

A Non-Invasive Procedure for the Assessment of Blood Glucose Level Using Gingival Crevicular Bleeding in Diabetic Patients with Chronic Periodontitis

Khoobi Shah^{1*} Anita Panchal² Sachin K³ Bhaumik Nanavati⁴ Rahul Shah⁵ Harshvardhan Chaudhary⁶

¹PG Student, Department of Periodontology and Oral Implantology, College of Dental Sciences & Research Centre, Bopal, Ahmedabad, India.

²Professor and Head, Department of Periodontology and Oral Implantology, College of Dental Sciences & Research Centre, Bopal, Ahmedabad, India.

³Reader, Department of Periodontology and Oral Implantology, College of Dental Sciences & Research Centre, Bopal, Ahmedabad, India.

⁴Reader, Department of Periodontology and Oral Implantology, College of Dental Sciences & Research Centre, Bopal, Ahmedabad, India.

⁵Senior Lecturer, Department of Periodontology and Oral Implantology, College of Dental Sciences & Research Centre, Bopal, Ahmedabad, India.

⁶Reader, Department of Preventive and Community Dentistry, College of Dental Sciences & Research Centre, Bopal, Ahmedabad, India.

ABSTRACT

Aim: The aim of the present study was to evaluate feasibility and accuracy of gingival crevicular bleeding when used as an aid to screen blood glucose level in dental office as compared to the conventional method of peripheral blood sampling.

Materials and Methods: A total of 13 non-diabetic and 13 newly onset Type 2 diabetic patients with moderate to severe periodontitis were randomly selected based on inclusion and exclusion criteria. Blood oozing from the gingival sulcus/pocket & regular finger stick capillary blood were collected & were analysed using 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 169.38 ± 23.9 mg/dl while mean PFB glucose was 168.0 ± 25.4 mg/dl.

Conclusion: The result of this study suggests that gingival crevicular bleeding is a reliable and definitive indicator for analysis of glycemic status of diabetic and non-diabetic individuals.

Keywords: Gingival crevicular bleeding, Diabetes, Capillary finger blood.

INTRODUCTION

Diabetes mellitus is a clinically and genetically heterogeneous group of metabolic disorders manifested by abnormally high levels of glucose in the blood. The hyperglycemia is the result of a deficiency of insulin secretion caused by pancreatic β -cell dysfunction or of resistance to the action of insulin in liver and muscle, or a combination of these.¹ It affects more than 120

million people worldwide, and it is estimated that it will affect 220 million by the year 2020.² Diabetes mellitus (DM) and chronic periodontitis are common chronic diseases in adults in the world population. Diabetes mellitus is a systemic disease with several major complications affecting both the quality and length of life. DM is a complex disease with both metabolic and vascular components characterized by hyperglycemia due to defects in

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*Correspondence Dr. Khoobi Shah.

Department of Periodontology and Oral Implantology, College of Dental Sciences & Research Centre, Bopal, Ahmedabad, India.

Email: khoobi_shah@yahoo.com

insulin secretion, insulin action or both as well as dysregulation of protein and lipid metabolism.³

DM is associated with a wide range of complications such as retinopathy, nephropathy, neuropathy, microvascular and macrovascular disease and altered wound healing.⁴ Periodontitis is an infectious disease resulting in inflammation within supporting tissues of the teeth, progressive attachment loss and bone loss.⁵ Also, as per of American Diabetes Association in 1993, periodontal disease is sixth most common complication in patients of diabetes mellitus.

Grossi et al have proposed a model for two-way relationship between periodontal disease and diabetes mellitus. One plausible biologic mechanism why diabetics have more severe periodontal disease is that glucose-mediated AGE (advanced glycation end products) accumulation would affect migration and phagocytic activity of mononuclear and polymorphonuclear phagocytic cells, resulting in the establishment of a more pathogenic subgingival flora. The maturation and gradual transformation of the subgingival microflora into an essential Gram-negative flora will in turn constitute, via the ulcerated pocket epithelium, a chronic source of systemic challenge.⁶

The interrelationships between periodontitis and diabetes provide an example of systemic disease predisposing to oral infection, and once that infection is established, the oral infection exacerbates systemic disease. Moreover, diabetes and periodontitis seem to interact in a bidirectional manner.⁷

MATERIALS AND METHODS

The study was conducted on the patients visiting the College of Dental Sciences and Research Centre, Manipur, Ahmedabad. A total of 26 [13 diabetic (type 2, previously diagnosed) and 13 non-diabetic] patients reporting to the department of periodontics were randomly selected based on inclusion and exclusion criteria. Patients with untreated moderate to severe periodontitis with history of Type 2 diabetes mellitus & should have at least one tooth that bleeds upon probing having atleast ≥ 5 mm were selected. Patients who were undergoing any current treatment for anemia, polycythemia, gout, dialysis or had any history of

severe cardiovascular, hepatic, immunological, renal, haematological or other organ impairment or individuals who had taken antibiotics in the past 6 months before the study were excluded from the study. Periodontal probing depth is assessed by Williams graduated periodontal probe. Contamination with saliva is prevented by using gauze and air drying. Teeth are probed mesially and distally (Figure-3). Blood oozing from the gingival sulcus/pocket is collected by placing the glucometer diagnostic strip at the entrance of the gingival sulcus (Figure-4). In addition to it, regular finger stick capillary blood was collected (Figure-1 & 2). Both samples, 3 μ l each are analysed using a glucose self-monitoring device (One Touch Select Simple), according to manufacturer's recommendations (Figure-5).



Fig 1: Pricking of finger by sharp lancet.



Fig 2: Measurement of glucose level using one touch glucometer.



Fig 3: Check for bleeding on gentle probing.



Fig 4: Measurement of glucose level in gingival capillary blood.



Fig 5: One touch select simple second generation glucometer.

Group Statistics

Statistical analysis was performed by students (paired and unpaired) *t*-test.

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	168.0±25.4	169.38±23.9	0.143	0.888*
Non-diabetic	93.54±16.6	93.08±16.5	0.071	0.944*

*Statistically not significant with $P < 0.05$

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	168.0±25.4	93.54±16.6	8.84	0.001*
Gingival Crevicular blood	169.38±23.9	93.08±16.5	9.44	0.001*

*Statistically significant with $P < 0.05$

RESULTS

The mean GCB glucose level of the subjects in diabetic group was 169.38 ± 23.9 mg/dl while mean PFB glucose was 168.0 ± 25.4 mg/dl and the mean GCB glucose levels of that of non-diabetic group was 93.08 ± 16.5 mg/dl while mean PFB glucose was 93.54 ± 16.6 mg/dl.

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.⁸ In our study, significant difference was seen between peripheral capillary and crevicular blood glucose even with increasing blood glucose levels in diabetic and non-diabetic patients. The values obtained from peripheral fasting blood

glucose and crevicular gingival blood glucose for diabetic and non-diabetic patients are more or less similar. [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 which means that gingival crevicular blood can be used as alternative to peripheral fasting blood. [Table 2].

A lot of research has been done to develop painless and non-invasive methods to measure blood glucose levels.⁹ Sites with periodontal inflammation have been shown to produce adequate amount of extravasate of blood during routine periodontal examination.¹⁰ 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 (3µl) 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.¹¹

Cohen et al found that diabetics had an increased degree of inflammatory changes in their periodontium compared with health controls. 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.¹²

Comparing diabetic and healthy children Bernick *et al.*, found more gingival inflammation in the diabetic group.¹³ 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.¹⁴ The poor cooperating group also showed higher levels of blood glucose suggesting a poor control of the disease. Strauss SM et al also found readings which were near consistent with results obtained from the present study.¹⁵ This is in agreement with Biekler T et al, Ardakani MR et al; where in a strong correlation was observed between GCB & finger prick method measured blood in diabetic and non-diabetic patients with positive bleeding on

probing.¹⁶ Similar findings have been reported by Shetty N et al with significant difference between gingival crevicular blood glucose values and peripheral finger blood glucose values in diabetic group and non-diabetic group as in the present study.¹⁷ 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.^{18,19} 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.

CONCLUSIONS

The result of this study suggests the evidence that the blood obtained during routine periodontal probing can be used for estimation of blood glucose levels. Hence, gingival crevicular blood is an efficient diagnostic tool for estimation of blood glucose levels in patients with or without diabetes mellitus. The technique described is safe, easy to perform, repeatable, comfortable for the patient, cost effective, and might therefore help to increase the frequency of diabetes screening in dental office.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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