Blood Glucose Monitoring in the Presence of Maltose

New Accu-Chek® Inform II and Accu-Chek® Performa test strips with advanced chemistry can be used by patients treated with maltose-containing or maltose-producing therapies.

SUMMARY

With the launch of the new Accu-Chek Inform II and Accu-Chek Performa blood glucose test strips, which use an advanced chemistry, maltose interference is not a concern when testing.

This document describes potential sources of maltose interference and clinically relevant levels of maltose based on a survey of recent studies. It also demonstrates the performance of the new Accu-Chek Inform II and Accu-Chek Performa blood glucose test strips at high concentrations of maltose.
Overview

Accuracy is a top priority for Accu-Chek. For this reason, Roche has created the new advanced chemistry Accu-Chek Inform II and Accu-Chek Performa blood glucose test strips, which are not subject to clinically relevant maltose interference. The systems' new advanced chemistry provides accurate test results in the presence of maltose, making it suitable for use by:

- people receiving therapy with solutions containing maltose, which is present in some immunoglobulin preparations, and
- people on peritoneal dialysis using solutions containing icodextrin, such as EXTRANEAL™ dialysis solution.

The packaging for Accu-Chek Inform II and Accu-Chek Performa test strips with advanced chemistry is marked with a green square, which indicates that the strips are not subject to clinically relevant maltose interference.
Advanced Test Strip Chemistry

Through the use of molecular-cloning techniques, Roche has created the Mut. Q-GDH enzyme. With this enzyme, patients undergoing therapies that contain or metabolize to maltose can have increased confidence that the glucose values they get with their meters are accurate. Hospitals and physician offices can be confident that glucose values are within the accuracy standards for glucose monitors.

The new Accu-Chek Inform II and Accu-Chek Performa test strips measure blood glucose using an electrochemical detection technique. The new version of the test strip employs a disposable dry reagent based on the Mut. Q-GDH enzyme for glucose determination.

When a drop of blood is applied to the test strip, the modified glucose dehydrogenase enzyme oxidizes the glucose. During the reaction, electrons are transferred by the enzyme to an electrochemical mediator, which then conveys these electrons to the surface of an electrode. The current generated by the reaction is proportional to the concentration of glucose present in the blood sample.

Maltose Interference

Under normal circumstances, maltose is not found in the blood. Ingested maltose is hydrolyzed to glucose in the intestine before absorption. However, maltose is found in the blood of patients on parenterally administered therapies containing maltose, such as some immunoglobulin preparations. In addition, icodextrin, which is used in dialysis solutions, is converted to small glucose polymers (maltose molecules (G2), maltotriose (G3) and maltotetraose (G4)) when administered parenterally, namely intraperitonealy for peritoneal dialysis. With strip chemistries susceptible to maltose interference, these polymers are misinterpreted as glucose.

Clinically Relevant Maltose Levels

Clinical studies have been conducted to assess the potential maltose concentrations in plasma when using various therapies. Since maltose levels in human plasma do not exist in any appreciable levels as a result of diet, relevant studies investigate:

- intravenous administration of maltose in subjects with normal renal function
- use of peritoneal dialysis solutions containing icodextrin (for example, EXTRANEAL™).
Direct Intravenous Infusion of Maltose

Various studies have been conducted of direct intravenous infusion of maltose in subjects with normal renal function. It is important to note that the metabolism of intravenously administered maltose depends on the patient’s health and the quantity, infusion rate, and total infusion time of the dose.

Sprandel\(^1\) infused a maltose solution with a dose of 0.5 g maltose per kg body weight per hour over 345 minutes in ten healthy male subjects. In a study by Tahara\(^2\), eight healthy male adults aged 22 to 39 years were given maltose infusions of 0.9 g per kg body weight over three hours or 4 g per kg body weight over eight hours. Schmidt\(^3\) infused a maltose solution with a dose of 0.5 g maltose per kg body weight per hour over eight hours in four healthy subjects.

Table 1 summarizes the results of the Sprandel, Tahara, and Schmidt studies.

### Table 1. Studies of Direct Intravenous Infusion of Maltose

<table>
<thead>
<tr>
<th></th>
<th>Sprandel</th>
<th>Tahara</th>
<th>Tahara</th>
<th>Schmidt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infusion rate of maltose per hour (g/kg body weight)</td>
<td>0.5</td>
<td>0.3</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Duration of infusion (hours)</td>
<td>5.75</td>
<td>3</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Total infused maltose (g/kg body weight)</td>
<td>2.9</td>
<td>0.9</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Total infused maltose for a 70 kg person (g)</td>
<td>201</td>
<td>63</td>
<td>280</td>
<td>280</td>
</tr>
<tr>
<td>Published plasma maltose (mmol/L)</td>
<td>6.4 (±1.2)</td>
<td>5.5</td>
<td>10.5 (single value)</td>
<td>7.6 (±0.6)</td>
</tr>
<tr>
<td>Published plasma maltose—single patient values (mmol/L)</td>
<td>6.4+2x1.2 = 8.8</td>
<td>10.5 (single value)</td>
<td>7.6+2x0.6 = 8.8</td>
<td></td>
</tr>
</tbody>
</table>

These data indicate that maximum plasma maltose concentrations of 10.5 mmol/L can be expected in individual patients with normal renal function under intravenous maltose administration.
Icodextrin Metabolites in Patients on Peritoneal Dialysis

DeWaart\textsuperscript{a} conducted a study of long-dwell effluents of 12 patients on peritoneal dialysis. All patients used 7.5\% icodextrin-containing dialysate for their long dwell on a chronic basis. In six patients, a heparinized plasma blood sample was drawn for analysis of icodextrin breakdown products.

Table 2 summarizes the results of the De Waart study.

**Table 2. Study of Icodextrin Metabolites in Patients on Peritoneal Dialysis**

<table>
<thead>
<tr>
<th>Icodextrin metabolites</th>
<th>De Waart</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maltose (G2)</td>
</tr>
<tr>
<td>Mean plasma concentration (mmol/L)</td>
<td>3.4</td>
</tr>
<tr>
<td>SD (estimated from literature)</td>
<td>+/-1.3</td>
</tr>
<tr>
<td>Mean + 2xSD (mmol/L)</td>
<td>5.9</td>
</tr>
</tbody>
</table>

* The molar concentrations are added, as the test strips have equal or reduced interference with G3 and G4 compared to G2 on a molar basis. Therefore, a model experiment with G2 can be regarded as a worst case experiment.

These data indicate that icodextrin metabolites (including maltose and longer oligosaccharides) of up to 10.4 mmol/L can be expected in individual patients using peritoneal dialysis solutions containing icodextrin.

Conclusion of Study Analyses

Based on the data above, maximum plasma maltose concentrations of 10.5 mmol/L can be expected in individual patients with normal renal function under intravenous maltose administration. Icodextrin metabolites (including maltose and longer oligosaccharides) of up to 10.4 mmol/L can be expected in individual patients using peritoneal dialysis solutions containing icodextrin.
Performance with Accu-Chek Inform II and Accu-Chek Performa Advanced Chemistry Test Strips

To demonstrate the performance of the advanced chemistry, Accu-Chek Inform II and Accu-Chek Performa test strips from two representative lots were tested with samples contrived to represent hypoglycemic, euglycemic and hyperglycemic glucose levels. Each of these samples were then divided to provide a control sample containing no maltose and a second sample where maltose was added to achieve an extreme concentration of 10.5 mmol/L. Both of these samples were then tested on the Accu-Chek Inform II and Accu-Chek Performa test strips. The responses, plotted on a Parkes error grid (Figure 2), demonstrate suitable accuracy for each of the representative glucose levels tested.

**Figure 2. Parkes error grid – maltose interference testing (10.5 mmol/L)**

Zone A: No effect on clinical action
Zone B: Altered clinical action—little or no effect on clinical outcome
Zone C: Altered clinical action—likely to affect clinical outcome
Zone D: Altered clinical action—could have significant medical risk
Zone E: Altered clinical action—could have dangerous consequences
Conclusion

Due to improved specificity, Accu-Chek Inform II and Accu-Chek Performa test strips with this new, advanced chemistry can be used by patients being treated with maltose-containing or maltose-producing therapies.

References