Isopropyl Alcohol Left on the Skin Falsely Lowers Capillary Glucose Values

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Abstract

• **Objective:** To evaluate the effect of isopropyl alcohol left on the skin during portable capillary blood glucose testing.

• **Methods:** Two capillary blood samples from 2 different fingers were obtained from 192 volunteers. The first finger was prepped with alcohol and the second finger had no preparation. The 2 samples were obtained within 2 minutes of each other and in most cases from the same hand.

• **Results:** Capillary blood glucose samples obtained from the finger prepped with alcohol yielded a consistently lower blood glucose level than those taken from the finger with no prep (mean difference, –10.44 points; \( P < 0.005 \)).

• **Conclusion:** Capillary blood glucose testing should be performed without prepping the skin with alcohol.

Intensive glycemic control is an effective way of reducing the complications associated with type 2 diabetes [1–3]. Many authoritative bodies recommend self-monitoring of blood glucose as an integral part of diabetes management. Capillary blood glucose testing is the standard for home self-monitoring of blood glucose and is often used in hospitals and other facilities as well.

One aspect of capillary blood glucose testing that has been frequently overlooked is preparation of the capillary sample site. The American Diabetes Association has issued guidelines for proper fingerstick technique [4]. These guidelines generally state that the hands are to be washed with warm soap and water, dried thoroughly, lanced, and then the sample is to be obtained. However, this practice is generally not followed. The most common fingerstick preparation is cleaning the site with an alcohol prep pad, a practice cited in current nursing standards and literature as the proper preparation technique [5–7]. Although some references state that the site should air dry or be dried with gauze, this too is often overlooked. As blood samples are often obtained from a finger wet with alcohol, it raises the question of whether alcohol left on the sample site affects blood glucose values and glucometer results. The objective of our study was to examine the effects of isopropyl alcohol left on the skin during portable capillary blood glucose testing.

**Methods**

The study was conducted at a medical school laboratory and an affiliated community hospital and was approved by the institutional review boards at each institution. Written informed consent was obtained from each participant. The study population consisted mainly of medical students and hospital employees of varying age, sex, and race. Inclusion criteria included any consenting adult. Prandial status and diabetes status were not obtained, as we felt this was outside the focus of our study. Exclusion criteria included those who were immunocompromised or on anticoagulation treatment for any reason.

The capillary blood of 192 volunteers was obtained twice using 2 separate techniques on 2 different fingers. We conducted our research in 3 different sessions (early morning, late morning, and early afternoon) to ensure a wide variance in glucose levels. The subjects were encouraged to thoroughly wash and dry their hands before any blood was drawn. The first finger was prepped with 2 brisk wipes with an alcohol prep pad, lanced with an automatic disposable lancet, and blood applied to the test strip of the glucometer within 10 seconds of the alcohol preparation. The second finger had no preparation and was lanced with an automatic disposable lancet, with blood applied to the test strip of the glucometer within 10 seconds. The 2 capillary samples were obtained within 2 minutes of each other and in most cases from the same hand to reduce the number of variables. The fingers and hand used were completely random and left to subject’s preference. One investigator performed all the preparations, needle sticks, and obtained the samples in the same order to ensure consistency [8,9]. All of the blood samples were obtained using manufacturer-recommended lancets with a preset depth to ensure consistency. The manufacturer’s guidelines for calibration and proper test strip handling were also followed; the meter was not calibrated to a laboratory standard. All results were recorded directly into a spreadsheet.

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We used a FreeStyle Flash (Abbott Diabetes Care, Abbott Park, IL) portable glucose monitor to perform the blood glucose measurement and used the same monitor throughout the trial. We chose this monitor because it is one of the most accurate monitors for capillary blood glucose measurement compared with other portable testing devices [10]. It can be used on the finger or the forearm and is widely used by both patients and practitioners. Unlike first-generation meters, the FreeStyle Flash is also accurate regardless of the patient’s hemoglobin concentration or temperature, making it an optimal choice for our study [11].

### Statistical Analysis

On the basis of previous similar trials, we calculated that 150 samples of each type would provide strong statistical power. To ensure statistical strength we exceed 150 subjects and continued our study until our supplies were exhausted. The significance of the difference between the wet and dry group was estimated by means of a 2-tailed Student’s t test. Further analysis was performed with GraphPad InStat version 3.06 (San Diego, CA). The paired 2-tailed t test and the Wilcoxon matched-pairs signed-ranks test were applied.

### Results

Over a 3-day period we performed 384 capillary glucose tests, half of which were performed on wet fingers and half on dry. The mean difference in blood glucose levels between the wet and dry finger readings was –10.44 mg/dL (P < 0.005). The paired 2-tailed t test demonstrated that the mean values differed at the P < 0.001 level. However, the data failed the normality test, so a Wilcoxon matched-pairs signed-ranks test was applied. This test also showed the difference to be significant (P < 0.001). Data are summarized in the Table.

The distribution of data covered a large range of absolute values for blood glucose, from 47 to 225 mg/dL. The difference between the 2 measurements on individuals ranged from –73 to 76 mg/dL. The slope of the regression line was calculated as 0.8807. However, the distribution was fairly tight around the mean, as seen in the Figure. Although there were a few outliers, the tendency for the dry blood glucose reading to be greater than the wet is apparent.

### Discussion

We found that subjects prepped with alcohol before administration of a capillary glucose test averaged a blood glucose reading that was 10.44 mg/dL lower than those with no prep. We found these results to be consistent at both ends of the capillary glucose spectrum. The Figure shows the minimal variation we observed. We did have a limited number of cases in which the reading from the wet finger was higher than the dry, but the differences were small and could be attributed to test strip and meter variance. The U.S. Food and Drug Administration requires glucose meters to produce results within 20% of a reference measurement [12].

A strength of our study is its simplicity. The effect of different preparations and soaps on glucose testing could be a subject for future research.

This study offers evidence to suggest that changes in hospital protocols and educational training guidelines for capillary blood glucose testing should be strongly considered. Previous studies have cited numerous opportunities for error in glucose testing. Avoiding the use of alcohol prep will help to increase accuracy [13,14]. Our findings also have cost implications; not using alcohol prep pads will lower the cost of testing, albeit by a small amount. With regard to safety taking samples with no prep, none of the test subjects contacted our clinic or disclosed any signs or symptoms of infection.

In summary, when conducting capillary glucose testing, alcohol should not be left wet at the sample site.

**Table.** Glucose Readings in Wet Versus Dry Fingers

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Wet</th>
<th>Dry</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>102.11</td>
<td>112.55</td>
<td>–10.44</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>29.07</td>
<td>29.55</td>
<td>15.15</td>
</tr>
<tr>
<td>Standard error</td>
<td>2.10</td>
<td>2.13</td>
<td>1.09</td>
</tr>
<tr>
<td>Minimum</td>
<td>47.00</td>
<td>61.00</td>
<td>–73.00</td>
</tr>
<tr>
<td>Maximum</td>
<td>219.00</td>
<td>225.00</td>
<td>76.00</td>
</tr>
<tr>
<td>Median</td>
<td>96.00</td>
<td>104.00</td>
<td>–10.00</td>
</tr>
<tr>
<td>Lower 95% CI</td>
<td>98.00</td>
<td>108.37</td>
<td>–12.59</td>
</tr>
<tr>
<td>Upper 95% CI</td>
<td>106.22</td>
<td>116.73</td>
<td>–8.30</td>
</tr>
</tbody>
</table>

CI = confidence interval.

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**References**


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