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RESEARCH ARTICLE

# ASSESSMENT AND CORRELATION OF BLOOD GLUCOSE LEVELS USING GINGIVAL CREVICULAR BLOOD, FINGER-CAPILLARY BLOOD AND VENOUS BLOOD SAMPLES IN DIABETIC AND NON-DIABETIC PATIENTS

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**ABSTRACT**

**Introduction:** Diabetes has a high prevalence rate in India. More than 62 million diabetic individuals were currently diagnosed with diabetes. Most often patients with diabetes go undiagnosed. This study was undertaken to screen patients for diabetes mellitus using gingival crevicular blood during dental procedures.
**Objective:** Objectives are to assess and compare the glucose levels in the gingival crevicular blood, Finger capillary, and intravenous blood.
**Materials and Methods:** The study involved 30 diabetics and 30 non-diabetic patients in the age group of 20 to 80 years of either sex with a positive sign of bleeding on probing. Glucometer has been used to measure blood glucose measurements from the samples of gingival crevicular blood (GCB) and finger prick(FP). Intravenous blood (IVB) was collected for glucose level measurement in a laboratory glucose analyzer.
**Results:** Among diabetics, GCB and IVB show moderate positive correlation (0.71) and strong positive correlation between FP and IVB (0.93). Among Non-diabetics, moderate positive correlation observed between FP and IVB (0.67) and GCB and IVB(0.76).
**Conclusion:** The data from this study shows that among diabetic patients FP can be taken as a strong tool for glucometric analysis. Whereas among non-diabetic patients GCB can be considered as good source of blood for glucometric analysis. In diabetics, GCB can be taken as a source for glucometric analysis but with caution as GCB and IVB showed moderate positive correlation.



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## INTRODUCTION

Diabetes is a metabolic disorder which is associated with abnormally high glucose levels in the blood. More than 62 million diabetic individuals have currently diagnosed with diabetes. Most often patients with diabetes go undiagnosed (Kaveeshwar *et al*., 2014). In the year 2000, Highest number of people with diabetes mellitus were seen in India (31.7 million) which was followed by China (20.8 million) and then the United States (17.7 million) in second and third place respectively. It is predicted that by 2030, 79.4 million diabetic individuals will be present in India (Wild *et al*., 2004). Various diagnostic tests viz. oral glucose tolerance test, fasting plasma glucose test, random blood glucose test, urine test, glycated hemoglobin are the complex tests used by physicians for definitive diagnosis (Tsutsui *et al*., 1985). A large number of patients undergo dental treatment not being aware of their undiagnosed diabetes mellitus, thus the dentist plays a vital role in diagnosing the undiagnosed asymptomatic diabetes mellitus patients. It is estimated that for every patient with known diabetes there is one with undiagnosed diabetes mellitus in dental patients (Stein *et al*., 1969). It's a responsibility of dental practitioners to screen for undiagnosed cases which may influence dental treatment or the general well-being of their patients (Council on Dental Health and Health Planning-1980). Thus, monitoring their blood glucose during the office visit may be a better alternative (Parker *et al*., 1993). Routine gingival probing during the periodontal examination is more familiar to the practitioner and less traumatic than a finger puncture with a sharp lancet. It is possible that gingival crevicular blood from probing may be an excellent source of blood for glucometric analysis using the technology of glucose self-monitoring device (Parker *et al*., 1993). Glucose self-monitoring systems have provided reliable, rapid blood glucose determinations in diabetes

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screening (William L Clarke *et al*., 1987). 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 (Tsutsui *et al*., 1985). Using glucose self-monitoring device might be of considerable interest to the dental practitioners since it is accurate, be used as an in-office screening device for any patient, suspected diabetes or a way to monitor blood sugar levels in known diabetics (Muller *et al*., 2004). The aim of the study is to establish whether Gingival crevicular blood can be used as a diagnostic aid in screening for diabetes. Objectives are to assess and compare the glucose levels in the gingival crevicular blood, Finger capillary, and intravenous blood.

## MATERIALS AND METHODS

A cross-sectional study was performed on a total of sixty patients, 30 diabetics and 30 non-diabetics, aged 20 to 70 years, with a positive sign of bleeding on probing who visited Department of Public Health Dentistry, SRM Dental College. The patients were divided into two groups i.e. Group I (30 diabetics) & Group II (30 non-diabetics). Patients who required antibiotic premedication, who were taking substances that interfere with the coagulation system and those with severe organ disorders were excluded from the study. Prior to collection of the samples, the oral health status of the patient was assessed using WHO proforma 2013. From each patient of both the groups, blood samples from Gingival crevicular blood (GCB), Finger-prick blood (FPB) and intravenous blood (IVB) were drawn and was analyzed for blood glucose values. The ethical clearance was obtained from the Department of Public Health Dentistry. Informed consent was taken from all the subjects prior to the start of the study. Sample size calculation has been done using G-Power software. Maxillary anterior teeth were isolated with gauze and air dried to avoid contamination and were probed with CPITN probe. It was evaluated for bleeding on probing after 30seconds. A Blood sample was collected on the test end of the strip of glucometer by a clean catch without contact with periodontal tissues. Manufacturer's instructions were followed. The test strip was held until the glucometer beeped giving the blood glucose measurements on the screen in mg/dl. The soft tissue surface of the patient's non-dominant hand of the index finger was wiped with the surgical spirit and was allowed to evaporate and was punctured with a sterile lancet. The drop of blood was touched to the test end of the strip and was held until the glucometer gives a beep displaying the blood glucose measurements on the screen in mg/dl. 0.5ml of Intravenous blood was drawn using a disposable syringe from the antecubital fossa and the blood sample was sent to the laboratory for blood glucose levels and packed cell volume measurement (to derive Hematocrit corrected venous glucose).

### Haematocrit Measurement

Self-monitoring glucose device measures whole blood glucose levels whereas laboratory glucose analyser measures glucose levels in the remaining plasma after cell separation. Thus, the plasma measurements are converted to whole blood measurements by the following formula: Hct corrected venous glucose (mg/dl) = laboratory (mg/dl) × [1.0-(.0024 × Hct)] ± 3.5mg/dl. Data was collected and tabulated. The results obtained were analysed by Student's independent *t* test, Pearson's correlation and ANOVA. All the statistical tests were performed using SPSS Version 20 and the p-value <0.05 was considered statistically significant.

## RESULTS

The mean blood glucose values of Gingival crevicular blood (GCB), finger prick blood (FP) and intravenous blood(IVB) glucose measurements of diabetic patients(Group I) was found to be ranged from 77mg/dl to 209 mg/dl (Mean ± S.D was 126.53 ± 33.16), 95mg/dl to 365 mg/dl (Mean ± S.D was 188.50 ± 69.05) and 138mg/dl to 390mg/dl (Mean ± S.D was 213.43 ± 65.93) respectively with p-value <0.001. The mean blood glucose values of Gingival crevicular blood, finger prick blood, and intravenous blood of non-diabetic patients (Group II) was found to be ranged from 52mg/dl to 104mg/dl (Mean ± S.D was 73.90 ± 14.47), 69mg/dl to 130mg/dl(Mean ± S.D was 94.70 ± 14.52) and 72mg/dl to 139 mg/dl(Mean ± S.D was 109.07 ± 16.05) respectively with p-value < 0.001. The correlation between GCB, FP, and IVB among diabetics, non-diabetics, and both groups has been done using Pearson correlation (Table 1).

**Table 1. Correlation between GCB, FP, and IVB among diabetics, non-diabetics and combined using Pearson correlation**

| Groups | Correlation between | Pearson correlation coefficient | |
|---|---|---|---|
| | | rvalue | P value |
| **Diabetic** | GCB & FP | 0.77 | <0.001 |
| | GCB & IVB | 0.71 | <0.001 |
| | FP &IVB | 0.93 | <0.001 |
| **Non Diabetic** | GCB & FP | 0.74 | <0.001 |
| | GCB & IVB | 0.76 | <0.001 |
| | FP &IVB | 0.67 | <0.001 |
| **All cases combined** | GCB & FP | 0.87 | <0.001 |
| | GCB & IVB | 0.86 | <0.001 |
| | FP &IVB | 0.96 | <0.001 |

**Table 2. Comparison of random mean glucose values in GCB, finger prick and venous samples among diabetics and non-diabetics using independent t-test**

| | Groups | N | Mean | Std. Deviation | P value |
|---|---|---|---|---|---|
| GCB | diabetic | 30 | 126.53 | 33.16 | <0.001 |
| | normal | 30 | 73.90 | 14.47 | |
| FINGER | diabetic | 30 | 188.50 | 69.05 | <0.001 |
| | normal | 30 | 94.70 | 14.52 | |
| VENOUS | diabetic | 30 | 213.43 | 65.93 | <0.001 |
| | normal | 30 | 109.07 | 16.05 | |

Among Diabetics, GCB and IVB showed moderate positive correlation (r = +0.71) and strong positive correlation between FP and IVB (r = +0.93). Among Non-diabetics, FP and IVB showed comparatively least correlation (r = +0.67) and comparatively strong correlation between GCB and IVB (r = +0.76). Both diabetics and non-diabetics showed strong correlation between FP and IVB (r = +0.96) and comparatively least correlation between GCB and IVB (r = +0.86).Comparison of random mean glucose values in GCB, FP and IVB samples among diabetics and non-diabetics was done using independent t-test (Table 2). All the results obtained were graphically presented with a scattered diagram (Figure 1,2,3,4).

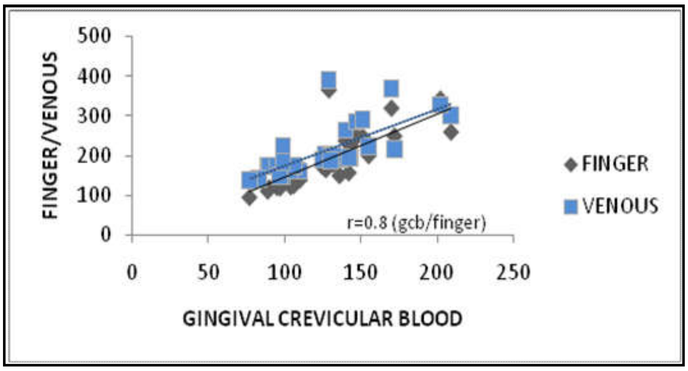


**Figure 1. Correlation between GCB/Finger, GCB/Venous among diabetics**

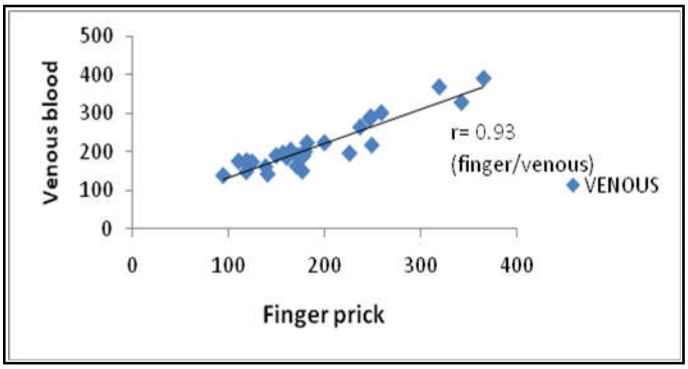


**Figure 2. Correlation between finger prick/venous among diabetics**

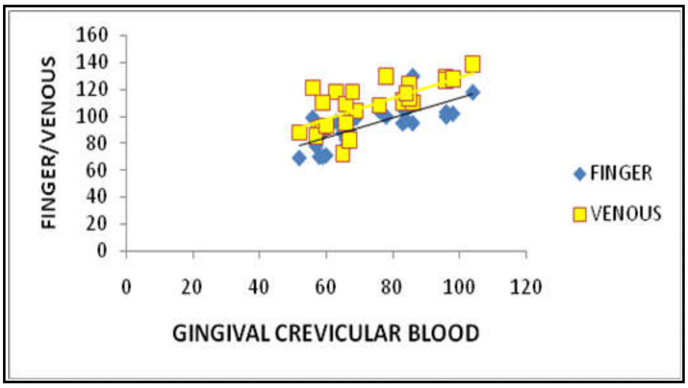


**Figure 3. Correlation between GCB/Finger prick, GCB/Venous among non-diabetics**

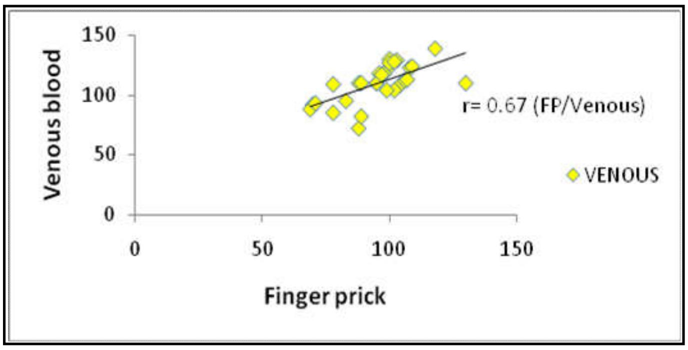


**Figure 4. Correlation between Finger prick/Venous among non-diabetics**

## DISCUSSION

In past few years, considerable effort has been made to develop Non-invasive methods to measure blood glucose. Even in the case of very low gingival crevicular bleeding, a glucose level measurement is possible with the use of the self-monitoring device, as the amount of blood (µl) necessary to perform the analysis is very low. In the present study, a strong positive correlation was seen between the FP and corrected IVB for diabetic patients. A Moderate positive correlation was seen between the GCB reading and corrected IVB and also between GCB and FP blood for diabetic group indicating that the two screening tools do not precisely correlate. A comparatively weak positive correlation was seen between the FP and corrected IVB for non-diabetic patients than the correlation between GCB and IVB and GCB and FP among non-diabetics. In the present study, the GCB showed consistently lower measurements compared to FP and IVB blood glucose. Gingival crevicular blood after probing is mostly a mixture of capillary blood and gingival crevicular fluid which may dilute the glucose concentration producing lower glucose measurements in gingival crevicular blood compared to capillary finger prick blood and intravenous blood. This might be the reason for consistently lower measurements of glucose in GCB when compared to FP and IVB blood glucose. The Present study is not in agreement with a study done by Mohammed Feroz *et al.* 2014 where a very strong correlation was observed between gingival crevicular and finger prick capillary blood glucose measurements among diabetic patients. IVB samples measurements from the laboratory glucose analyzer are considered to be true values for glucose concentration and these values are required for correlation which was lacking in this study. In a study done by Kaur *et al*. 2013 strong correlation was noted between GCB, FP, and IVB with an r value of 0.99. These results are not in agreement with the present study where the strong positive correlation was seen between FP and IVB values among diabetics whereas other correlations were moderately positive. In a study by Priyanka Chopra *et al*. 2011, GCB, FP and IVB values showed the significant correlation among each other, but the correlation between glucose values obtained using IVB and GCB were higher than the correlation between glucose values obtained using IVB and FP among diabetics. These results are not in agreement with this study were strong correlation was seen between FP and IVB and a weak positive correlation GCB and IVB among diabetic patients. Priyanka Chopra *et al* have collected GCB samples by pricking gingiva with sterile lancet because of which there might not be dilution with crevicular fluid resulting in almost similar measurements with FP and IVB hence showing a strong correlation. All the values mentioned in the present study were random glucose values whereas in other studies it has not been mentioned whether it is fasting, random or post-prandial showing that this may also be a factor for the discrepancy. Careful interpretation of results obtained from gingival crevices has to be done.

### Conclusion

Among diabetic patients, FP can be taken as a strong tool for glucometric analysis. GCB can be taken as a source for glucometric analysis but with caution as GCB and IVB showed the moderate positive correlation among diabetics and non-diabetics. The sample collection performed in the study is comparatively easier and less time consuming and the amount of blood (0.3microlitre) required is very minimal for analyzing the glucose values using self-monitoring glucose device. Further studies to be carried out on a larger population using both fasting and postprandial glucose measurements for a better assessment and correlation among the groups.

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