Capillary–Venous Differences in Blood Glucose Values during the Oral Glucose Tolerance Test

To the Editor:

The oral glucose tolerance test (OGTT) currently is frequently used to screen for individuals with impaired glucose metabolism. To improve the reproducibility as well as the predictive value of the test, it is important to control as many external sources of variability as possible. Three major factors influencing glucose values are the laboratory procedure used, the type of sample analyzed (whole blood, plasma, or serum), and the source of the blood (venous or arterial) (1).

Although the concentration of glucose in capillary blood usually reflects its concentration in arterial blood, it has been known since the 1920s that the relative concentrations in arterial and venous blood vary with the status of feeding or fasting, such that during fasting the differences are usually minute or negligible, 1 h after oral glucose or a meal they are substantial, and after 2 h smaller but still appreciable (1). This has led to the currently recommended criteria of 7.0 and 8.0 mmol/L, respectively, as the upper normal limits for venous and capillary blood glucose concentrations after 120 min in the standardized OGTT (2). However, more data are needed on the normal capillary–venous blood glucose differences in this test (1). We therefore report on our simultaneous measurements of glucose in venous and capillary blood at 0, 20, 40, 60, 90, and 120 min in a consecutive random subsample of routine OGTTs.

Table 1. Mean Glucose Concentrations in Capillary and Venous Blood in the Study Sample

<table>
<thead>
<tr>
<th>Blood sample</th>
<th>Time after Ingestion, minutes</th>
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<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Capillary</td>
<td>5.06</td>
</tr>
<tr>
<td>Venous</td>
<td>4.98</td>
</tr>
<tr>
<td>Difference</td>
<td>0.08</td>
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</tbody>
</table>

*Difference significant at p < 0.0005 (Student’s t-Test).

Total birth-year cohorts of middle-aged Malmö men are invited to our multiphasic health screening and intervention program (3); about 75% respond and participate. OGTT is included among the screening tests, with all investigations being performed in the morning after an overnight fast. Instruction on caloric balance before screening and on overnight fasting and smoking abstinence before the examination is given in the invitation letter; compliance is checked by questioning. In the OGTT, the subjects ingest, within 5 min, 30 g of glucose per square meter of body surface in the form of a 100 g/L aqueous solution of glucose.

For this study we chose 53 consecutive individuals in the male birth year cohorts 1926 and 1937 who had a second OGTT to verify previous screening-test results. The material thus contained different ages (mean 55 and 45 years, respectively) and both normal and above-normal glucose results to test the capillary–venous difference over this range. Blood glucose was obtained simultaneously by intravenous catheter in the antecubital fossa and by fingertip capillary puncture at the times mentioned above and analyzed by a standard glucose hexokinase method (4). To rule out the possibility of influence from the intravenous sampling method, we also obtained simultaneous 60-min values from venipuncture in the antecubital fossa and fingertip puncture in a subsample of 25 individuals. They showed exactly the same results as the entire study group.

As Table 1 shows, the capillary and venous glucose values are almost identical at the zero time, but after that they are greater in the capillary samples, to an extent that appears to correlate better with concentrations than with the interval after ingestion. The differences are closely intercorrelated, as shown by linear regression analysis. At 120 min, the correlation coefficient is as great as 0.94, and the relation between the capillary (c) and the venous (v) blood glucose values, is c = 0.95v + 1.17 mmol/L. Similar regression equations can be obtained for the other time values, but may be of less interest because interpretation of OGTT results currently focus on the 120-min values (2). There is increasing evidence that other time values are also relevant, however, particularly those related to the peak of the glucose concentration after the ingestion. If such is the case, and repeated samplings are then required, the availability of firm transformation factors may be of considerable practical importance. Although our findings are in principle already well known and described in the literature (1, 5), there might be a considerable value in re-emphasizing them in light of the more widespread use of fingertip capillary puncture, as in the Home Blood Glucose Monitoring programs. Furthermore, to the best of our knowledge no exact numerical data have been reported before from a population sample of healthy middle-aged men, and they are similar to the results previously obtained by Larson-Cohn (6) for 36 women, ages 46 to 57 years.

References

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Alternative Method for Stabilizing Carbon Dioxide in Serum

To the Editor:

Before analysis for serum electrolytes, we used to stabilize carbon dioxide by alkalinization, according to the method of Gambino and Schreiber (1). They recommend that one drop (35 μL) of a 1 mol/L solution of ammonium hydroxide be added per milliliter of serum; this increases the serum pH to about 8.7 and prevents loss of carbon dioxide.

Recently, we have used a Beckman Astra 8 to measure serum electrolytes. It measures potassium by use of an ion-selective electrode, which is subject to interference by ammonium ions (2).