of patients with gingivitis was observed in 25-35 year age group i.e 52.2%. The highest percentage of subjects with periodontitis was observed in 35-44 year age group i.e 51.7% (Table.2).

Table 2: Distribution of study population according to age & periodontal status.

Age group (years)	Group 1 (Gingivitis) Group 2 Total (Periodontitis)		
	n % (Within group)	n % (Within group)	n % (Within group)
15-25	18 20.0%	0 0%	18 12.0%
25-35	47 52.2%	19 31.7%	66 44.0%
35-45	25 27.8%	31 51.7%	56 37.3%
45-55	0 0%	10 16.6%	10 6.7%
Total	90 100%	60 100%	150 100

In Group 1 percentage of males & females were 58.88% & 41.12% respectively. Similarly In Group 2 percentage of males & females were 61.66% & 38.34% respectively (Table-3).

Table 3: Gender wise distribution of subjects between Group 1 & Group 2.

Gender	Group 1 (Gingivitis)	Group 2(Periodontitis)	Total
	n % (within group)	n % (within group)	n % (within group)
Males	53 58.88	37 61.66	90 60
Females	37 41.12	23 38.34	60 40
Total	90 100	60 100	150 100

Overall mean (SD) age of subjects was 33.52 ± 7.5 Mean (SD) age of subjects with gingivitis was significantly (p= <0.001) lower than that of subjects with periodontitis. There was no statistically significant difference (p>0.05) in between the mean age of males and females in group 1 (gingivitis) and group 2 (periodontitis) (Table.4).

Table 4: Descriptive mean age & gender according to periodontal status.

Periodontal status	Gender	Age		Total Age		P value	Overall Age	
		Mean	SD	Mean	SD		Mean	SD
Gingivitis	Male	32.57	5.5	30.544	5.95	<0.001**	33.52	7.5
	Female	27.65	5.38					
Periodontitis	Male	37.54	7.97	38	7.38			
	Female	38.74	6.45					

**-statisticallly highly significant (p<0.01)

GCB & FCB was measured of all the 150 subjects. Out of 150 subjects 10 subjects were diagnosed as diabetic patients (3 in Group 1 & 7 in Group 2). (Table.5). Total 140 subjects were non- diabetics (87 in Group 1 & 53 in Group 2) (Table.5).

Table 5: Group wise distribution of subjects according to their diabetic status.

TYPE	Group 1		Group 2		Total	
	n	%	n	%	n	%
Diabetic	3	30	7	70	10	100
Non Diabetic	87	62.14	53	37.86	140	100
Total	90	60	60	40	150	100

The mean GCB in Group 1 was 107.92mg/dl with standard deviation of 21 mg/dl. Similarly the mean FCB in Group 1 was 107.87mg/dl with standard deviation of 21 mg/dl. A perfect positive correlation was observed between GCB and FCB measurements among subjects in Group 1. This correlation was found to be highly statistically significant with P value <0.001 (Table.6).

Table 6: GCB & FCB according to periodontal status.

Periodontal status	GCB		FCB		P value	Correlation coefficient	
	Mean	SD	Mean	SD		Spearman R value	Sig
Gingivitis	107.92	21	107.87	21	<0.124	1.000	<0.001**
Periodontitis	135.83	53.85	135.53	53.85	NS	1.000	<0.001**

**-statistically highly significant.

On comparison of gingival crevicular blood glucose and finger-prick blood glucose measurements of Group I subjects, the Pearson's correlation coefficient showed an r - value of 1.00 and a P-level <0.001. (Table.6).

Table 6: GCB & FCB according to periodontal status.

Periodontal status	GCB		FCB		P value	Correlation coefficient	
	Mean	SD	Mean	SD		Spearman R value	Sig
Gingivitis	107.92	21	107.87	21	<0.124	1.000	<0.001**
Periodontitis	135.83	53.85	135.53	53.85	NS	1.000	<0.001**

**-statistically highly significant.

On comparison of the mean Plaque score and Gingival Index scores, Mean Score in Group 1 is 1.43 ± 0.52 and in group 2 is 2.16 ± 0.76. Group 1 median is 1 and group 2 median is 2 which indicates lower scores in plaque index and Gingival index in Group 1 which is statistically highly significant (p<0.001) (Table. 7).

Table 7: Comparison of Mean Plaque and Gingival Scores in both the groups.

Group	Mean Score	SD	Median	Confidence Interval (95%)	P Value
Gingivitis	1.433333	0.520372	1	0.10899	<0.001**
Periodontitis	2.166667	0.762837	2	0.197062	

**-statistically highly significant.

There is statistically significant difference present in the Plaque score (Table 8).

Table 8: Mean plaque score in Diabetics & non diabetics.

Group	N	Mean Plaque Score	SD	F value	P Value
Diabetic	10	2	0.667	4.132	0.044*
Non - Diabetic	140	1.707	0.7247		

*-Statistically significant (P<0.05)

and Gingival score (Table 9) with a p value of Diabetic group have higher score than non diabetic group.

Table 9: Mean Gingival index score score in Diabetics & non diabetics.

Group	N	Mean Gingival index Score	SD	F value	P Value
Diabetic	10	2	0.667	4.132	0.044*
Non - Diabetic	140	1.707	0.7247		

*-Statistically significant (P<0.05).

DISCUSSION

Diabetes mellitus is a complex disease involving multiple systems of the body and syndromes, which have glucose intolerance in common.[8]

If it is uncontrolled, associated with a wide range of

complications, such as, retinopathy, nephropathy, micro- and macrovascular disease, altered wound healing and periodontitis. It is one of the most frequent metabolic disorders with an estimated prevalence of 7% in developing countries of which nearly half the cases are undiagnosed.[5] India has nearly 33 million diabetic subjects today with an overall prevalence rate of 4.3%.[12] Type 2 DM i.e. Non insulin dependent Diabetes Mellitus (NIDDM) constitutes nearly 90% of the diabetic population in India, with a prevalence of 2.4% in rural population and 11.6% in urban population.

The current classification of periodontal disease and conditions lists DM- associated gingivitis under dental plaque induced gingival diseases modified by systemic factors.[4] Periodontitis has thus been proposed as a sixth complication of DM.[12]

Infact, there is a two-way relationship between DM and periodontitis. On one hand, poorly controlled DM increases the risk for developing destructive periodontitis and impairs treatment outcome; on the other, chronic inflammatory periodontal disease may considerably complicate diabetic control.[2] It has been estimated that about one third of type 2 D M cases are undiagnosed, and screening for undiagnosed type 2 DM is highly recommended.[13] In addition, recent data predicts that the incidence of type 2 DM may increase by upto 6% per year.[6]

It is, thus, very clear that due to the close interrelationship between diabetes and periodontitis, it can be assumed that the dental practitioners and especially the periodontists are extremely likely to encounter an increasing number of patients with periodontitis who are undiagnosed diabetics. Therefore an early diagnosis of diabetes may help to prevent its long-term complications that are responsible for the high morbidity and mortality of diabetic patients.[5]

Various methodologies are available in the literature as to the method of estimating blood sugar measurements. Cohen SL et al. 1964[14] used capillary blood sample by placing test strip of Dextrostix and found this method to be simple, quick and accurate enough. Walford S et al. 1978[15] conducted a study to compare the blood glucose measurements obtained with reflectance meters and autoanalysers and found that reflectance metres have high degree of accuracy when compared with an analyser. Shetty S et al. 2004[16] felt that gingival blood glucose by haemoglucotest reagent strips could prove a convenient method of obtaining a screening type of blood glucose to detect undiagnosed diabetes in population. Boyd R et al. 2005[17] concluded that venous bedside glucose estimation could be used with some degree of confidence in the midranges of blood glucose measurements as it correlates well with both capillary derived blood glucometre estimation and laboratory blood glucose estimations. Interestingly, Savitha B et al. 2003[18] suggested that gingival crevicular blood may be an excellent source of blood for glucometric analysis. As this method is safe, easy to perform and comfortable for the patient and periodontist, it may be used for DM screening in a dental office setting**.**

In view of compelling evidences as cited above, it was decided to screen periodontal population for Diabetes mellitus by Blood Glucose estimation.

Periodontal inflammation with or without complicating factor of DM is known to produce ample extravasation of blood during diagnostic periodontal examination.[11] No extra procedure, such as finger puncture with a sharp lancet is necessary to obtain blood for glucometric analysis.

Even with a minimum amount of gingival crevicular bleeding, a glucose measurement is possible with the utilization of self monitoring device.

A second generation glucometer offers the advantage over the first generation glucometer, which requires a larger blood sample i.e. about 10-15µl and that the blood sample has to be placed on the test strips to be wiped off later by the user after a certain time interval, thus, giving a reading by color matching.[8] Hence, the use of third generation glucometer for detecting the glucose with the GCB sample may not be possible. Dental practioners, thus may find the intraoral sampling technique more convenient as the sample can be obtained during routine examination and the strip system could provide a more objective indicator for referral to physicians than traditionally used methods such as review of medical history and symptoms which suggest DM.[8]

Out of the 150 patients who participated in the present study, they were divided into two groups i.e. Group I: Patients with Gingivitis, which included 90 (53 males and 37 females) patients with mean age of 30.54 ± 5.97 years. Group II: Patients with Periodontitis, which included 60 (37 males and 23 females) patients with mean age of 38 ± 7.38 years. Gingival Capillary Blood and Finger Capillary Blood were measured in each patient with or without a positive history of diabetes using a second-generation self- monitoring glucometric device. When GCB glucose measurements were compared with FCB glucose measurements in diabetic patients, a very strong positive correlation was seen, which was statistically highly significant **(P value< 0.001)**.

Plaque Index (SILNESS & LOE 1964) and Gingival Index (LOE & SILNESS 1963) were assessed for all patients. Six sites were examined for each tooth (mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual and distolingual) Results obtained in present study, interestingly, are in consonance with studies carried out by YS Khader et al. 2008[19], which concluded that Periodontal diseases as measured by

Mean Gingival Index, Probing Pocket Debth, Clinical Attachment Level, Plaque Index and Mobility score was more severe in diabetics than non diabetics. In other study done by Vaibhav Tandon et al. 2015[20] which stated that with the increase in fasting blood sugar levels, there was significant rise in Probing Pocket Debth, Plaque Index and Gingival Index. Ringerberg ML et al. 1977[21] infered that children with diabetes had significantly more gingival diseases than the children without diabetes when compared with either measure and significant correlation was found between GCF flow and clinical scores with the children with diabetes but not with the children without diabetes. Sznajder N et al. 1978[22] surmized that loss of attachment and gingival index was higher in diabetics over 30 years of age and among combined age groups.

The results of this study are in agreement with the studies conducted by Parker et al. in 1993,[9] who examined diabetic patients with unknown periodontal status, and wherein a very strong correlation was observed between gingival crevicular, finger capillary blood and the collected intravenous blood glucose measurements. In the study by Beikler T et al. 2002[5] a strong correlation was observed between GCB and FCB glucose levels when diabetic and non-diabetic patients with moderate to advanced periodontitis were examined. Other study done by Nishimura F et al. 1988[2] is in favor of this present study, which concluded that Diabetes Mellitus patients have an increased susceptibility to periodontal diseases. Kabadi UM et al. 1994[23] deduced that the clinic glucose metre is a suitable alternative to a clinical laboratory for user proficiency checks.

In the present study, the GCB measurements showed marginally higher measurement in some subjects when compared to FCB glucose measurements with minimum difference of -2 in both groups & maximum difference of 2 in gingivitis group & 1 in periodontitis group. This variation can be due to dilution by GCF when collecting the crevicular blood. This fact of a possible contamination leading to marginally higher values has been confirmed by Muller HP et al. 2004.[24]

According to public health service estimation, nearly one patient per hundred (1 percent) has undiagnosed or potential diabetes.[7] In the present study, patients belonged to both gingivitis & periodontitis group for the random blood glucose sampling. The random blood glucose values of over 140mg/dl, which were further confirmed by evaluation of Fasting Blood Glucose levels. The random blood glucose values of over 140mg/dl were considered to be positive for diagnosis of Diabetes.[7] These patients were therefore referred to a physician for further management.

The basic nature of periodontal disease consists of the process of gingival injury and repair, which is expressed as inflammation of the gingival tissues and its vasculature. Hence, subjects with periodontal diseases could be at a slightly higher risk of being diagnosed with diabetes.[7] Only 6.6% patients were diagnosed to be diabetic according to the present study. It is, thus, considered very beneficial for the patient's medicare, having been unaware of it earlier.

The outcomes of present study indicate that gingival crevicular blood collected during diagnostic periodontal examination may be an excellent source of blood for glucometric analysis. The sampling procedure performed in the study is much easier and less time consuming; since no additional tools are necessary to collect GCB and adequate amount of blood was found to cover the strip. Contrastingly, Muller HP et al. 2004[24] concluded that there is no usefulness of gingival crevicular blood for the testing of blood glucose during routine periodontal examination as bleeding on probing was not sufficient in every third case. This limitation of insufficient bleeding on probing was however, not observed in the present study.

A strong correlation has been seen between GCB, and FCB glucose measurements This is important because even a perfect correlation can have poor clinical significance for individual measurements. The precision must be considered to better weigh the values of individual measurements.[9]

As adequate blood flow may not be obtained from non-inflamed gingiva, this method of GCB estimation can only be carried out in patients who exhibit at least one area of inflamed periodontal tissue. Possible discrepancy may also be seen due to the dilution of blood oozing from sulcus after probing gingival crevicular fluid. However this was minimized in the present study by using approx. 3µl of blood sample. Albeit venous & capillary blood samples have, till date, been considered as a gold standard for screening of diabetes mellitus in a medical setup. The use of gingival crevicular blood during dental office screening offers a potentially promising alternative in periodontal patients for blood glucose estimations for undiagnosed or potential cases of diabetes, thus preventing its various complications & hence successfully bringing down the high morbidity & mortality of diabetic patients too.

CONCLUSION

Gingival Crevicular Blood is reliable, easy to perform, and almost atraumatic for the patient, it can be concluded that it may help to diagnose Diabetes mellitus during routine dental and periodontal check ups in unsuspecting patients & thus may prevent consequent high morbidity and mortality if left undiagnosed.

REFERENCES

1. Grossi SG, Genco RJ. Periodontal disease and diabetes mellitus: A two-way relationship. *Ann Periodontol*, 1998; 3: 51-61.
2. Nishimura F, Takahashi K, Kurihara M, Takashiba

S, Murayama Y. Periodontal disease as a complication of diabetes mellitus. *Ann Periodontol*, 1998; 3: 20-29.
3. American Academy of Periodontology. Parameter on Systemic Conditions affected by periodontal diseases. *J Periodontol, 2000*; 71(5 Suppl): 880-883.
4. Santana RB, de Mattos CM, Van Dyke T. Periodontal status of patients with diabeties mellitus. *J Clin Periodontol*, 2007; 34: 146-53.
5. Beikler T, Kuczek A, Petersilka G, Flemming TF. In-dental-office screening for diabetes mellitus using gingival crevicular blood. *J Clin Periodontol*, 2002; 29: 216- 218.
6. Rees TD. Periodontal management of the patient with diabetes mellitus. *Periodontology, 2000*. 2000; 23: 63-72.
7. Stein GM, Nebbia AA, Greensburg Pa, Teaneck NJ. A chair side method of diabetic screening with gingival blood. *Oral Surg Oral Med and Oral Pathol*, 1969; 27: 607-612.
8. Tsutsui P, Rich SK, Schonfeld SE. Reliability of intraoral blood for diabetes screening. *J Oral Med*., 1985; 40: 62-66.
9. Parker RC, Rapley JW, Isley W, Spencer P, Killoy WJ. Gingival crevicular blood for assessment of blood glucose in diabetic patients. *J Periodontol*, 1993; 64: 666-672.
10. Council on Dental Health and Health Planning – 1980 Report of Joint National Committee on detection, evaluation, and treatment of high blood pressure. *J Am Dent Assoc*., 1981; 103(3): 451-2.
11. Ervasti T, Knuuttila M, Pohjamo L, Haukipuro K. Relation between control of diabetes and gingival bleeding. *J Periodontol*, 1985; 56: 154-57.
12. Ramachandran A. Epidemiology of diabetes in India – Three decades of Research. *J Assoc Physicians of India*, 2005; 53: 34-38.
13. Mehta M, Vincze G, Lopez DA. Emerging technologies in diabetes care. US Pharmacist, 2002; 27: 11/15/2002: http://www.uspharmacist.com/index.asp. Last ascessed on 11, August 2014.
14. Cohen SL, Legg S, Bird R. A bed side method of blood glucose estimation. The Lancet, 1964; 24: 883-884.
15. Walford S, Gale EAM, Allison SP, Tattersall RB. Self monitoring of blood glucose. Improvement of Diabetic Control. The Lancet, 1978; 38: 732-735.
16. Shetty S, Kohad RM, Akarte NR. Gingival blood glucose estimation by haemoglucotest reagent strips – A potential chair side screening for diabetes. *J Indian Soc Periodontol*, 2004; 7: 109-114.
17. Boyd R, Leigh B, Stuart P. Capillary versus venous bedside blood glucose estimations. *Emergency Medicine Journal*, 2005; 22: 177-79.
18. Savitha B, Prakash S. Gingival crevicular blood for assessment of blood glucose in diabetic patients. *KSDJ*., 2003; 22: 34-36.
19. Khader S Y, Albashaireh M S Z. Peridontal status of type 2 diabetes compared with nondiabetics in north Jordan. East Mediterr Health J., 2008 May-Jun; 14(3): 654-61.
20. Tandon V, Arora V, Tirth A. Effects of diabetes mellitus on periodontal diseases in the adult population of Moradabad. J Dent, 2015; 29(1): 5-8.
21. Ringelberg ML, Dixon DO, Francis AO, Plummer RW. Comparison of gingival health and gingival crevicular fluid flow in children with and without diabetes. *J Dent Res*., 1977; 56: 108-111.
22. Sznajder N, Carraro JJ, Rugna S, Sereday M. Periodontol findings in diabetic and non-diabetic patients. *J Periodontol*, 1978; 49: 445-448.
23. Kabadi UM, O'Connell KM, Johnson J, Kabadi M. The effect of recurrent practice at home on the acceptability of capillary blood glucose readings. Accuracy of self blood glucose testing. *Diabetes Care*, 1994; 17: 1110-1123.
24. Muller HP, Behbehani E. Screening of elevated glucose levels in gingival crevice blood using a novel, sensitive self-monitoring device. Med Princ Pract., 2004; 13: 361-365.