Continuous subcutaneous glucose monitoring in children with type 1 diabetes

Background information
- Achieving and maintaining tight glycemic control in children with type 1 diabetes is more challenging than in adults.
- Continuous glucose monitoring (CGM) allows glucose levels to be accurately measured and recorded 24 hours a day. This should result in improved glycemic control through the detection of asymptomatic hyper- and hypoglycemic episodes, and subsequent fine-tuning of insulin therapy.

Aims
- To determine whether, in children with type 1 diabetes and poor glycemic control, CGM assists in detecting asymptomatic nocturnal hypoglycemia and in improving HbA1c levels.

Methods
- Children and adolescents with type 1 diabetes and HbA1c > 8.0% were enrolled and randomized to one of two groups. The first group monitored their blood glucose (BG) levels at least 4 times daily by standard methods (i.e. self-monitoring). In the second group, glucose levels were measured continuously using the Medtronic Continuous Glucose Monitoring System (CGMS).
- Children in the continuous monitoring group wore a CGMS glucose sensor for 6 periods of 3 days each, during the 30-day study period. In addition, they self-monitored their BG at least 4 times per day.
- Adjustments to insulin dosage were made by the lead investigator only, and were based on data downloaded from the CGMS after each 3-day period, or on self-monitored BG values in the control group (faxed every 5 days during the 30-day study period).
- HbA1c was measured at baseline and after 1 and 3 months in all children. Additionally, Fear of Hypoglycemia and DCCT Quality of Life questionnaires were completed at the same time-points.

Results
- Eleven patients aged 10–17 years and with a duration of diabetes ranging from 2.1 to 11.6 years were enrolled. Five patients were randomized to the CGMS arm, and 6 to the control arm.

Key points
- HbA1c levels decreased in all CGM patients at 1 month; in 4 patients, levels remained below initial values at 3 months.
- Unlike self-monitoring, CGM allowed the detection of episodes of asymptomatic nocturnal hypoglycemia.
- This facilitated the fine-tuning of insulin dosage, resulting in improved HbA1c levels without an increase in hypoglycemic events.
Changes in HbA1c for individual patients in the CGMS arm are shown in Figure 1. Mean HbA1c decreased significantly among patients in the CGMS arm, but did not show significant reductions among children who self-monitored their BG (Table 1).

At 3 months, 4 of the 5 children in the CGMS arm had HbA1c values that were lower than their initial levels, compared with 3 of 6 children in the control group.

Hypoglycemic episodes (BG or CGMS values < 60 mg/dL [3.3 mmol/L]) were detected more frequently in the CGMS group than in the control group. There were 64 such episodes in the CGMS group (an average of 12.8 per person); 20 episodes occurred at night, and three of these were symptomatic. In comparison, there were 40 episodes among control patients (6.7 per person), including 4 symptomatic nocturnal events.

Consequently, CGMS patients had more insulin dosage adjustments than did patients in the control group (mean number of changes 11.5 vs 5.2). This was achieved without increasing the incidence of severe hypoglycemia.

No significant between- or within-group (i.e. vs baseline) differences were observed in the scores obtained at any time-point from either of the quality-of-life instruments used.

**Conclusion**

CGMS allowed the recognition of nocturnal hypoglycemic episodes that were asymptomatic and would otherwise have gone undetected. As a result, patients in the CGMS group had more adjustments to their insulin regimen than control patients, and were more likely to complete the study with HbA1c values below their initial levels.

**Table 1. Mean (± SD) HbA1c levels**

<table>
<thead>
<tr>
<th>Group</th>
<th>Previous 6 months</th>
<th>Start of study</th>
<th>1 month</th>
<th>3 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>CGMS (n = 5)</td>
<td>9.3 ± 0.7</td>
<td>10.0 ± 0.7</td>
<td>9.5 ± 0.9*</td>
<td>8.8 ± 0.3</td>
</tr>
<tr>
<td>Control (n = 6)</td>
<td>8.9 ± 0.7</td>
<td>9.0 ± 1.2</td>
<td>8.8 ± 0.4</td>
<td>8.4 ± 0.2</td>
</tr>
</tbody>
</table>

* p < 0.01 versus start of study. All other comparisons were non-significant

**From the authors**

"Continuous subcutaneous glucose monitoring was very helpful in detecting low blood sugars, particularly during the night."