Possibility of glucose level assessment using the blood of gingival probing and dental socket after tooth extraction

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ABSTRACT

Background: The association between diabetes and inflammatory dental diseases had been studied extensively for more than 50 years. A large evidence base suggests that diabetes is associated with an increased prevalence, extent and severity of gingivitis and periodontitis and loss of teeth. Many patients do not aware that they are diabetic.

Objectives: The aim of the current study was to assess a fast, non-invasive, safe procedure to screen for diabetes and its severity in dental clinics and to assess the change in blood glucose level before and after tooth extraction during periodontal

Results: there were no significant differences between the blood samples collected before tooth extraction from finger puncture method (FPB) and the gingival crevicular blood (GCB) P > 0.05

Also there were no significant differences between finger blood glucose levels (FBGL) before and after the tooth extraction (P > 0.05).

There weresignificant differences between the blood samples collected after tooth extraction from finger puncture method(FPB)and the socket blood (SB),   P <

0.05.There were highly significant differences between the gingival crevicular blood (GCB) before tooth extraction and the socket blood (SB)after tooth extraction P<0.01.

Conclusion: The data of this study has shown the followings the gingival crevicular blood could be an excellent source of blood for glucometric analysis. The blood obtained from the socket of the extracted tooth is undependable for glucometric analysis. There is no effect of tooth extraction procedure on the blood glucose level of the controlled diabetic patients

Key words: Serum sugar, Gingival probing, Socket, Extraction.

D iabetes mellitus is an extremely important disease from a dental standpoint. It is a complex metabolic disease characterized by chronic hyperglycemia. Diminished insulin production, impaired insulin action, or a combination of both results in the inability of glucose to be transported from the bloodstream into the tissues, which in turn, results in high blood glucose levels and excretion of sugar in the urine. Lipid and protein metabolism is also altered in diabetes. Uncontrolled diabetes (chronic hyperglycemia) is associated with several long-term complications, including microvascular diseases (retinopathy, nephropathy, neuropathy); macrovascular diseases (cardiovascular and cerebrovascular), an increased susceptibility to infections; and poor wound healing[1-4].

The influence of diabetes on the periodontium has been thoroughly investigated, a variety of changes have been described, including a tendency toward enlarged gingiva, sessile or pedunculated gingival polyps, polypoid gingival proliferations, abscess formation, periodontitis and loosened teeth[5,6].

In 1993, Löe[7] proposed that periodontal disease was the sixth complication of diabetes mellitus. In a 2008 article, Taylor and Borgnakke[8]identified periodontal disease as a possible risk factor for poor metabolic control in people with

diabetes mellitus. This bidirectional relationship between periodontal disease and diabetes mellitus makes diabetes a disorder of importance to dentists and dental hygienists and to patients seen in the dental office.

Recognition of the bilateral relationships between oral and systemic health will challenge physicians and dentists to work together closely in the future when managing patients with diabetes and periodontal disease[9, 10].

Perhaps the most striking changes in uncontrolled diabetes are the reduction in defense mechanisms and the increased susceptibility to infections leading to destructive periodontal disease. Periodontitis in type 1 diabetes appears to start after age 12. The prevalence of periodontitis has been reported as being 9.8% in 13 to 18 year olds, increasing to 39% in those 19 years and older [1]. A multivariate risk analysis showed that subjects with type 2 diabetes had approximately threefold increased odds of having periodontitis compared with subjects without diabetes, after adjusting for confounding variables including age, sex and oral hygiene measures[11, 12].

The extensive literature on this subject and the overall impression of clinicians point to the fact that periodontal disease in diabetics follows no consistent or distinct pattern. Very severe gingival inflammation, deep periodontal pockets, rapid bone loss, and frequent

periodontal abscesses often occur in diabetic patients with poor oral hygiene[13].

Despite the fact that few studies have not found a correlation between the diabetic state and the periodontal condition, the majority of well-controlled studies show a higher prevalence and severity of periodontal disease in individuals with diabetes than without, with similar local factors. Findings include a greater loss of attachment, increased bleeding on probing, and increased tooth mobility. Perhaps the different degrees of diabetic involvement and control of the disease in patients examined and the diversity of indices and patient[14].

The introduction of glucose self-monitoring device provided diabetic patients with a simple method for rapid daily monitoring of their disease. Self-monitoring uses one drop of finger puncture whole blood placed on a test strip impregnated with glucose oxidoreductase .periodontal inflammation with or without the complicating factor of diabetes mellitus is known to produce ample extravasated blood during diagnostic procedure. Routine probing during periodontal inflammation is more familiar to a dental practitioner and less traumatic than a finger puncture with a sharp lancet. It is possible that gingival blood from probing may be excellent source for glucometric analysis using portable glucose self-monitoring device [15]. In healthy situations glucose levels in gingival crevicular fluid are considerably lower than blood glucose levels. Thus the question arises whether glucose levels measured in blood samples obtained during periodontal examination are sufficiently related to glucose levels measured in capillary fingerstick blood (CFB).

The aims of this study was to evaluate a quick , safe and non-invasive method to screen for diabetes and its severity in dental clinicsduring periodontal examination and extraction of teeth using accu-check, self-monitoring glucometer . Also to assess the effect of tooth extraction on blood glucose level by measuring the change in blood glucose level before and after tooth extraction.

Methods:A total of 50 diabetic patients (type II) were enrolled in this study, (23 male and 27 female, age ranged 30-60 year, mean 45 year). The patients selected according to the following criteria: history of 5 years diabetes, type II, controlled, with untreated moderate to severe periodontitis, each patient had at least one hopeless tooth indicated for extraction. Those patients were recruited from the patients attending the department of Periodontics, Oral Surgery at the teaching hospital of College of Dentistry /Al-Mustansiria University and the Dental clinic in the College of Health and Medical Technologies. The patients were examined intraorally and detailed dental status was recorded. All the patients informed about the study and instructed to take their medications and to be fasting 4 hours before attending to the dental clinic. First the blood glucose level was measured before administration of local anesthesia, the blood sample was taken from the patient's finger for glucometric analysis. Following that bleeding on probing was assessed during 30-60 seconds after probing, a site with more profuse

bleeding was chosen for collecting the gingival crevicular blood (GCB),The area was isolated with cotton rolls to prevent contamination with saliva and dried with compressed air. Probing was repeated until sufficient amount of blood appeared in the gingival crevice. A plastic capillary tube of 2mm was used for collection of blood from the gingival sulcus. Blood glucose level was also checked after the tooth extraction procedure using the blood of the socket of the extracted tooth which was collected witha plastic capillary tube of 2mm immediately after extraction to prevent contamination with saliva (the tooth isolated with cotton rolls before and during extraction). Another blood sample was taken 5 minutes after tooth extraction by finger puncture method. The accu-check active glucometer (roche diagnostics, Germany) was used in glucometric analysis. The samples were analyzed and readings were recorded..

Patients were excluded from the study if they required antibiotic premedication, any disorder that was accompanied by an abnormally low or high hematocrit , e.g., polycythemiavera , anemia, dialysis , intake of substance that would interfere with the coagulation system, e.g., coumarin derivatives, non-stroidal anti-inflammatory drugs, heparin and actual severe cardiovascular, hepatic, immunologic, renal , hematological , or other organ disorders.

Statistical analysis:The data obtained by the methods described in methodology were statistically analyzed using paired t-test for tow variables (mean, standard deviation and P-value).

Results. *Pre extraction:*The finger blood glucose level (FBGL); the mean & standard deviation were 217.8 & 58.0 respectively.The gingival blood glucose level (GBGL); the mean & standard deviation were 202.5 & 55.9 respectively. There were no significant differences between the (FBGL) and (GBGL). P ≤0.05

Table 1: Statistical analysis of the blood sample obtained by finger puncture method (FBGL) and the gingival blood (GBGL) before tooth extraction.

	Mean	SD	P value
FBGL	217.8	58.0	0.184
GBGL	202.5	55.9	

Post extraction. The finger blood glucose level (post FBGL); the mean & standard deviation were 239.3 & 64.9 respectively. The socket blood glucose level (post SBGL); the mean & standard deviation were 268.0 & 74.1 respectively.There were significant differences between (post FBGL) and (post FBGL), P < 0.05.

Comparison between the data before and after teeth extraction. The finger blood glucose level preextraction(pre FBGL); the mean & standard deviation were 217.8 &

58.0 respectively.The finger blood glucose level postextraction (post FBGL); the mean & standard deviation were 239.3 & 64.9 respectively.There were no significant differences between the (pre FBGL) and (post FBGL).   P > 0.05.

The gingival blood glucose level pre extraction (pre GBGL); the mean & standard deviation were 202.5 & 55.9 respectively.

The socket blood glucose level (post SBGL); the

Table 2: statistical analysis of the blood sample obtained by finger puncture method (FBGL) and   the socket blood (SBGL) after tooth extraction.

	Mean	SD	P value
Post FBGL	239.3	64.9	0.042
Post SBGL	268.0	74.1	

Table 3: statistical analysis of the blood samples obtained by finger puncture method (FBGL) before and after tooth extraction

	Mean	SD	P value
Pre FBGL	217.8	58.0	0.084
Post FBGL	239.3	64.9	

Table 4: statistical analysis of the gingival blood (GBGL) before tooth extraction and socket blood (SBGL) after extraction.

	Mean	SD	P value
Pre GBGL	202.5	55.9	0.000
Post SBGL	268.0	74.1	
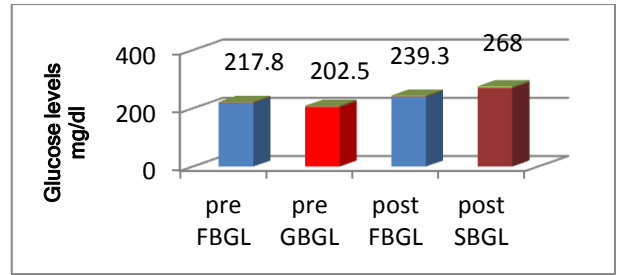
Figure 1: Mean comparison of glucose levels in finger blood glucose (FBGL),gingival blood glucose(GBGL) and socket blood glucose(SBGL) pre & post extraction.

Mean and standard deviation were 268.0 & 74.1 respectively.

There were highly significant differences between The gingival blood glucose level pre extraction (pre GBGL) and The socket blood glucose level (post SBGL),p< 0.01.

Discussion. The prevalence of both types of diabetes varies considerably around the world, and is related to differences in genetic and environmental factors [16]. It is estimated that, in the year 2000, 171 million people worldwide had diabetes, and this is expected to double by 2030[17]. This increase in diabetes is occurring in all countries; however, developing countries are particularly at risk. The prevalence rate of diabetes in Iraq is estimated to be 10% [18].

So that monitoring and screening of blood glucose level and thereby diagnosis of DM may be recognized by the dentist during routine examination and treatment of patients especially those who are not aware of their disease. Dentists should also be aware of the potential influence that poor glycemic control has on the periodontium of patients with diabetes, but they also should recognize that patients with well-controlled diabetes can have periodontal diseases just as patients with poorly controlled diabetes may have a healthy periodontium[19].

Diabetes mellitus is a systemic disease with several major complications affecting both the quality and length of life. Several complications affecting the oral and dental tissues, one of these complications is periodontal disease (periodontitis). Periodontitis is much more than a localized oral infection. Recent data indicate that periodontitis may cause changes in systemic physiology. 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[12].

In this case, it may also be possible for the oral infection to predispose to systemic disease. Diabetes-induced changes in immune cell function produce an inflammatory immune cell phenotype (upregulation of proinflammatory cytokines from monocytes/polymorphonuclear leukocytes and downregulation of growth factors from macrophages).

This predisposes to chronic inflammation, progressive tissue breakdown, and diminished tissue repair capacity [20]. Periodontal tissues frequently manifest these changes because they are constantly wounded by substances emanating from bacterial biofilms. Diabetic patients are prone to elevated low density lipoprotein cholesterol and triglycerides (LDL/TRG) even when blood glucose levels are well controlled. This is significant, as recent studies demonstrate that hyperlipidemia may be one of the factors associated with diabetes-induced immune cell alterations. Recent human studies have established a relationship between high serum lipid levels and periodontitis. Some evidence now suggests that periodontitis itself may lead to elevated LDL/TRG.Periodontitis-induced bacteremia/endotoxemia has been shown to cause elevations of serum proinflammatory cytokines such as interleukin-1 beta (IL-1β) and tumour necrosis factor-alpha (TNF-α) [21.22] which have been demonstrated to produce alterations in lipid metabolism leading to hyperlipidaemia. Within this context, periodontitis may contribute to elevated proinflammatory cytokines/serum lipids and potentially to systemic disease arising from chronic hyperlipidaemia and/or increased inflammatory mediators. These cytokines can produce an insulin resistance syndrome similar to that observed in diabetes and initiate destruction of pancreatic β cells leading to development of diabetes. Thus, there is potential for periodontitis to exacerbate diabetes-induced hyperlipidemia, immune cell alterations, and diminished tissue repair capacity. It may also be possible for chronic periodontitis to induce diabetes.

There was statistically no significant differences between gingival crevicularblood and blood sample obtained by finger puncture method(P> 0.05) .

The above results agree with those reported by Beikler et al 2003 [23]. He evaluated whether blood oozing from gingival tissues during routine periodontal examination can be used for determining glucose levels.

The present study also in agreement with the study by Parker et al 1993 [24] who reported that 92% of the gingival crevicular blood glucose measurements with the non-wipe glucose self monitor were within 15% of the true glucose concentration.

Our study also in agreement with the study by Mohammed Feroz et al 2014 [25] who reported that gingival crevicularbloodcan provide an acceptable source for measuring blood glucose .

Variations in glucose plasma levels during dental treatment have been the subject of study and controversy in the literature. [29,30,31,32] Tily and Thomas [29] compared the effect of epinephrine (adrenaline) administration in the dental local anesthetic solution on blood glucose concentrations in healthy and diabetic dental patients after extraction. They observed no significant differences in pre- and postoperative blood glucose levels. Nakamura et al [30] investigated the changes in blood pressure, plasma catecholamines, glucose, and insulin concentrations in [33].

normotensive patients during dental surgery and found that the administration of both local anesthetics and tooth extraction activates sympathoadrenal outflow, resulting in increases of the SyBP, HR, plasma epinephrine, and serum glucose concentrations. They concluded that the adrenaline concentration increased and reached its peak just after the administration of local anesthetics, yet the peak of epinephrine occurred within a time period similar to that of the increase of the serum glucose level, suggesting that there is a close relationship between the two variables. The increase in the glucose level may be small and transient for healthy patients due to compensatory and regulatory mechanisms of the body. In our study; only the controlled diabetic patients were included, although an increase in the mean glucose levels was observed, it did not reach statistical or even clinical significance.

The results of the socket blood glucose revealed a significant increase in the mean glucose levels after tooth extraction but we considered it undependable because it interferes with results obtained by finger puncture method and these inaccurate results may be due to contamination of the socket blood with the tissues exudates even we did complete isolation from saliva.

Assessment of crevicular and socket blood glucose level with the Accu-Chekself-monitoring device is sensitive, since it can provide results with just 2-3 ul of blood within 10 seconds. Regarding the development of painless and non-invasive methods to measure blood glucose, considerable efforts have been made in the past few years. Since periodontal inflammation with or without the complication factor of diabetes mellitus is known to produce ample extravasate of blood during diagnostic oral or periodontal examination, no extra procedure ,e.g. finger puncture with a sharp lancet, is necessary to obtain blood for glucometric analysis . The incidence of DM in Iraq increasing at an alarming rate. So that if the dentists participate in the challenge of undiagnosed DM especially those with advanced or severely progressed periodontal disease with highly mobile hopeless teeth need to be extracted , it would really prove beneficial for mankind. In our study, a fine micropipettes were used for collection of crevicular and socket blood, the fine diameter of these capillary tubes reduced the contamination of blood samples with calculus, debris and inflammatory exudates.

In conclusion,The data of this study has shown the followings:The gingival crevicular blood could be an excellent source of blood for glucometric analysis. . In addition, this procedure is easy to be done, noninvasive , safe and comfortable for dental patients and might be therefore assist in increasing the frequency of monitoring the DM in the dental clinics.The blood obtained from the socket of the extracted tooth is undependable for glucometric analysis. There is no effect of tooth extraction procedure on the blood glucose level of the controlled diabetic patients.

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