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Screening for type 2 diabetes mellitus using gingival crevicular blood

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Abstract: This study was conducted to assess the usefulness of the gingival crevicular blood for estimating the glucose level during routine periodontal examination using Xitux Diagnostics Smart-X self-monitoring blood glucose device among Jordanian patients attending dental teaching clinics. A total of 34 type 2 diabetic patients (18 males and 16 females) and 26 non-diabetic patients (14 males and 12 females) participated in this study. Glucose level was measured in a sample of gingival crevicular blood and in another sample obtained by finger puncture using a self-monitoring device. Glucose measurements from gingival crevicular blood samples, ranged from 57 to 250 mg dl^{-1} with a mean of 125.4 ± 60.7 mg dl^{-1} (±SD) and glucose measurements obtained by finger puncture, ranged from 62 to 263 mg dl^{-1} with a mean of 131.9 ± 61.1 mg dl^{-1}. Pearson's correlation coefficient was performed to assess the correlation between the glucose measurements in these two samples. Pearson's correlation coefficient showed an almost perfect positive correlation between the gingival readings and finger-puncture readings ($r = 0.997$, $P < 0.0001$). In conclusion, gingival crevicular blood can provide an acceptable source for measuring blood glucose level. However, the technique to obtain an acceptable blood sample from gingival crevices is not always feasible which would limit its application as a clinical practice. Additional studies that refine this technique and use larger sample size are recommended.

Key words: blood glucose; crevicular fluid; diabetes mellitus; gingiva; screening

Introduction

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycaemia resulting from defects in insulin secretion,

insulin action or both (1). Diabetes is often asymptomatic in its early stages and can remain undiagnosed for many years (2). Screening for type 2 diabetes would allow earlier recognition of cases, with the potential to intervene earlier in the disease course (3). The early diagnosis of diabetes may help to prevent its long-term complications (4). Community screening is not a cost-effective approach of screening. It may best be performed in primary care as part of a review of patient's health. Other situations may be appropriate such as dental clinics. Because of the association between dental infections and diabetes and because the presence of one promotes the other (5, 6), dentists are extremely likely to encounter an increased number of undiagnosed diabetic patients (4).

Self-monitoring devices provide simple method for rapid monitoring of the glucose level in blood by utilizing a blood sample from the finger (7) but they require a needle puncture of the skin to obtain a drop of blood. Oozing blood during periodontal examination and probing as a source of blood may allow non-invasive or minimally invasive monitoring of blood glucose levels. Monitoring glucose level in gingival crevicular blood was considered to be a reliable and less traumatic method than finger puncturing with a sharp lancet in some studies (4, 7). This study was conducted to assess the usefulness of the gingival crevicular blood for estimating the glucose level during routine periodontal examination using a self-monitoring device among Jordanian patients attending dental teaching clinics.

Material and methods

A list of 34 consecutive patients with type 2 diabetes seeking periodontal treatment in dental teaching clinics at Jordan University of Science and Technology (JUST), between 1 March and 1 May 2005, was obtained. All non-diabetic patients who attended the same clinic in the same period were listed. The two lists consisted of file numbers, name of patients and their addresses and phone numbers. All diabetic and 34 randomly selected non-diabetic patients (using random numbers table) were contacted by telephone and invited to attend the dental teaching clinics at a given day after an overnight fast. Subjects on regular medications were asked not to take their medications early at that day. All diabetic patients and 26 (76%) non-diabetic patients responded and participated in this study after obtaining the informed consent. All (32 men and 28 women) were free of any medical condition that could contraindicate periodontal examination and dental treatment.

The gingiva around upper anterior teeth was chosen to be the donor site for the gingival crevicular blood sample. The donor sites were dried and isolated with gauze to prevent contamination with saliva. Standard periodontal examination was carried out for each subject with probing around the anterior teeth. Sites with profuse bleeding were preferred as donor sites while sites with suppurations were avoided. Xitux Diagnostics Smart-X self-monitoring blood glucose device (HMM Heidelberger-Medical-Marketing GmbH, Dossenheim, Germany) was used according to the manufacturer's recommendations to measure glucose level from the gingival crevicular blood directly and the results were recorded for each subject. Another sample of blood was obtained from each subject by finger puncture and the glucose level was again measured for these samples using the same device. Both samples from each individual were taken at the same visit.

Statistical analysis using Pearson's correlation coefficient was performed to assess the correlation between the glucose measurements in the gingival blood samples and samples obtained by finger puncture. Paired *t*-test was performed to test the significance of the difference in glucose level between the gingival and finger readings.

Results

This study included 34 diabetic patients (18 men and 16 women) aged between 33 and 58 years and 26 non-diabetic patients (14 males and 12 females) aged between 31 and 57 years. The mean age of all participants was 41.0 ± 8.2 year (±SD).

Glucose measurements from gingival crevicular blood samples, ranged from 57 to 250 mg dl^{-1} with a mean of 125.4 ± 60.7 mg dl^{-1} (±SD) and glucose measurements obtained by finger puncture, ranged from 62 to 263 mg dl^{-1} with a mean of 131.9 ± 61.1 mg dl^{-1}. Pearson's correlation coefficient showed an almost perfect positive correlation between the gingival readings and finger-puncture readings ($r = 0.997$, $P < 0.0001$). This linear relationship is shown graphically in the scatterplot (Fig. 1). However, paired *t*-test showed a significant difference between the gingival readings and finger-puncture readings (mean difference of 7.03 mg/100 ml, $P < 0.0001$).

When they were classified based on their diabetic status, all patients with diabetes and all patients without diabetes were correctly classified using both gingival readings and finger-puncture readings. In addition, there was a perfect agreement between the two sets of readings to diagnose diabetes when different cut-off points (100, 110 and 126 mg dl^{-1}) were used.

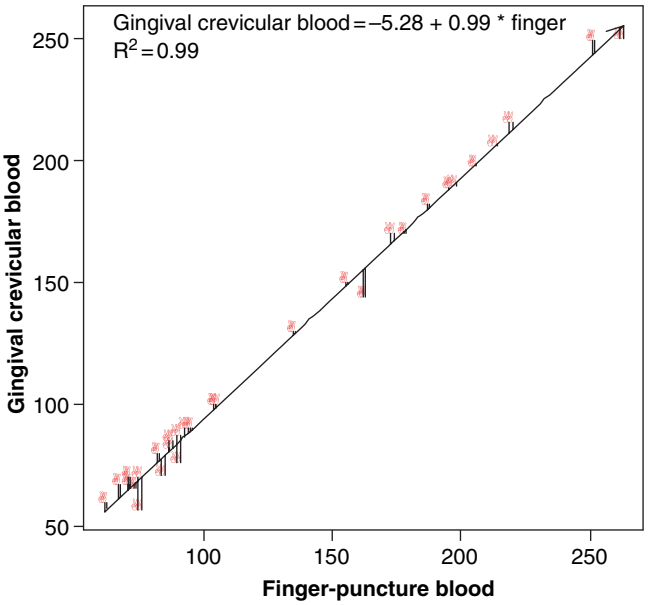

Fig 1. Scatter plot of the linear relationship between the glucose measurements from the gingival blood and finger-puncture method.

Discussion

Early detection and consequently early treatment of diabetes mellitus may reduce the burden of diabetes and its complications. This is most important in high-risk population (8). Tight blood glucose control reduces the risk and significantly delays the onset for diabetes-related complications (9). Self-monitoring of blood glucose level by the patient is an essential component for management of diabetes. A reliable blood sample for measurement of glucose level in blood can be obtained by sticking the finger with a sharp lancet. Self-monitoring devices can be used easily by the patient to measure the glucose level with these samples (10). However, alternative ways and sites for testing blood glucose were investigated to decrease the inconvenience and pain associated with traditional finger-stick technique (11). One of these suggested ways, which was investigated in this study, is utilizing blood oozing from gingival crevice during periodontal probing for monitoring glucose level in blood (4, 7, 12, 13).

The finding of the strong correlation between glucose measurements in gingival blood samples and glucose measurements in finger-puncture blood samples is in agreement with previous studies (4, 7). However, the strength of this correlation was higher in this study that may be explained by the small sample size. Therefore, one should consider this study as a pilot when interpreting its results.

A significant difference between the finger readings and gingival readings was observed. On average, the gingival reading was lower than the finger reading by 6.5 mg dl^{-1}. The difference between paired readings ranged from 0 to 19 units. This could be attributed to the possible contamination of gingival blood samples with saliva, plaque or gingival fluid which could dilute the glucose concentration in these samples. Even though, both ways of measuring glucose level in blood had 100% agreement in classifying subjects based on their diabetic status. This suggests that using gingival blood for measuring glucose level in blood would lead to the same diagnostic conclusions as blood from finger puncture would.

However, high possibility of contamination of blood with plaque, gingival fluid and debris and insufficient volume of blood to perform the test may limit the use of gingival crevicular blood for estimating the glucose level in blood during routine periodontal examination. Furthermore, visiting dental clinics without fasting may limit the use of gingival blood for screening of diabetes mellitus in dental clinics. In conclusion, results suggested that gingival crevicular blood can provide an acceptable source for measuring blood glucose level. However, the technique to obtain an acceptable blood sample from gingival crevices is not always feasible which would limit its application as a clinical practice. Further studies that use larger sample size, refine the technique of blood glucose measurements, and compare the findings between men and women are recommended.

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