Glucocorticoids, Insulin Sensitivity & Tight Glycemic Control in the ICU

C Pretty, J G Chase, J Lin, G Shaw, A Le Compte, N Razak, J Parente, F Suhaime

Background

- Glucocorticoids reduce insulin sensitivity in healthy individuals by 30-62%.
- They are used in critical care to treat a variety of inflammatory and allergic disorders, but may inadvertently exacerbate stress-hyperglycemia through reduced insulin sensitivity.
- This research uses model-based methods to determine the extent to which glucocorticoids reduce insulin sensitivity in critically ill patients and how it affects tight glycemic control (TGC).

Subjects & Methods

- A retrospective study using data from 80 patients admitted to the Christchurch Hospital Intensive Care Unit (ICU) between 2005 and 2007.
- Two cohorts of 40 patients matched for overall cohort statistics (Table 1). Patients in one group received glucocorticoid treatment, while patients in the other group received none.
- Patients were excluded if they received β-blocker treatment as it can affect glucose metabolism.
- All patients were on the SPRINT TGC protocol for 24+ hours.
- A clinically validated glucose-insulin system model was used to identify an insulin sensitivity (SI) parameter every hour for every patient.
  - The model-based insulin sensitivity was used to quantify differences between the cohorts.
  - In-silico virtual trial simulations were performed to determine the clinical impact of these differences on TGC.

Results

- A 7% reduction in insulin sensitivity was seen for patients receiving glucocorticoids compared to the control group (Figure 1).
- Per-patient analyses showed 8-21% reductions in insulin sensitivity at the median (Figures 2 & 3) for patients in the steroid group.
- Higher percentile-patients tended to show greater suppression of SI with administration of steroids (Figure 3).
- Virtual trial simulations indicate that there is no clinically significant difference in glycemic control achieved under the SPRINT protocol with changes in SI of 10-20%.

Table 1. Cohort statistics

<table>
<thead>
<tr>
<th>N</th>
<th>Mortality (%)</th>
<th>Operative/Non-operative</th>
<th>Age (yrs)</th>
<th>APACHE II Score</th>
<th>APACHE II Risk of death (%)</th>
<th>Patient median blood glucose (mmol/l)</th>
<th>Total time on SPRINT (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>20 (45-79)</td>
<td>12/28 (49-73)</td>
<td>63.5</td>
<td>31 (16-27)</td>
<td>21.5 (19-26)</td>
<td>33.6 (22-53)</td>
<td>129.5 (99-189)</td>
</tr>
<tr>
<td>40</td>
<td>20 (45-79)</td>
<td>13/28 (49-73)</td>
<td>63.5</td>
<td>31 (16-27)</td>
<td>21.5 (19-26)</td>
<td>33.6 (22-53)</td>
<td>129.5 (99-189)</td>
</tr>
</tbody>
</table>

Glucocorticoids reduce insulin sensitivity in critically ill patients and how it affects tight glycemic control (TGC).