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GINGIVAL CREVICULAR BLOOD GLUCOSE LEVEL : AN ALTERNATIVE TO FINGER-PRICK BLOOD SAMPLES IN DIABETIC PATIENTS

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ABSTRACT **Aim:-** To compare the glucose levels in gingival crevicular blood and capillary blood from finger puncture of diabetic with non-diabetic population and to assess the correlation of GBGL (Gingival blood glucose level) with CBGL (Capillary blood glucose level). **Methods:-** 90 patients with moderate to severe periodontitis with uncontrolled diabetes, control diabetes and no diabetes were selected. Patients were divided into 3 groups. 30 participants in each group based on their glycosylated hemoglobin level (HbA1c). (As per standards of medical care in diabetes by American Diabetes Association in 2013).Periodontal examination was performed using a William's graduated probe. Blood oozing from gingival tissues during periodontal examination was collected on the strip of the glucose self-monitoring device (Accuchek, Roche Diagnostics, Germany). Then the finger stick capillary blood was drawn as controls. Statistical analysis was performed using ANOVAtest and Pearson's correlation coefficient. **Results:-** The prevalence of diabetes in periodontal patients was found to be 46.67%. The GBGL and CBGL derived from all samples were 150.93mg/dl and 156.36mg/dl respectively. Highly significant differences between diabetic and non-diabetic periodontal patients were found with respect to GBGL and CBGL. Highly significant correlation between CBGL and GBGL ($p<0.001$) was found. **Conclusion:-** Both the GBGL and CBGL were significantly greater in diabetics than their non-diabetic counterparts and the GBGL correlated with CBGL.

KEYWORDS : Blood glucose level, finger prick blood sample, diabetes, periodontitis

INTRODUCTION :-

Diabetes mellitus is a metabolic disorder of multiple aetiologies characterized by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both.[1] The chronic hyperglycaemia of diabetes is associated with long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart and blood vessels.[1]

The word “diabetes” stems from a Greek term for passing through, a reference to increased urination (polyuria), a common symptom of the disease. “Mellitus” is the Latin word for honeyed, a reference to glucose noted in the urine of diabetic patients.[1]

Asian Indians are at greater risk of developing diabetes. India is world`s second most popular country with significant number of patients with type 2 diabetes than any other nation.[2]

According to WHO estimate, 70% diabetics reside in developing countries, India has world`s largest diabetes population with 50.8 million people suffering from diabetes followed by China. In 2025, approximately 57.2 million diabetics will be noticed in India.[3]

The American Diabetes Association provided the most recent classification of diabetes mellitus, in 1997. The most common forms of diabetes are termed type 1 and type 2. Type 1 diabetes was previously called insulin-dependent diabetes or juvenile diabetes while type 2 diabetes was formerly known as non-insulin-dependent diabetes or adult onset diabetes.[3,4]

Periodontal disease has been called diabetes' sixth complication, along with retinopathy, nephropathy, neuropathy, macrovascular disease and an altered wound healing. Periodontitis also seems to be a risk factor for incident diabetes.[5]

Periodontal inflammation with or without the complicating factor of diabetes mellitus is known to produce ample extravasated blood during diagnosticprocedure. Routine probing during periodontal inflammation is more familiar to a dental practitioner and less traumatic than a finger puncture with a sharp lancet. It is possible that gingival blood from probing may be excellent source for glucometric analysis using portable glucose self-monitoring device.[6]

The aim of this study was to compare the glucose levels in gingival crevicular blood and capillary blood from finger puncture diabetic with non-diabetic population and to assess the correlation of GBGL (Gingival blood glucose level) with CBGL (Capillary blood glucose level).

Materials and methods :-

The study population included 90 participants with age range of 20 to 80 years who visited department of oral medicine and radiology in CDSRC, Manipur during year 2012-2015.

Divided into 3 groups, 30 participants in each group based on their glycosylated hemoglobin level (HbA1c). (As per standards of medical care in diabetes by American Diabetes Association in 2013). (Table. 1)

Table 1 :- Participants in each study group based on HbA1c.

	Groups	HbA1c level(%)	No. of participants
Group I	Non diabetic	Below 5.7%	30
Group II	Controlled diabetic	5.7% to 6.5%	30
Group III	Uncontrolled diabetic	More than 6.5%	30

Inclusion criteria :-

Any well-established cases of diabetes mellitus diagnosed with the features of polyuria, polydypsia, polyphagia, unexplained weight loss and elevated blood glucose levels, as per the criteria established by the expert committee on diagnosis and classification of diabetes mellitus in 1998.

- Clinical parameters were assessed in each participant, which included bleeding on probing (BOP).

- Participants with diagnosis of gingivitis or periodontitis were selected for the study.

Exclusion criteria :-

- Participants with any other systemic diseases other than diabetes were excluded from the study.
- Participants on medications other than those for diabetes such as on anti-coagulant therapy, on salicylates, acetaminophen, ascorbic acid and other reducing substances were excluded.
- Participants with major oral diseases other than periodontitis were excluded from the stmudy.
- Participants with habit of smoking, tobacco chewing or alcohol were excluded from study.

Patients were asked to rinse with 0.2% w/v chlorhexidine mouthwash for 10 seconds. The upper anterior segment was isolated with cotton roll. A plastic capillary tube of 2mm bore marked up to 3µl was used for collection of blood from the gingival sulcus and a probing force of approximately 0.2N was used to elicit bleeding from the site. The Accu-chek Active Glucometer (Roche Diagnostics, Germany) monitoring device was loaded with the active test strip (impregnated per cm with glucose di-oxireductase 0.7µ) and 2µl of blood was transferred on to the test strip. The testing time was about 10 seconds. Then the regular finger stick capillary blood was collected. Both samples were analyzed and readings were recorded. Statistical analysis was performed.

Results :-

Out of these 90 participants 41 were males (45.55%) and 49 were females (54.45%). Group I having 30 participants out of which 12 were males (40%) and 18 were females (60%). In group II out of 30 participants 14 were males (46.66%) and 16 were females (53.33%). In group III out of 30 participants 15 were males (50%) and 15 were females (50%). (Table 2)

Table 2:- Gender-wise distribution of all 3 groups.

Gender	Group I	Group II	Group III	Total
Male	12 (40%)	14 (46.66%)	15 (50%)	41 (45.55)
Female	18 (60%)	16 (53.33%)	15 (50%)	49 (54.45)
Total	30	30	30	90

Out of 90 participants 4(4%) patients were below age of 25 years, 4(4%) participants were within the age group of 25-34 years, 8(8%) participants were within the age group of 35-44 years, 20(22%) participants were within the age group of 45-54 years, 34(37%) participants were within the age group of 55-64 years, 17(18%) participants were within the age group of 65-74 years and 3(3%) participants were above age of 75 years. (Table 3)

Table 3 :- Age-wise distribution of all 3 groups.

Age	Group I	Group II	Group III	Total
< 25	3 (10%)	0	1(3%)	4(4%)
25-34	2(6.6%)	0	2(6.6%)	4(4%)
35-44	4(13%)	2(6.6%)	2(6.6%)	8(8%)
45-54	4(13%)	9(30%)	7(23%)	20(22%)
55-64	11(36%)	10(33%)	13(43%)	34(37%)
65-74	5(16%)	8(26%)	4(13%)	17(18%)
> 75	1(3%)	1(3%)	1(3%)	3(3%)
Total	30	30	30	90

Group I has mean value of finger stick capillary blood glucose was 88 mg/dl and a standard deviation of 8.204 mg/dl. Group II has mean value of finger stick capillary blood glucose was 123.4 mg/dl and a standard deviation of 8.8439 mg/dl. Group III has mean value of finger stick capillary blood glucose was 196.37 mg/dl and a standard deviation of 40.466 mg/dl. All these 3 mean values were studied with ANOVA test. It gives f- value 154.73mg/dl and p value 0.001 which is <0.05, thus giving statistically significant difference. (Table 4)

Table 4:- Comparison of finger stick capillary blood glucose level.

Group	Mean (mg/dl)	SD (+/-) (mg/dl)	f-value (mg/dl)	p-value
Group I	88	8.204	154.73	0.001
Group II	123.4	8.439		
Group III	196.37	40.466		

Group I has mean value of gingival capillary blood glucose was 88.5 mg/dl and a standard deviation of 9.573 mg/dl. Group II has mean value of gingival capillary blood glucose was 123.33 mg/dl and a standard deviation of 8.206 mg/dl. Group III has mean value of gingival capillary blood glucose was 202.17 mg/dl and a standard deviation of 42.892 mg/dl. All these 3 mean values were studied with ANOVA test. It gives f value 330.4 and p value 0.001 which is <0.05 , thus giving statistically significant difference. (Table 5)

Table 5:- Comparison of gingival capillary blood glucose level.

Group	Mean (mg/dl)	SD (+/-) (mg/dl)	f-value (mg/dl)	p-value
Group I	88.5	9.573	152.71	0.001
Group II	123.33	8.206		
Group III	202.17	42.892		

In Group I participants, gingival capillary blood glucose showed a higher mean value (88.5 mg/dl) than finger stick capillary blood glucose mean value (88.0 mg/dl) and the Pearson's correlation coefficient showed an r-value of 0.936 and a p-value of 0.001 which is <0.05, thus giving statistically significant correlation.

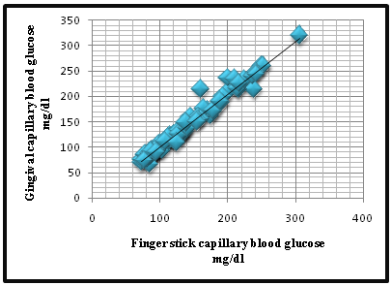
In Group II participants, finger stick capillary blood glucose showed a higher mean value (123.4 mg/dl) than gingival capillary blood glucose mean value (123.3 mg/dl) and the Pearson's correlation coefficient showed an r-value of 0.922 and a p-value of 0.001 which is <0.05, thus giving statistically significant correlation.

In Group III participants, gingival capillary blood glucose showed a higher mean value (202.17 mg/dl) than finger stick capillary blood glucose mean value (196.37 mg/dl) and the Pearson's correlation coefficient showed an r-value of 0.953 and a p-value of 0.001 which is <0.05, thus giving statistically significant correlation.

Table 6 shows plotting of gingival capillary blood glucose levels and finger stick capillary blood glucose levels of all 90 participants. The correspondence between these two parameters were shown in this graph, together with the line of equality. This line suggestive of a strong positive, linear and significant correlation existed between gingival capillary blood glucose levels and finger stick capillary blood glucose levels. (Graph 1)

Table 6 :- Intra-group comparison of finger stick capillary blood glucose level versus gingival capillary blood glucose level.

Group	Mean finger stick capillary blood glucose + SD (mg/dl)	Mean gingival capillary blood glucose + SD (mg/dl)	Pearson's correlation value (r)	p-value
Group I	88 + 8.204	88.5 + 9.573	0.936	0.001
Group II	123.4 + 8.439	123.33 + 8.206	0.922	
Group III	196.37 + 40.466	202.17 + 42.892	0.953	



Graph 1:- Showing correlation between finger stick capillary blood glucose level and gingival capillary blood glucose level.

DISCUSSION :-

The present study was conducted to find an alternative medium like gingival crevicular blood that can be used to diagnose and monitor diabetes. In present study we divided the participants into three subgroups based on their HbA1c percentage. Patients with HbA1c <5.7% were considered ideal control level, 5.7% to 6.5% were considered reasonable control, and >6.5% were considered poor control.[9] Each group contain 30 participants.

In our study out of these 90 participants 41 were males (45.55%) and 49 were females (54.45%). The prevalence of diabetes seems to be more or less the same in both gender.[7] The slight female predominance seen in our study corresponds to other studies by Al

zahawi et al[8] and Abikshyeet P et al. [9]

As in our study we found higher mean value of finger stick capillary blood glucose was 196.37 mg/dl and a standard deviation of 40.466 mg/dl in uncontrolled diabetics than controlled diabetics. Controlled diabetics had mean value of finger stick capillary blood glucose was 123.4 mg/dl and a standard deviation of 8.8439 mg/dl. while healthy non diabetics had mean value of finger stick capillary blood glucose was 88 mg/dl and a standard deviation of 8.204 mg/dl. which was lesser than both Group II and Group III the difference was statistically highly significant ($p< 0.001$). It was in accordance with studies by Prabhu S et al.[10] and Meti M et al. [16]

On comparison of finger stick capillary blood glucose and gingival crevicular blood glucose measurements gingival crevicular blood glucose showed a higher mean value than finger stick capillary blood glucose mean value in all 3 groups and the Pearson's correlation coefficient showed an r-value of 0.936, 0.922 and 0.956 respectively and a p-value of 0.001 which is <0.05, thus giving statistically significant correlation.

The results of this study are in agreement with the studies conducted by Parker et al.[11], who examined diabetic patients with unknown periodontal status, and wherein a very strong correlation was observed between gingival crevicular, finger prick capillary and the corrected intravenous blood glucose measurements, and, Beikler T et al.[12] wherein, a strong correlation was observed between GCB and finger stick capillary measured blood glucose when diabetic and non-diabetic patients with moderate to advanced periodontitis were examined.

The present study is in agreement with another study that demonstrated strong correlation between gingival crevicular and fingerstick capillary blood. such as Strauss SM et al. concluded that gingival crevicular blood samples were suitable to screen for diabetes in persons with sufficient bleeding on probing to obtain a sample without touching the tooth or gingival margin.[14] G. N. Bala Raghavendra et al[13], Prabhu S et al. [10] and Meti M et al. [6] also concluded that both the GBGL and CBGL were significantly greater in diabetics than their non-diabetic counterparts and the GBGL correlated with CBGL.

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 stick capillary blood. However, in a study conducted by Muller et al. (2005)[15] on diabetic and non-diabetic patients with gingivitis and moderate to advanced periodontitis, the results failed to provide any evidence for the usefulness of gingival capillary blood for testing blood glucose level during routine periodontal examination.

CONCLUSION :-

We may conclude that a high correlation exists between gingival crevicular blood glucose and finger stick capillary blood glucose level in diabetic patients and non-diabetic patients,that may be an excellent source of blood for glucometric analysis. The technique is safe, easy to perform, and comfortable for the patient and therefore, helps to increase the frequency of diagnosing diabetes during routine periodontal examination which provides a more objective indicator for referral to physicians than traditional methods. Thus, the dentist should increase his importance as a member of the oral health team by participating in the search for undiagnosed asymptomatic diabetes mellitus.

Though capillary/venous blood samples used for diabetes mellitus screening is gold standard, the gingival crevicular blood may prove to be promising approach for routine dental office screening for diabetes mellitus in periodontal patients. During routine dental examination the blood glucose level estimation using gingival crevicular blood would definitely contribute greatly to patients who have undiagnosed diabetes mellitus.

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