Correlation between Levels of Sulcular and Capillary Blood Glucose in Screening of Diabetes Mellitus in Chronic Periodontitis Patients

Harry Nihal Nayagam¹, Deepalakshmi Nagarajan², Malathi Krishnamurthi³

¹ Senior Assistant Surgeon, Department of Dental Surgery, Kuzhithurai Govt. Hospital, Kanyakumari, Tamilnadu, India.
² Assistant Professor, Department of Dental Surgery, Coimbatore Medical College & Hospital, Coimbatore, Tamilnadu, India.
³ Professor & HOD, Department of Periodontics, Tamilnadu Government Dental College and Hospital, Chennai, Tamilnadu, India.

DOI: https://doi.org/10.24321/2456.141X.201801

Abstract

**Background:** Diabetes mellitus is a heterogeneous metabolic disease characterized by impaired glucose tolerance and altered carbohydrate and lipid metabolism. Importantly, the prevalence of diabetes in periodontitis patients is twice as high when compared to periodontally healthy subjects. Diabetes mellitus remains undiagnosed in approximately 50% of the patients; hence, a large number of patients with periodontitis may have undiagnosed diabetes mellitus.

**Aim of the Study:** To evaluate the correlation between gingival sulcular blood glucose and capillary blood glucose levels for screening of diabetes mellitus in chronic periodontitis patients.

**Materials and Methods:** Thirty diabetic and 30 non-diabetic subjects, with moderate to severe chronic periodontitis, were enrolled and subjected to routine periodontal examination. Blood oozing from the gingival sulcus was collected using a micropipette from the gingival crevice of maxillary anterior teeth and transported to a test-strip of a self-monitoring glucometer (Accu-Check Active). Finger-prick capillary blood glucose level values were considered as the control.

**Results:** The results revealed a highly positive significant correlation between two methods for blood glucose values, i.e., gingival crevicular and finger-prick capillary (p<0.0001) and the reliability of the two procedures in both the groups was significantly high (p<0.0001).

**Conclusion:** The blood expressed during routine periodontal examination may be used as a rapid chair-side screening procedure for diabetes mellitus in a dental office setting.

**Keywords:** Chronic periodontitis, Diabetes mellitus, Blood glucose, Gingival sulcular blood, Capillary blood

Introduction

Diabetes mellitus encompasses a heterogeneous group of disorders with the common characteristic of altered glucose tolerance or impaired lipid and carbohydrate metabolism.¹ Diabetes mellitus is of two main types, namely, Type-I (insulin-dependent diabetes mellitus) and Type-II (non-insulin dependent diabetes mellitus). The prevalence of periodontitis is significantly greater in diabetic subjects than in non-diabetic individuals.² Gingival bleeding is an
early manifestation of periodontal disease and in diabetics, gingival bleeding is even more severe. The sulcular blood that is expressed during routine periodontal examination can be used as an excellent alternative source of blood for glucometric analysis, using the technology of portable glucometer. This method of glucometric analysis was selected because with this method, dentists are relatively more comfortable in obtaining blood samples, the patient is not unduly alarmed, and there is no fear complex involved for the patient. Though diabetes mellitus is one of the most common metabolic disorders, nearly half the cases go undiagnosed. Patients with undiagnosed diabetes mellitus are at significantly increased risk for coronary heart disease, stroke, and peripheral vascular disease. The early diagnosis of diabetes can help to prevent its long-term complications that are responsible for the high morbidity and mortality. It is essential for a patient suffering from diabetes mellitus to regularly monitor the concentration of blood glucose in order to prevent any unseen complications that may occur.

Thus, development of a non-invasive assay for biochemical materials is an urgent necessity and it will allow us to utilize these screening tests widely for many patients. Hence the present study was undertaken to establish the role of a dentist in screening patients with undiagnosed diabetes with the help of a relatively comfortable, non-invasive, and chair-side technique during routine periodontal examination.

**Materials and Methods**

**Study Design and Subject Selection**

The study was conducted after obtaining the Institutional Ethical Committee clearance. Sixty subjects of age group 40–60 years of both the genders (26 males and 34 females) were selected from the out-patient Department of Periodontics, Tamil Nadu Government Dental College and Hospital, Chennai. Following selection of subjects, written informed consent was obtained after explaining the study procedure. Examination was preceded by a thorough medical and dental history of the subjects. Periodontal evaluation was done by measuring the gingival bleeding index, plaque index, probing pocket depth and clinical attachment level.

**Exclusion Criteria (Both Groups)**

- Patients with anemia/haematological disorders
- Patients under anticoagulant therapy
- Patients with systemic disorders such as cardiovascular, hepatic, immunologic, renal disorders or other organ failures
- Patients requiring antibiotic premedication
- Patients with a history of periodontal treatment during the past 6 months
- Areas of periodontium with suppuraton

The selected subjects were divided into two groups based on the following criteria:

**Group I**

Thirty diabetic subjects, with chronic periodontitis, diagnosed clinically with clinical attachment loss (CAL) of ≥3 mm and with radiographic evidence of bone loss.

**Group II**

Thirty non-diabetic patients with chronic periodontitis, diagnosed clinically with clinical attachment loss (CAL) of ≥3 mm and with radiographic evidence of bone loss.

**Study Protocol**

- Institutional ethical committee approval.
- Medical history and informed consent – obtained.
- Intraoral examination was done using a mouth mirror and Williams's periodontal probe under artificial light.
- Periodontal examination was done using clinical parameters, namely, gingival bleeding index, plaque index, probing pocket depth and clinical attachment level.
- Orthopantomogram (OPG) was taken to inspect the radiographic parameters and the periodontal status.
- Maxillary anterior sextant was chosen as the site for blood sampling as they offer ideal access for collecting gingival crevicular blood.
- The random blood glucose levels were analyzed from both gingival crevicular blood and finger-prick blood, using glucose self-monitoring device.

**Gingival Crevicular Blood**

**Site Selection**

Each patient was examined intra-orally for the visual signs of gingival inflammation and sites with bleeding on probing. Maxillary anterior teeth with CAL ≥3 mm was chosen as the sample collection site to establish the glucose level as they offer ideal access for obtaining gingival crevicular blood. For each measurement, only one site with bleeding on probing was selected. Every attempt was made to obtain the blood sample on the strip by a clean catch, without contacting either the tooth surface or the periodontal tissues.

**Sample Collection**

After selecting the sampling site, a Williams’s periodontal probe was used to probe along the periodontal pocket. As soon as the probe was removed, the gingival crevice was observed for bleeding. The blood that got collected first at the gingival sulcus was washed away in an attempt to minimize the contamination. The sampling site was isolated.
with gauze or cotton rolls and gently air dried. A periodontal probe was used, to probe along the periodontal pocket and observed for bleeding. At this stage, about 2 to 3 μL of blood oozing from the gingival sulcus was collected with a micropipette and transferred to the test end of the strip mounted on the glucose monitoring device. The test strip was left in place until the instrument beeped giving the blood glucose measurement in mg/dL, and the reading was recorded.

**Finger-Prick Capillary Blood**

**Site Selection**

Samples of finger-capillary blood were taken preferably from the pad of the index finger of the patient’s non-dominant hand.

**Sample Collection**

The pad of the index finger was wiped with surgical spirit and the spirit was allowed to evaporate. The finger was punctured with a sterile lancet and a drop of blood was allowed to form on the finger. The first drop of blood was discarded and as soon as the second drop of blood formed, the test end of the strip was touched to the bleeding site and was held until the instrument gave a beep displaying the blood glucose measurement on the screen in mg/dL.

**Self-Monitoring Glucometer**

A self-monitoring glucometer is an electrochemical biosensor, intended for use in the quantitative measurement of the whole blood.

**Principle**

Glucose biosensors are generally based on the enzyme glucose oxidase (GOD). Glucose oxidase is hyper specific for β-D-glucose, and any glucose present in the “α” form must be converted to “β” form before reacting. This enzyme catalyzes the reaction of β-D-glucose by molecular oxygen producing gluconolactone and hydrogen peroxide. It is a two-stage enzyme process. The process consists of enzymatic oxidation of glucose by the enzyme in which the cofactor flavin adenine dinucleotide (FAD) is reduced to FADH2 (reaction 1), followed by oxidation of the enzyme cofactor (regeneration of the biocatalyst) by molecular oxygen with formation of hydrogen peroxide (reaction 2). The gluconolactone produced during the reaction (1) is hydrolyzed in aqueous media to gluconic acid (reaction 3).

\[
\text{β-D-glucose} + \text{GOD(FAD)} \rightarrow \text{glucone-δ-lactone} + \text{GOD(FADH2)} \quad \text{reaction 1.}
\]

\[
\text{GOD(FADH2)} + \text{O}_2 \rightarrow \text{GOD(FAD)} + \text{H}_2\text{O}_2 \quad \text{reaction 2.}
\]

\[
\text{Glucone-δ-lactone} + \text{H}_2\text{O} \rightarrow \text{Gluconic acid} \quad \text{reaction 3.}
\]

The overall reaction is

\[
\text{β-D-glucose} + \text{O}_2 + \text{H}_2\text{O} \rightarrow \text{gluconic acid} + \text{H}_2\text{O}_2
\]

Electrochemical biosensors are constructed on amperometric principle based on the oxidation or reduction of electrochemically active substances involved or produced in reactions 1 and 3.

The main method for the construction of electrochemical glucose biosensors involves the use of enzyme electrodes which the biologic component (enzyme) is incorporated as a part of the transducer design. The glucose in the blood sample reacts with the glucose dehydrogenase enzyme to yield gluconolactone and produces a small electric current. This current is measured by the meter and is displayed as glucose level.

**Method**

When the user inserts a test strip, the meter turns on and displays a symbol for blood drop and battery level. The edge of the test strip is touched to the blood drop (obtained by prick) and the sample chamber on the strip fills by capillary action in approximately 2 sec. The meter sounds a tone (beep) to let the user know that the sample chamber is full and the glucose oxidase reaction has begun. The samples were collected between 8 to 10 a.m. to assess the random blood glucose level. When the test is complete, the meter displays the glucose reading on the liquid crystal display (LCD) screen in approximately 5 sec. The data is collected and analyzed statistically.

**Limitations**

- Uneven layer of blood on the strip may lead to a variation in the reading as it might possibly lead to inadequate distribution of blood.
- As adequate blood flow may not be obtained from non-inflamed gingiva, hence, it is necessary to select patients with inflamed tissue.
- Possible discrepancy may occur due to dilution of blood, by gingival crevicular fluid, oozing from sulcus after probing.

**Statistical Analysis**

The statistical analysis was done using the computer software program SPSS version 15 (Statistical Package for Social Science, Version 15). Descriptive data is presented as mean±SD and range values. The comparison of mean values between the two groups was calculated using Mann-Whitney U-Test. The comparison of mean values between the two methods in both the groups was calculated using Wilcoxon Signed Ranks test. Spearman’s rank correlation coefficient test was used to analyze the correlation between gingival and capillary methods.
Results

In the present study, 60 subjects were included – 30 Type-II diabetes mellitus patients (18 males and 12 females) with chronic periodontitis were categorized as Group-I and 30 non-diabetes subjects (8 males and 22 females) with chronic periodontitis were categorized as Group-II. The range of the gingival crevicular blood glucose (GCBG) measurements of the Group-I patients varied from 119 to 347 mg/dL, with a mean value of 226 mg/dL and a standard deviation of 60 mg/dL. The range of the finger-prick capillary blood glucose (CBG) measurements of the Group-I patients varied from 130 to 366 mg/dL, with a mean value of 234 mg/dL and a standard deviation of 61 mg/dL. The difference between the mean values of GCBG and CBG level from the patients of Group-I was 8 mg/dL with the standard deviation of 10 mg/dL, which was statistically significant (p=0.001) (Table 1).

The range of the GCBG measurements of the Group-II patients varied from 85 to 496 mg/dL, with a mean value of 148 mg/dL and a standard deviation of 87 mg/dL. The range of CBG measurement of Group-II patients varied between 91 and 525 mg/dL, with a mean value of 156 mg/dL and a standard deviation of 91 mg/dL. The difference between the mean values of GCBG and CBG levels from patients of Group-II was 7 mg/dL with the standard deviation of 6 mg/dL, which was statistically significant (p<0.001) (Table 1).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group-I Mean±SD</th>
<th>Group-II Mean±SD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gingival Crevicular Blood Glucose (mg/dL)</td>
<td>226±60</td>
<td>148±87</td>
<td>&lt;0.0001 (Sig.)</td>
</tr>
<tr>
<td>Capillary Blood Glucose (mg/dL)</td>
<td>234±61</td>
<td>156±91</td>
<td>&lt;0.0001 (Sig.)</td>
</tr>
<tr>
<td>Difference</td>
<td>8±10</td>
<td>7±6</td>
<td>0.11 (N.S.)</td>
</tr>
</tbody>
</table>

Mann-Whitney U-test

Table 1. Comparison of Mean Values between Two Groups

The mean value of GCBG of Group-I (226±60) was significantly higher than of Group-II (148±87) (p<0.0001). Similarly, the mean value of CBG level in Group-I (234±61) was significantly higher than in Group-II (156±91) (p<0.0001). Mann-Whitney U-Test was used to calculate the p-value. However, there was no significant difference in the mean difference between the two procedures of glucose level estimation in Group-I and Group-II (p=0.11). In Group-I, the correlation coefficient between both the methods was 0.981 with the p-value <0.0001 and in Group-II, the correlation coefficient between both the methods was 0.976 with p-value <0.0001. In both the groups, blood glucose values obtained using both the methods were highly positively significantly correlated (Table 2).

Table 2. Results of Correlation Analysis between Gingival and Capillary Methods in Both Group-I and Group-II

<table>
<thead>
<tr>
<th>Group</th>
<th>Correlation Coefficient</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0.981</td>
<td>&lt;0.0001 (Sig.)</td>
</tr>
<tr>
<td>II</td>
<td>0.976</td>
<td>&lt;0.0001 (Sig.)</td>
</tr>
</tbody>
</table>

Spearman’s rank correlation coefficient

In Group-I, the intra-class correlation coefficient between both the methods (GCBG and CBG) was 0.987 and the p-value was <0.0001 and in Group-II, the intra-class correlation coefficient between both the methods (GCBG and CBG) was 0.998 and the p-value was <0.0001. In both the study groups, the reliability of both the procedures was significantly high (p<0.0001) (Table 3).

Table 3. Results of Reliability Analysis in Both Group-I and Group II

Discussion

Type-II diabetes mellitus results from defects in the insulin molecule or from altered cell receptors for insulin and represents impaired insulin function, i.e., insulin resistance rather than deficiency. As the condition progresses, insulin production often decreases and patients have a relative insulin deficiency in association with peripheral insulin resistance, and insulin supplementation may become necessary. Though autoimmune destruction of β-cell does not occur, β-cell dysfunction arises from prolonged and increased secretory demand placed on them due to the insulin resistance. In fact, there is a two-way relationship between diabetes mellitus and periodontitis.

On one hand, poorly controlled diabetes mellitus increases the risk for developing destructive periodontitis and impairs treatment outcome and on the other, chronic inflammatory
Periodontal disease considerably complicates diabetes control. Inflammation is hypothesized to play a significant role in the development of Type-II diabetes mellitus, and periodontal disease is a known inflammatory condition. Diabetic patients with periodontal infection have a greater risk of worsening glycemic control over time compared to diabetic subjects without periodontitis.

To emphasize the problem of diabetes and to bring this problem into greater focus, a general understanding of the prevalence of this disease is valuable. The increased prevalence and severity of periodontitis, commonly seen in patients with diabetes especially with poor metabolic control, led to the designation of periodontitis as the sixth complication of diabetes mellitus.

The incidence of periodontal disease increases with increasing age, and severe periodontal disease is associated with patients in higher age groups. Periodontitis and diabetes are both generally diseases of advancing age. A population with periodontal disease must be considered at a slightly higher risk of diabetes mellitus than a population without periodontal disease.

Epidemiological studies have clearly established that diabetes is a risk factor for periodontal disease and diabetes is often associated with increased gingival inflammation in response to bacterial plaque. Considerable effort has been made in the past few years to develop painless and noninvasive methods to measure blood glucose in patients with diabetes mellitus so as to avoid the trauma of drawing venous blood each and every time. One of the most commonly used sites to obtain blood is from the pads of the index finger which is less traumatic than venous blood collection. Since periodontal inflammation with or without the complication factor of diabetes mellitus is known to produce ample extravasate of blood during diagnostic periodontal examination, no extra procedure, such as finger puncture with a sharp lancet is required to obtain blood for glycometric analysis.

Even in the case of very low gingival crevicular bleeding, glucose measurement is possible with the use of self-monitoring glucometer, as a very minimum amount of blood (3 μL) is sufficient to perform the analysis. The sampling procedure that was applied in this study is much easier to perform and less time-consuming, since no sophisticated armamentariums are necessary to collect gingival crevicular blood. Diabetes is often associated with increased gingival inflammation in response to bacterial plaque. This response may be related to the level of glycemic control in subjects with well-controlled diabetes having a similar degree of periodontitis as non-diabetic individuals and poorly controlled diabetic subjects having significantly increased inflammation. Increased gingival inflammation may be seen in diabetic subjects even though plaque levels are similar to non-diabetic controls. The level of diabetic control is a more important factor than plaque control in relation to the severity of gingival inflammation.

Because of the ease of availability of sulcular blood, especially in inflamed periodontium, it can be used regularly to screen for diabetes. In the present study, in Group-I, the mean gingival crevicular blood glucose level was lower than the mean finger-prick blood glucose level by a mean difference of 8 mg/dL. Similarly, in Group-II also the mean gingival crevicular blood glucose level was lower than the mean finger-prick capillary blood glucose level by a mean difference of 7 mg/dL. This could be attributed to the possible contamination of gingival blood samples with saliva, plaque or gingival fluid which could dilute these samples. Also in the present study, the intra-group correlation coefficient for Group-I was found to be 0.987 (p<0.0001), and for Group-II, it was found to be 0.998 (p<0.0001). Hence in both the study groups, the reliability of both the methods was found to be significantly high. Therefore, gingival crevicular blood can be a good alternative non-invasive source for chair-side blood glucose level monitoring.

There is a positive correlation between gingival crevicular blood and capillary blood glucose level (r=0.826), and gingival blood glucose level estimates 68.2% of capillary blood glucose level. The capillary blood glucose level may be estimated with the following regression equation.

**Capillary blood glucose=84.66+0.77xgingival crevicular blood glucose level**

The majority of periodontal therapy produces extravasated blood from the gingival crevice due to inflammation. As a glucometer provides instantaneous assessment of blood glucose, it is highly beneficial in the dental office environment. Multiple measurements of a diabetic patient’s blood glucose levels allow the periodontist to better assess the patient’s diabetic control as the treatment progresses. The glucometer measures whole blood glucose whereas reference laboratory instrument measures blood glucose in remaining plasma after separation. Hematocrit (packed cell volume, PCV – the percentage of blood volume occupied by RBC) is used to convert the reference laboratory measurement (plasma glucose) to whole-blood glucose value. This corrected laboratory value is now considered the true value of blood glucose and allows for direct comparison of gingival crevicular blood glucose with true laboratory value of blood glucose.

Hematocrit corrected venous glucose (mg/dL)=Lab (mg/dL)×[1.0−(0.0024×Hct)]

Also the technique described is safe, easy to perform, painless, and comfortable for the patient and can therefore be applied for screening of diabetes mellitus in dental
It takes only 5 sec to obtain the glucose level and that too from the blood that is generated during routine periodontal examination. In addition, the cost of the kit is extremely modest. Therefore the limited investment of time and money for the clinician and the minimal anxiety and pain for the patient adds to the merits by which dental professionals can play a critical part in the systemic health of their patient in addition to their dental health. Due to the close interrelationship between diabetes mellitus and periodontitis, it can be assumed that dental practitioners, especially periodontists, are extremely likely to encounter an increasing number of undiagnosed diabetes mellitus patients with periodontitis. The early diagnosis of diabetes might help to prevent the long-term complications that are responsible for the high mortality and morbidity associated with diabetic patients.

The severity of the periodontal disease found among diabetics was a manifestation of peripheral vascular occlusive disorder associated with diabetes mellitus. Increased collagenase activity and decreased collagen synthesis is found in individuals with diabetes with chronic periodontitis. In the hyperglycemic state, numerous proteins and matrix molecules undergo a nonenzymatic glycosylation resulting in formation of accumulated glycation end products (AGEs). The formation of AGEs occurs at normal glucose levels as well, but in hyperglycemic environments, AGE formation is excessive. Collagen is cross linked by AGE formation, making it less soluble and less likely to be normally repaired or replaced. As a result, collagen in the tissues of poorly controlled diabetics is aged and more susceptible to break down in periodontal tissues as well. AGE plays a central role in the classic complications of diabetes and may play a significant role in the progression of periodontal disease as well.

The cumulative effect of altered cellular response to local factors, impaired tissue integrity, and altered collagen metabolism undoubtedly play a significant role in the susceptibility of individuals with diabetes to infections and destructive periodontal disease. Diabetes mellitus has a wide range of complications, such as retinopathy, nephropathy, micro and macro vascular disease, altered wound healing, and periodontitis.

Periodontal therapy may not be associated with improved glycemic control in diabetes patients who are relatively well controlled, but may result in improved metabolic control in some individuals with poorly controlled diabetes. Though there are a few limitations in this study, such as the sample size and possible contamination of the sample with plaque, saliva, and GCF, screening for diabetes using gingival crevicular blood samples has to be encouraged as it could be the first step to identify those for whom follow-up tests regarding possible diabetes are warranted. Because of the ease with which sulcular blood can be obtained, especially in patients with chronic periodontitis, it can be used not only to screen for diabetes mellitus, but also to monitor the level of control of the disease.

**Conclusion**

Sixty patients were screened and selected from the patients who attended the outpatient department, Department of Periodontics, Tamil Nadu Government Dental College and Hospital, Chennai. Thirty Type-II diabetic subjects with chronic periodontitis were categorized as Group-I and 30 non-diabetic subjects with chronic periodontitis were categorized as Group-II, based on AAP classification 1999. Gingival crevicular blood and finger-prick capillary blood samples were taken to correlate the glucose levels using a self-monitoring glucometer. The data was statistically analyzed with Mann-Whitney U-test, Wilcoxon Signed Ranks test and Spearman’s rank correlation coefficient method. The results obtained by this study show that both the methods were highly positively significantly correlated (P<0.0001), which shows that gingival crevicular blood that is expressed in a chronic periodontitis patient during routine periodontal examination can be used to screen the diabetic status of the chronic periodontitis patient. Hence the study offers an alternative method to detect diabetes in chronic periodontitis patients who were earlier unaware of their diabetic status, and would also help them to prevent developing further diabetic complications and bring down the rate of morbidity and mortality associated with diabetes.

The glucometer is a safer, convenient, quick, and inexpensive apparatus that can be used as a chair-side aid during routine periodontal examination to screen blood glucose. The self-monitoring blood glucometer should not be used to replace the conventional blood glucose measurement method which is still considered to be the gold standard. The result of the present study suggests that the gingival crevicular blood expressed during routine periodontal examination can be used to screen for diabetes. GCGB estimation through glucometer from gingival crevice during routine periodontal examination might be used as a valuable, rapid, non-invasive, chair-side diagnostic tool to estimate, monitor and/or screen diabetes in periodontal disease patients.

A larger sample size and the ability to adopt the blood sample mixed with purulent discharge to determine the blood glucose level would aid in overcoming the limitations in this study and at large be a blessing to the society. There are several published and unpublished data regarding the use of gingival crevicular blood to estimate blood glucose level. A meta-analysis has to be done in order to review all the published evidence to quantify the reliability of gingival crevicular blood to estimate the blood glucose level.
Figure 1. Mean Values of Finger-Prick Capillary Blood Glucose Level and Gingival Sulcular Blood Glucose Level in Diabetic and Non-Diabetic Groups.

Figure 2. Comparison of Mean Values between Two Methods in Group-I.

Figure 3. Comparison of Mean Values between the Two Methods in Group-II.
Figure 4. Comparison of Gingival Crevicular Blood Glucose Level and Capillary Blood Glucose Level in Diabetic Subjects with Chronic Periodontitis

Figure 5. Comparison of Gingival Crevicular Blood Glucose Level and Capillary Blood Glucose Level in Non-Diabetic Subjects with Chronic Periodontitis

Photograph 1. Micropipette
Photograph 2. Glucometer, Lancet, Test-Strips

Photograph 3. Micropipette Used to Collect Sulcular Blood

Photograph 4. Sulcular Blood Being Transferred to the Test-Strip and the Blood Glucose Reading on the Glucometer Monitor
Photograph 5. The Lancet in Position on the Index Finger

Photograph 6. A Drop of Blood on the Pad of the Index Finger

Photograph 7. Glucometer Showing Reading
Conflict of Interest: None

References