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Dentist' Role in Managing Patients with Established Diabetes Mellitus by Correlation of Glucose Levels among Venous, Gingival and Finger-Prick Blood Samples

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Abstract: ***Background: Periodontitis is often associated with diabetes and considered as the "sixth complication of diabetes". Hence it is a common finding in the medical history of patients receiving treatment for periodontal disease. Although periodontal disease itself is associated with gingival bleeding, if the patient is diabetic, investigators find that gingival bleeding is more severe. Aim: This study were undertaken to establish a dentist' role in managing patients with established diabetes mellitus based on their oral clinical manifestations. Methods: A total of 15 subjects, were selected from the department of oral medicine/periodontics Al-Badar Dental College, Gulbarga. Blood samples were collected from venous, gingival and finger-prick, and analyzed by glucose oxidase method, and also by using commercially available glucometer. Results: The present study shows that highly significant positive correlation between the venous blood glucose and gingival, finger prick and laboratory values of blood glucose. Conclusion: Gingival blood collected during diagnostic periodontal examination may be an excellent source of blood for glucometric analysis.***

Keywords: diabetes mellitus, periodontitis, glucometer

1. Introduction

Diabetes mellitus (DM) is a metabolic disorder characterized by hyperglycemia due to defective secretion or activity of insulin.[1], [2] It is one of the most important risk factors for destructive periodontitis.[3]At the same time periodontal diseases can have significant impact on diabetes, it may worsen the glycemic control over time and alter the metabolic state and hence considered as pathognomic sign of diabetes mellitus.[4] Periodontal disease is recognized as sixth complication of diabetes mellitus, hence ignoring diabetes could cause therapeutic failure.[5]

A number of studies found a higher prevalence of periodontal disease among diabetic patients than among healthy controls.[6] In a large cross-sectional study, Grossi and others showed that diabetic patients were twice as likely as non-diabetic subjects to have attachment loss.[7] Firatli followed type 1 diabetic patients and healthy controls for 5 years, and found that the people with diabetes had significantly more clinical attachment loss than controls.[6]

In another cross-sectional study, Bridges and others found that diabetes affected all periodontal parameters, including bleeding scores, probing depths, and loss of attachment and missing teeth.[8] In fact, one study has shown that diabetic patients are 5 times more likely to be partially edentulous than non-diabetic subjects.[9]

In 1998, World Health Organization adopted the diagnostic parameters for diabetes established by the American Diabetes Association, according to which measuring the fasting blood glucose is considered to be the gold standard for diagnosing diabetes[10] but these conventional laboratory methods employed to detect blood glucose are time consuming, invasive and require elaborative equipment. The advent of blood glucose monitors allows the clinician to assess blood glucose at the chair side[11] and it would be more preferable for a periodontist to collect blood sample from gingiva rather than venous blood**.**

Hence this study was undertaken to establish a dentist's role in managing patients with established diabetes mellitus based on their oral manifestations.

2. Materials and Methods

A total of fifteen patients in the age group of 40 to 65 years of either sex were selected for the study. From the department of periodontics Al-Badar Dental College and Hospital, Gulbarga, Karnataka. Selected patients having at least one tooth that bled upon probing, periodontal pocket and mobility preferably mandibular anterior teeth and should be free from any systemic disease other than diabetes were included. Patients under supplement such as ascorbic acid (vitamin C) and Lactating mothers and smokers were excluded from study.

For gingival blood sampling, the most inflamed site in the lower anterior region was selected and isolated with cotton rolls Lignocaine gel (2%) was applied. After 1 minute, the gel was wiped off and the selected site was freshly isolated with cotton rolls. The outer surface of the gingiva was pricked with a sterile lancet. Approximately 10 µl of blood was collected using capillary tube. The blood was transferred onto a slide. The commercially available (Accu Chek- Active) strip (placed in the glucometer) was touched onto this blood drop on the slide and analyzed using a glucometer. For finger-prick blood: the pulp of the fingertip was pricked with a sterile lancet, and a drop of blood was collected. For both the samples, the reading was obtained after 15 seconds by placing on a commercially available glucose oxidase test strip in the self-monitoring device. For venous blood sampling, approximately 1ml of routine venous blood was drawn from the patient's cubital fosse and analyzed by glucose oxidase method, and also by using glucometer.

3. Statistical Analysis

The glucose values obtained from gingival blood, finger-prick blood, and venous blood from laboratory method were analyzed using SPSS statistical package.

The correlation between blood glucose measurement pairs of patients with periodontitis was determined by calculating intra class correlation coefficient (ICC). In each method of the study, Pearson's rank correlation was used.

4. Results

Table 1, shows Diabetic Patients with periodontitis included 9 males and 6 females with a mean age of 56.33 ± 7.15 years old.

Table 1: Age and gender distribution of study subjects

		n	%
Gender	Male	9	60.0%
	Female	6	40.0%
	Total	15	100.0%
Age in years (mean and standard deviation)		56.33±7.15	

The percentage deviations of gingival blood glucose level measurements and finger-prick blood glucose level measurements from the standard venous blood glucose level measurements were recorded, which showed that 72.86% of gingival and 68.57% of finger-prick blood glucose level measurements were found to be within ±15% of the standard venous blood glucose level measurements.

Table 2, figure 1, show means and standard deviations of venous, gingival and finger-prick blood glucose level measurements, of which mean of finger-prick blood glucose level measurements were the highest, being 212.27 mg/dl and standard deviation of lab values of venous blood glucose level measurements were higher being 953.45 mg/dl, which indicates that deviations of fingerprick and lab values of blood glucose level measurements are more than those of gingival blood glucose level measurements when both are compared with venous blood glucose level measurements.

Table 2: Means and standard deviations of venous, gingival and finger-prick blood glucose level measurements

	Mean	Standard Deviation
Gingival_ Blood_ Glucose (mg/dl)	186.20	69.89
Finger_ Prick_ Blood Glucose (mg/dl)	212.27	88.40
Venous_ Blood_ Glucose (mg/dl)	186.33	84.20
Lab_ Values (mg/dl)	193.80	93.45

Figure 1: Mean and SD values of glucose level measurements. (mg/dl)

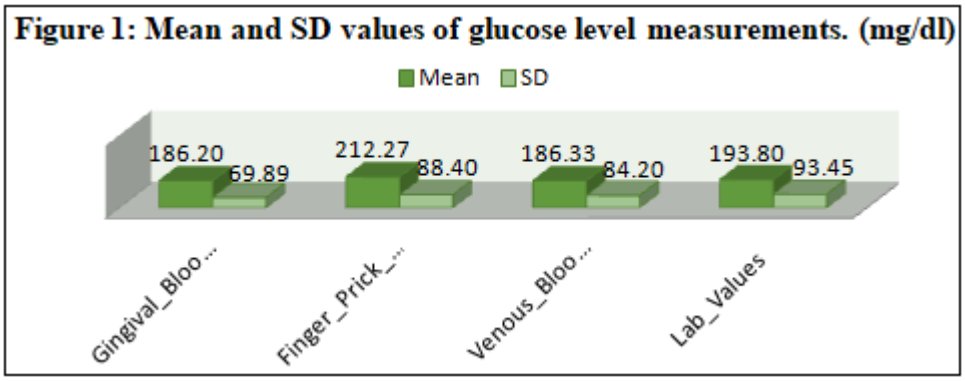

Table 3: Pearson's Correlation tests between venous, gingival, finger prick and lab blood glucose levels

		Venous_ Blood_ Glucose	Gingival_ Blood_ Glucose	Finger_ Prick_ Blood Glucose	Lab_ Values
Venous_ Blood_ Glucose	Pearson Correlation	1	.969**	.930**	.908**
	Sig. (2-tailed)		**.000**	**.000**	**.000**
	N	15	15	15	15
Gingival_ Blood_ Glucose	Pearson Correlation	.969**	1	.924**	.925**
	Sig. (2-tailed)	**.000**		**.000**	**.000**
	N	15	15	15	15
Finger_ Prick _BloodGlucose	Pearson Correlation	.930**	.924**	1	.779**
	Sig. (2-tailed)	.000	.000		.001
	N	15	15	15	15
Lab _Values	Pearson Correlation	.908**	.925**	.779**	1
	Sig. (2-tailed)	.000	.000	.001	
	N	15	15	15	15
**. Correlation is significant at the 0.01 level (2-tailed).					

Table 3, shows highly significant positive correlation between the venous blood glucose and gingival, finger prick and laboratory values of blood glucose.

5. Discussion

The American Diabetes Association recommends that screening for diabetes should start at the age of 45 years and be repeated every 3 years in persons without risk factors,

and earlier and more often in those with risk factors for diabetes.[12] Moreover, testing at younger age or more frequently should be carried out in individuals who are (a) obese, (b) have a 1st degree relative with diabetes, (c) are members of a high-risk ethnic population, (d) have delivered a baby weighing 4.05 kg or have been diagnosed with gestational diabetes mellitus, e) are hypertensive (>140/90), (f) have an HDL cholesterol level <35 mg/ dl and/or a triglyceride level >250 mg/ dl, (g) had on previous testing an impaired glucose tolerance or an impaired fasting glucose.[13]

The primary methods used to diagnose diabetes mellitus and monitor blood glucose levels have traditionally been fasting blood glucose, a combination of fasting blood glucose with a 2-hour test after glucose loading (2-hour post-prandial) and oral glucose tolerance test.[14] These tests require fasting by the patient, tend to be highly dependent on patient compliance, and results usually will only be available at subsequent visit (second appointment). Thus, more than one appointment is usually needed to assess the glycemic status and make necessary therapeutic decisions. It may be more convenient for the dental surgeon to obtain blood sample from the gingival site.[12]

Stein and Nebbia 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.[15]

Tsutsui et al. reported the rubbing of blood onto the test strip from a blood-laden dental curette.[16] 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.[17] Also, significant contamination may occur from saliva and oral debris present at the wiped gingival area or from plaque and crevicular fluid on the dental curette from its entry into the gingival sulcus.[18]

American Diabetes Association in their consensus statement on blood glucose monitoring (1987) 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.[18] To over-come these errors, Parker et al used a glucometer, which is self-timing and requires no wiping. The use of plastic pipette is claimed to reduce contamination of the sample with saliva, plaque, and debris.[16]

Beikler et al, suggested direct use of test strip of glucometer to collect blood sample from gingiva. In contrast to Parker's study, the sampling procedure used in this study was much easier to perform and less time consuming and required no additional tools to collect gingival blood. Estimation of Gingival blood glucose level can be done as an in-office screening procedure.[19]

The advantages of this method are, it is safe, reliable, and easy to perform, inexpensive, comfortable for patients, non-invasive, painless and convenient for the dentist.

The strong correlation obtained in the present study on comparison between the various blood glucose measurements indicates the feasibility of using gingival blood as an alternative to the Finger prick blood in accordance to the previous studies. But significant correlation was found between gingival blood glucose levels and venous blood glucose levels

6. Conclusion

Gingival blood collected during diagnostic periodontal examination may be an excellent source of blood for glucometric analysis. Though capillary/venous blood samples used for diabetes mellitus screening is gold standard, the gingival blood may prove to be promising approach for routine dental office screening for diabetes mellitus in periodontal patients. The technique is cost effective, safe, easy to perform, comfortable and patient is less apprehensive as there is no venous blood withdrawal, gives quick results and therefore, helps to increase the frequency of diagnosing diabetes during routine periodontal therapy.

7. Clinical Significance

1) Hyperglycemia has the potential to alter the local environment in the periodontal pocket.
2) Diabetes increases glucose concentration in the gingival crevicular fluid and decreases the salivary levels, which plays an important role in wound healing.
3) Modification in gingival crevicular fluid may affect plaque composition.[20]

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