Developing a chair side, safe and non-invasive procedure for assessment of blood glucose level using gingival crevicular bleeding in dental clinics

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Abstract

Aim: To study the accessibility of chair side blood glucose non-invasive screening method for diabetes mellitus during routine periodontal examination. **Materials and Methods:** Fifteen non-diabetics and 15 newly onset type 2 diabetics patients with moderate to severe periodontitis were selected after meeting inclusion and exclusion criteria. Periodontal pocket probing was performed using a Williams Graduated periodontal probe. Blood oozing from gingival sulcus of anterior teeth following periodontal pocket probing was collected with stick of a glucose self-monitoring device. As control, finger stick capillary blood was taken. **Results:** A statistically significant correlation was observed between the blood glucose level of gingival crevicular blood (GCB) and peripheral fasting blood (PFB) of diabetic subjects. The mean GCB glucose level of the subjects in diabetic group was 172.27 ± 5.02 mg/dl while mean PFB glucose was 167.80 ± 8.87 mg/dl. The correlation coefficient of diabetic and non-diabetic subjects were $r = +0.715$ and $r = +0.619$, respectively. **Conclusion:** The results suggested that blood oozing during routine periodontal examination may be used for diabetic mellitus screening in a dental office setting without the need for any extra procedure.

Key words: Chronic periodontitis, gingival crevicular fluid, type 2 diabetes

INTRODUCTION

Diabetes mellitus (DM) and chronic periodontitis are common chronic diseases in adults in the world population. DM is a complex disease with both metabolic and vascular components characterized by hyperglycemia due to defects in insulin secretion, insulin action or both as well as dysregulation of protein and lipid metabolism.[1] DM is associated with a wide range of complications such as retinopathy, nephropathy, neuropathy, micro and macrovascular disease and altered wound healing.[2] Also, as

per of American Diabetes Association in 1993, periodontal disease is sixth most common complication in patients of diabetes mellitus.[3] Moreover, diabetes and periodontitis seem to interact in a bidirectional manner.[4]

Periodontitis is defined as an infectious disease resulting in inflammation within the supporting tissue of the teeth leading to progressive attachment and bone loss. Periodontal infections are mixed infections characterized by a complex microbiodata. Microscopic examination of sub-gingival plaque samples obtained from sites with periodontitis has revealed elevated levels of Gram-negative aerobes and Bacteriodes.[5] These microbial species have even been shown to affect the endocrine metabolical status of diabetic patients. Research has been conducted into the relationship between diabetes and periodontal disease since 1960s.[6] The incidence and severity of periodontal disease has shown to be influenced by DM and level of blood glucose levels. An improvement in

serum glycemic control has also been noticed after PDL therapy.[7-9]

Going by close relationship between diabetes and periodontitis, it can be assumed that the dental practitioners are extremely likely to encounter more number of patients having both, DM and periodontitis. The early diagnosis of diabetes, however, might help to prevent its long-term complications that are responsible for the high morbidity and mortality of diabetic patients.[10] Periodontitis is also likely to be more severe in diabetic individuals with advanced systemic complications because of poorly controlled, persistently high blood sugar levels known as sustained hyperglycemia.[11]

The release of bio-inflammatory cytokines in both the cases explains their bidirectional relationship. The mechanism associated with periodontitis found in diabetic patients is the accumulation of advanced glycation end products (AGEs), which would affect the migration and phagocytosis of polymorphonuclear cells, producing a sub-gingival flora with a predominance of Gram-negative anaerobes.[12] This would trigger the secretion of soluble mediators that facilitate connective tissue destruction and bone resorption and produce a state of insulin resistance in the tissues at the same time, the periodontal infection would also induce resistance to insulin in the tissues, which would contribute in turn to the accumulation of AGEs.

A lot of diabetic patients undergoing dental treatment, needs to be first ascertained of their existing blood sugar level, so that appropriate treatment strategies can be provided to the individual patients. For this, they need to provide blood sample after a small prick. However, in such patients, this small amount of blood can also be obtained by simply probing the periodontium without any discomfort to the patient.

Therefore, the aim of the present study was to evaluate feasibility and accuracy of gingival cervicular blood when used as an aid to screen blood glucose in dental office as compared to the conventional method of peripheral blood sampling.

MATERIALS AND METHODS

The study was approved by the ethical committee of the institution and an informed consent was taken from all the subjects prior to start of the study. A total of 15 diabetic (type 2, previously undiagnosed) and 15 non-diabetic patients in the age group of 40-55 years with untreated moderate to severe periodontitis, having probing depth in the upper anterior teeth ≥5 mm, were selected from Diabetes Care and Research Centre, S. P. Medical

College, Bikaner. Patients requiring premeditation or prophylactic drug regime, suffering from any other systemic infection/diseases or sites with suppuration were excluded from the study. Periodontal probing depth was assessed by Williams graduated periodontal probe. Contamination with saliva was prevented by using gauze and air drying. Teeth were probed mesially and distally. Blood oozing from the gingival sulcus/pocket was collected by placing the glucometer diagnostic strip at the entrance of the gingival sulcus. In addition to it, regular finger stick capillary blood was collected. Both samples, 3 μl each were analyzed using a glucose self-monitoring device (Quicktest, Braun Company, Germany), according to the manufacturer's recommendations.

Statistical analysis
Statistical analysis was performed by students (paired and unpaired) *t*-test or coefficient correlation test by SPSS (Software package version) 10.0.

RESULTS

Results of this study revealed a strong correlation ($r = 0.715$, $P < 0.001$) of blood glucose levels between gingival crevicular blood (GCB) and peripheral capillary blood (PFB). The mean blood glucose level from GCB of the subjects in diabetic group was 172.27 ± 5.02 mg/dl while mean blood glucose level from PFB was 167.80 ± 8.87 mg/dl. The correlation coefficient of diabetic and non-diabetic subjects were $r = +0.715$ and $r = +0.619$, respectively [Table 1]. There was significant difference between peripheral capillary and crevicular blood glucose even with increasing blood glucose levels in diabetic and non-diabetic subjects [Table 2].

Table 1: The mean blood glucose level of diabetic and non-diabetic patients measure by gingival crevicular blood and peripheral blood

Group	Peripheral fasting blood Mean±S.E.	Gingival Crevicular blood Mean±S.E.	t value	P value
Diabetic	167.8±8.87	172.27±5.02	5.15	<0.001*
Non-diabetic	106.93±1.80	109.8±5.11	6.48	<0.001*

*Statistically significant with $P < 0.01$

Table 2: The mean blood glucose level of diabetic and non-diabetic patients measure by gingival crevicular blood and peripheral blood

Group	Diabetic Mean±S.E.	Non-diabetic Mean±S.E.	t value	P value
Peripheral fasting blood	167.8±8.87	106.93±1.80	6.72	<0.001*
Gingival Crevicular blood	172.27±5.02	109.8±5.11	6.06	<0.001*

*Statistically significant with $P < 0.01$

DISCUSSION

The American Diabetes Association recommends that screening for diabetes should start at age of 45 years and be repeated every 3 years in persons without risk factors and earlier and more often in those with risk factor for diabetes.[9]

In our study correlation between PFB and GCB glucose readings from diabetic group participants was high i.e. $r = 0.715$. By contrast, for participants in non-diabetic group, correlation between the glucose readings was lower ($r = 0.619$).

A lot of research has been done to develop painless and non-invasive methods to measure blood glucose levels.[13] Sites with periodontal inflammation have been shown to produce adequate amount of extavasate of blood during routine periodontal examination.[14] Therefore, it prevents the need for an extra procedure (finger puncture with sharp needle) to obtain blood sample for assessment of blood glucose levels. There is also an added advantage in cases with very low gingival crevicular bleeding as lesser amount of blood (3 μl) is necessary to perform the analysis.

Although gingival bleeding is an indicator of inflammation, it may also be possible that vascular changes in DM result in increased gingival bleeding. The relation of the control of diabetes to development of vascular changes has been studied by Tchobroutsky who observed less vascular changes in well-controlled diabetes.[15] Comparing diabetic and healthy children Bernick *et al.*, found more gingival inflammation in the diabetic group.[16] Kjellman *et al.*, came to the conclusion that diabetics with poor cooperation in the care of the disease had more gingivitis than those with good cooperation.[17] The poor cooperating group also showed higher levels of blood glucose suggesting a poor control of the disease.

According to our findings, there is a significant correlation between fingerstick capillary blood and gingival crevicular blood glucose levels. The present study is in agreement with another study which also demonstrated a strong correlation between gingival crevicular and fingerstick capillary blood.[15] Moreover, in this study, the correlation of fingerstick and crevicular gingival blood measured in a laboratory analyzer was found to be highly statistically significant ($r = 0.715$, $P < 0.001$).

Cohen *et al.*, found that diabetics had an increased degree of inflammatory changes in their periodontium compared with health controls.[18] In the same study it was found that the amount of soft deposits was smaller in the diabetic group while the amount of hard deposits was equal in

both groups. Belting *et al.*, found more severe periodontal changes in diabetic patients.[19] Sheridan *et al.*, showed that pocket formation, presence of calculus, increased tooth mobility and tooth loss occurred with greater frequency in patients with a decreased glucose tolerance.[20,21] Patients with confirmed or possible diabetes also showed increased alveolar bone loss and marginal widening of periodontal membrane.

So the results of present study indicate the gingival crevicular blood can provide an excellent source for measuring blood glucose level during diagnostic periodontal examination by glucometric analysis. However, study was carried out on a small group of population and the technique to obtain an acceptable blood sample from gingival crevices is not always feasible and reliable which would limit its application as a clinical practice. Further studies should be carried out on a large group of subjects to arrive at a confirmatory diagnosis and to establish benchmark GCB glucose levels for both Diabetic and non-diabetic patients.

CONCLUSIONS

The result of this study suggests that gingival crevicular blood is a reliable and definitive indicator for analysis of glycemic status of an individual. However, further studies are required to isolate uncontaminated blood, ascertain ratio of contamination and large sample size for better comparison of gingival crevicular blood and variations with peripheral capillary blood values.

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