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ORIGINAL ARTICLE

Glucometer As A Chairside Diagnostic Device To Assess Blood Glucose In Chronic Periodontitis Patients With And Without Diabetes

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ABSTRACT

Diabetes and periodontal health status have long been considered to be biologically linked. It is essential for a dental surgeon or a periodontist to detect blood glucose level for patients whose signs and symptoms are suggestive of diabetes. Self monitoring devices provide a simple method for rapid monitoring of the glucose level in blood. The present study was designed to check the validity of glucometer as a chairside diagnostic device in chronic periodontitis patients with and without diabetes. The study included 45 patients divided into three groups (15 chronic periodontitis patients with diabetes mellitus, 15 chronic periodontitis patients without diabetes mellitus and 15 healthy patients). Samples were taken from gingival crevicular, gingival capillary, finger prick blood and values were compared with standardized venous blood sample results. The results of study show a strong correlation between blood sugar values of gingival crevicular blood with laboratory venous blood sugar than other parameters.

KEY WORDS: Chronic Periodontitis, Diabetes, Glucometer.

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INTRODUCTION

Periodontal disease is the sixth most common complication of diabetes making it a major risk factor influencing the incidence and severity of periodontal related problems. The prevalence of diabetes mellitus in patients with periodontitis is greater than in periodontally healthy patients. Therefore, a high number of patients with periodontitis may have undiagnosed diabetes mellitus (1).

Diabetes mellitus is associated with a wide range of complications, such as retinopathy, nephropathy, neuropathy, micro- and macrovascular disease, altered wound healing, and periodontitis (Expert Committee on the Diagnosis and Classification of Diabetes Mellitus 1997) (2). Moreover, diabetes and periodontitis seem to interact in a bidirectional manner (Grossi & Genco 1998) (3). At present, there is strong evidence to suggest that the incidence and severity of periodontitis is influenced in part by diabetes mellitus and the level of blood glucose control (Nishimura et al. 1998) (4). Moreover, periodontal therapy might exert beneficial effects on diabetes control (Miller et al. 1992) (5).

The conventional laboratory methods that are employed to screen for diabetes are time consuming and necessitates elaborative equipments. The advent of blood glucose monitors allows the clinicians to assess blood glucose levels at the chair side and results are obtained instantaneously in contrast to laboratory methods (6).

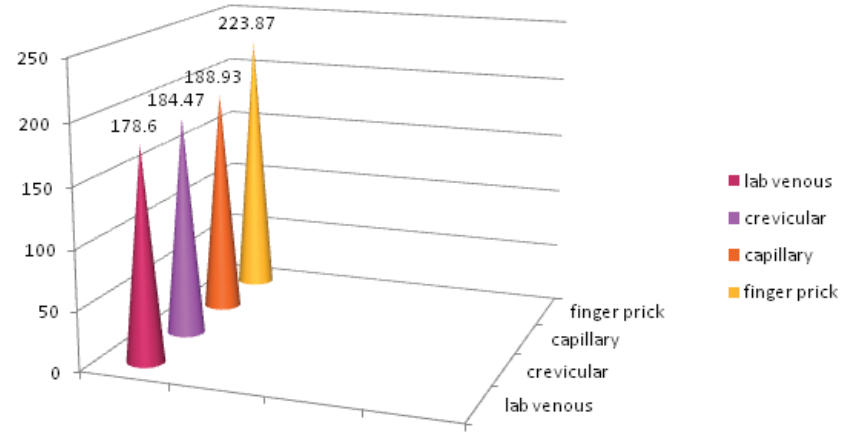
Glucose self-monitoring systems have

provided reliable, rapid blood glucose determinations in diabetes screening and in home monitoring. When utilized in a dental office, such a system could result in a more objective parameter for referral for diagnosis of diabetes mellitus. Dental office screening could result in earlier treatment and possible minimization of serious complications. Development of an intra oral blood sampling technique as opposed to the typically used finger site could make such tests even more suitable for use by dental practitioners (7). Dentist seems to be more secure in obtaining blood samples from gingival tissues than using conventional blood collection method (6).

The aim of the study was to check the validity of glucometer as a chairside diagnostic device in chronic periodontitis patients with and without diabetes and to correlate the values of blood sugar obtained from gingival crevicular blood, gingival capillary blood, finger prick blood samples with the standardised laboratory blood samples.

MATERIALS AND METHODS

Forty five patients in the age group 30-55 years suffering from chronic periodontitis were selected amongst the patients visiting the Department of Periodontology and Oral Implantology, Dasmesh Institute of Research and Dental Sciences, Faridkot (Punjab) in the months of January & February, 2015. The subjects were selected randomly with no discrimination of sex, caste, religion or socioeconomic status. All subjects were verbally informed and written informed consent was taken for participation in the study. The patients's past dental and family histories were note. The forty five subjects were divided into three groups of 15 patients each as follows, group A (patients with Chronic Periodontitis and diabetes mellitus), group B (patients with Chronic Periodontitis without diabetes mellitus) and group C (systemically healthy patients). Blood samples for blood glucose testing were taken from gingival crevicular blood, gingival capillary blood, finger prick blood and these values were correlated with standardized laboratory venous blood values.



1: 3-D cone graph of correlation between lab venous, gingival crevicular, gingival capillary and finger prick blood samples in patients with chronic periodontitis with diabetes mellitus (Group A).

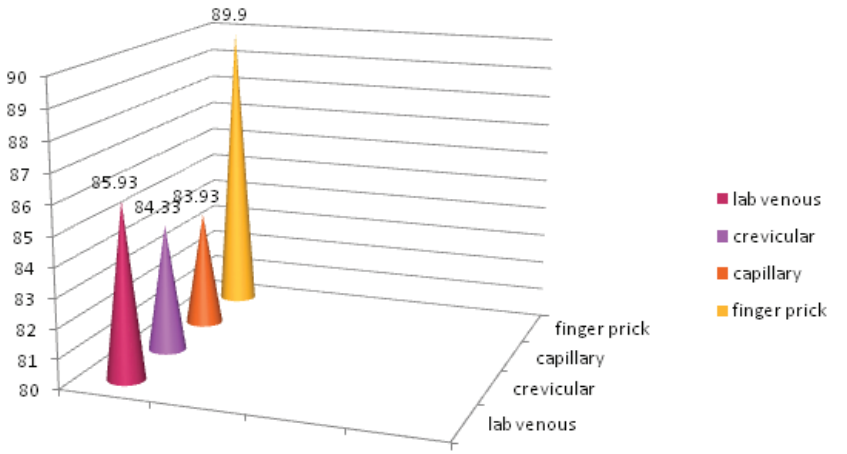


Figure 2: 3-D cone graph of correlation between lab venous, gingival crevicular, gingival capillary and finger prick blood samples in patients with chronic periodontitis without diabetes mellitus (Group B).

Glucometer used in the study: New AKKISCANTM ZEE+

**Manufactured by NEMPRO CARE (An ISO 9001-2008 Certified organisation), Haryana, India. Principle of the test method: Amperometric, glucose oxidase. It requires blood volume of 0.7 microlitres, measurement range: 1.1 ~33.3 mmol/L, measurement time: 6 seconds.*

Inclusion criteria

- Chronic periodontitis patients with probing pocket depth equal to or greater than 5mm.
- Patients of either sex being in age group 35-55 years having at least one lower anterior tooth that bled upon probing.
- Patients with no history of systemic antibiotic intake for the last three months.
- Patients who do not require an antibiotic premedication.
- Patients with no history of bleeding disorders.

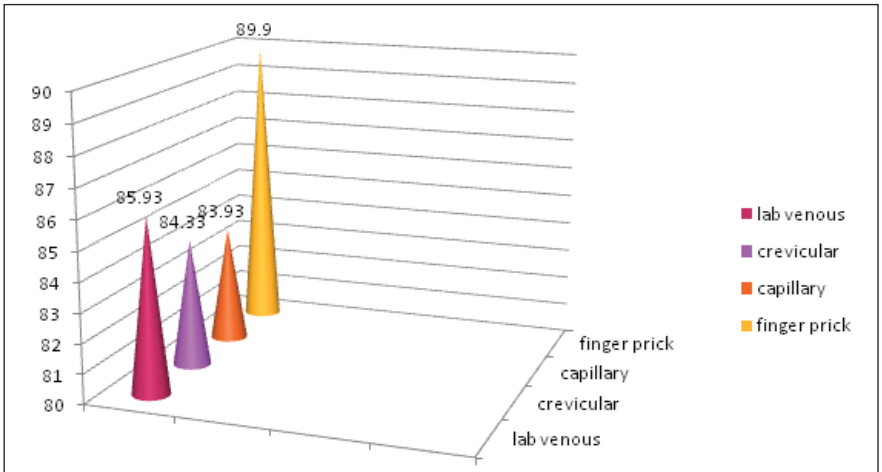


Figure 3: 3-D cone graph of correlation between lab venous, gingival crevicular, gingival capillary and finger prick blood samples in healthy patients (Group C).

Exclusion criteria

Following patients were excluded from study:

- Those were taking anti-coagulants eg; Coumarin derivatives, Non steroidal anti-inflammatory drugs or Heparin.
- Those with severe cardio-vascular, hepatic, immunologic, renal, haematological or other organ disorders.
- Those who were taking ascorbic acid medications.
- Pregnant females. Figure 1

BLOOD GLUCOSE MEASUREMENT

Gingival crevicular blood

As maxillary anterior teeth offer an ideal access for the collection of gingival crevicular blood, the gingival crevicular blood from either of the maxillary central incisors were taken for estimation of blood glucose levels. For each measurement, only one site with bleeding on probing was selected. Sites with suppuration were excluded from the study. After selecting the bleeding site, the site was isolated with cotton rolls. The interdental papilla between the central incisors was probed with a Williams graduated probe.

As soon as the probe was removed after few seconds, the gingival crevice was observed for bleeding. At this stage, the test end of the strip (mounted on the glucose monitoring device already) was kept on to the bleeding site to obtain the blood sample on the test strip without contacting the gingival or palatal tissues. The test strip was held until the instrument beeped giving the blood glucose measurements in mg/dl. (Fig. 2a)

Gingival capillary blood

For gingival capillary blood sampling, the most inflamed site in the lower anterior region (Fig. 2b) 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. The commercially available strip (placed in the glucometer) was touched onto this blood drop and analyzed using a glucometer.

Finger-prick Blood

The pulp of the finger was wiped with the surgical spirit and spirit was allowed to evaporate. The finger was then punctured with a sterile lancet. The first drop of blood was discarded and the second drop of blood was touched to the test end of the strip. It was held until the instrument gave a beep displaying the blood glucose measurements on the screen in mg/dl. (Fig. 2c)

Table1: mean, standard deviation and range values of blood sugar levels measured at different sites in three groups

Group	No	Particulars	Gingival crevicular blood sample (mg/dL)	Gingival capillary blood sample (mg/dL)	Finger prick blood sample (mg/dL)	Lab venous blood sample (mg/dL)
Groupa A	15	Mean	184.47	188.93	223.87	178.60
(Chronic Periodontitis		SD	556.653	58.476	86.380	54.854
with diabetes mellitus)		Range	118-316	112-329	104-469	117-280
Group B	15	Mean	84.33	83.93	89.80	85.93
(Chronic Periodontitis		SD	16.087	16.668	18.013	17.503
without Diabetes mellitus)		Range	66-119	57.118	56-121	60-119
Group C	15	Mean	82.67	86.87	91.53	77.87
(Healthy patients)		SD	11.069	11.686	16.466	7.160
		Range	69-110	66-113	63-110	70.87

Intravenous Blood

The flexor surface of the patient's non-dominant arm was wiped with spirit and the spirit was allowed to evaporate. Using a disposable syringe, 0.5 ml of venous blood was drawn from the ante-cubital fossa into the syringe (Fig. 2d) and the blood sample was analyzed for the measurement of blood glucose levels using a reference glucose analyzer.

Statistical analysis

Statistical analysis was performed by Pearson Product Moment Correlation. Descriptive data is presented as mean, standard deviation and range of blood sugar levels in (Table 1). The difference between the measurements in the same individual was tested by paired't' test. Pearson's correlation coefficient was used to assess the relationship between lab venous blood sugar and other parameters in different groups (Table 2).

RESULTS

Our study showed a strong correlation between blood sugar values of gingival crevicular blood (highly significant) with laboratory venous blood sugar values followed by gingival capillary (significant) and finger prick blood values (non-significant).

- **Group A –** A highly significant correlation was found between blood sugar values of gingival crevicular blood and laboratory venous blood (p value =0.000; r = 0.942). Blood sugar values of gingival capillary blood were significant (p value = 0.04, r value = 0.690). Blood sugar values of finger prick blood were non- significant (p value = 0.18, r = 0.361) (Table 2)
- **Group B –** A highly significant correlation was found between blood sugar values of gingival crevicular blood and laboratory venous blood (p value =0.002; r = 0.739). Blood sugar values of gingival capillary blood were significant (p value = 0.007, r value = 0.668). Blood sugar values of finger prick blood were non- significant (p value = 0.183, r = 0.363) (Table 2)
- **Group C –** A highly significant correlation was found between blood sugar values of gingival crevicular blood and laboratory venous blood (p value =0.000; r = 0.872). Blood sugar values of gingival capillary blood were highly significant (p value = 0.000, r value = 0.789). Blood sugar values of finger prick blood were non- significant (p value = 0.192, r = 0.391) (Table 2)

DISCUSSION

The close interrelationship between diabetes and periodontitis can be assumed that the dental practitioner is extremely likely to encounter an increasing number of undiagnosed diabetes patients with periodontitis.

As early as 1969, Stein and Nebbia (8) used the interdental gingival papilla prick method with test strips to screen patients with high gingival blood glucose. Since periodontal inflammation with and without complication factor of diabetes is known to produce ample extravagate of blood during diagnostic periodontal examination (Ervasti et al 1985) (9) no extra procedure, e.g., finger puncture with a sharp lancet is necessary to obtain blood for glucometric analysis. Even in the case of very low gingival crevicular bleeding, a glucose measurement is possible with the use of self-monitoring device, due to the low amount of blood (μl) necessary to perform the analysis (10-12).

With regard to the development of painless and noninvasive methods to measure blood glucose, considerable effort has been made in past few years (Kost et al 2000) (13) However, until now, none are in routine clinical practice.

Since the corrected laboratory measurement is considered to be true (or reference) value, its comparison to gingival crevicular, gingival capillary and finger prick blood measurements allows the evaluation of accuracy and precision of each blood collecting technique and the self-monitor (7,14).

Our study showed a strong correlation between blood glucose values of gingival crevicular blood samples with labo-

Table 2: Relationship between Lab venous blood sugar and other parameters in different groups

Groups	Correlation between	Pearson correlation	P value	
Group A	Lab Venous & Gingival Cervicular Blood	0.942	0.000	HS
	Lab venous & gingival capillary blood	0.690	0.04	S
	Lab venous & finger prick blood	0.361	0.18	NS
Group B	Lab Venous & Gingival Crevicular Blood	0.739	0.002	HS
	Lab venous & gingival capillary blood	0.668	0.007	S
	Lab venous & finger prick blood	0.363	0.183	NS
Group C	Lab Venous & Gingival Crevicular Blood	0.872	0.000	HS
	Lab venous & gingival capillary blood	0.789	0.000	HS
	Lab venous & finger prick blood	0.391	0.192	NS

* S= significant; HS= highly significant; NS= non significant.

Figure 4: Armamentarium

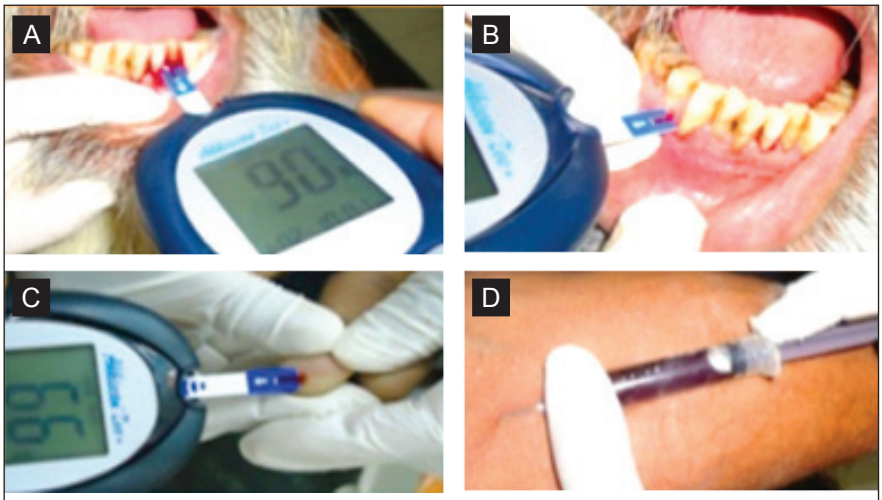


Figure 5: (a) Gingival Crevicular Blood Sampling (b) Gingival Capillary Blood Sampling (c) Finger Prick Blood Sampling (d) Laboratory Venous Blood Sampling

ratory venous blood glucose values followed by gingival capillary and finger prick blood values. A highly significant correlation was found between blood sugar values of gingival crevicular blood and laboratory venous blood in all the groups [(group I- p value=0.000; r =0.942), (group II- p value=0.002; r=0.739), (group III- p value=0.000, r=0.872)]. This is in agreement with Parker et al (1993)(15), Beikler T et al (2002)(16), Ardakani MR et al (2009)(1) and Strauss et al (2009) (17).

However, the correlation between the measures can be influenced by a variety of factors such as site of sample collection, sampling methodology, type of instrument used and duplicate sampling. Regarding site of sample collection, a previous study by Strauss et al (2009) (17,18) reported that GCB samples were suitable to screen for diabetes in persons with sufficient bleeding on probing to obtain a sample without touching the tooth or the gingival margin (i.e., in patients having the basic clinical signs of gingivitis or periodontal disease). Also, the method of collection of sulcular blood is critical because the resultant glucose values may be altered if there is any contamination of the collected sample by the oral tissues or tissue products. Past intraoral blood glucose studies have transferred blood onto the test strip by wiping blood directly from the hemorrhagic gingival tissue with the test strip itself or by rubbing blood onto the test strip from a blood laden dental curette. Rubbing or direct wiping of intraoral blood onto the strip will not produce a uniformly timed reaction and may damage the strip's chemical indicator surface. 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. In the present study, isolating the bleeding gingival site with a gauze after scaling and more recently, Shetty and Kohad et al (2011)(19) studied a previously unsuspecting periodontal population for diabetes using the same method. However, because majority of the patients are usually apprehensive whenever invasive techniques are used, we have incorporated the non-invasive method where the blood oozing out during routine periodontal examination is checked for diabetes (11).

In this study, 2% Lignocaine jelly was used as a topical anesthetic and was applied 1 minute prior to gingival prick. This makes the gingival prick almost painless. Finger prick produces trauma to fingers, as well as subjective symptoms of pain invariably. Fingertips are full of nerve endings (receptors) which make finger prick very painful. Gingival blood sampling may be more comfortable in patients because of local anesthesia application. Quick results are obtained with glucometer; the result may be displayed within 15 to 90 seconds (American Diabetes As-

sociation) (20). Because of the quick recordings obtained, glucometer can be used as an educational tool for the patient for easy and quick chair-side counseling. The main controversial issue is the reliability of glucometer, as they may show large deviations. Future research with larger sample size should be done (21,22).

CONCLUSION

The results of present study indicate that glucometer is a reliable chairside diagnostic aid to detect blood glucose levels in a dental clinic and gingival crevicular blood 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.

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