Evaluation of a Continuous Glucose Monitoring System for Use in Goats and Calves

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Introduction

Hospitalized goats with pregnancy toxemia and calves with diarrhea require frequent glucose monitoring. Current glucose monitoring options are either expensive or inaccurate, so an affordable and accurate continuous glucose monitoring system (CGMS) is desirable.

CGMSs have previously been evaluated in dogs, cats, adult cattle, and horses. Freestyle Libre is a CGMS with a small filament that inserts under the skin and measures interstitial glucose concentrations, which is at equilibrium with blood glucose concentrations. Glucose measurements can be read using a mobile phone app or handheld scanner.

Benefits of Freestyle Libre include:
- 14 day application to animal
- Unlimited glucose readings
- No physical restraint or blood draw required
- Reusable handheld scanner

Methods

Randomized cross-over study design

Animals:
- 7 healthy goats
  - Female
  - 13-14 months old
- 7 healthy calves
  - Male
  - <2 weeks old

Glucose measurements determined by a continuous glucose monitoring system (CGMS) is desirable.

Hypothesis

Glucose measurements determined by a continuous glucose monitoring system will be similar to those determined by a chemistry analyzer (reference method).

To determine the accuracy of a CGMS by comparing glucose concentrations measured over time by the CGMS, the chemistry analyzer, the ICU machine, and the POC glucometer in normoglycemic, hyperglycemic, and hypoglycemic healthy goats and calves.

Results - Calves

Figure 5. Average glucose concentrations of cohort of calves as determined by CGMS, POC glucometer, ICU machine, and chemistry analyzer over time.

<table>
<thead>
<tr>
<th>Glycemia</th>
<th>Bias</th>
<th>95% Limits of Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperglycemia</td>
<td>6.7 mg/dL</td>
<td>-54.0 to 67.3 mg/dL</td>
</tr>
<tr>
<td>Control</td>
<td>8.1 mg/dL</td>
<td>39.4 to 45.5 mg/dL</td>
</tr>
<tr>
<td>Hypoglycemia</td>
<td>-2.1 mg/dL</td>
<td>-56.7 to 52.3 mg/dL</td>
</tr>
</tbody>
</table>

Results - Goats

Figure 3. Average glucose concentrations of cohort of goats as determined by CGMS, POC glucometer, ICU machine, and chemistry analyzer over time.

<table>
<thead>
<tr>
<th>Glycemia</th>
<th>Bias</th>
<th>95% Limits of Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperglycemia</td>
<td>1.7 mg/dL</td>
<td>-43.5 to -46.8 mg/dL</td>
</tr>
<tr>
<td>Control</td>
<td>10.2 mg/dL</td>
<td>8.9 to 29.2 mg/dL</td>
</tr>
<tr>
<td>Hypoglycemia</td>
<td>-31.2 mg/dL</td>
<td>-13.8 to 8.8 mg/dL</td>
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Discussion

Conclusions
- CGMS has acceptable accuracy in healthy goats and calves for potential clinical use
- CGMS is most accurate in hyperglycemic goats and hypoglycemic calves

Future Direction
- Test accuracy of CGMS in sick goats and calves

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References