Insulin Sensitivity as a Marker for Reduced Outcome in the NICU

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Introduction

Hyperglycemia in neonatal intensive care units (NICUs) is associated with mortality and morbidity. This research aims to use machine learning methods to provide a prediction of outcomes in hyperglycemic neonates, based on model-based metabolic (glycemic control) data as a non-invasive marker.

Methods

Clinical Data
Glycemic control data from 44 patients (4499 hours) under the STAR-NICU or STAR-GRYPHON3 model-based glycemic controllers from Christchurch Women’s Hospital were used.

<table>
<thead>
<tr>
<th>Sepsis</th>
<th>IVH</th>
<th>Non-Survivors</th>
<th>Survivors</th>
</tr>
</thead>
<tbody>
<tr>
<td>N patient (died)</td>
<td>12</td>
<td>8(2)</td>
<td>6</td>
</tr>
<tr>
<td>Mean BG (mmol/L)</td>
<td>7.31</td>
<td>7.80</td>
<td>9.15</td>
</tr>
<tr>
<td>Mean S_I (L/mU/min)</td>
<td>$7.51 \times 10^{-4}$</td>
<td>$5.47 \times 10^{-4}$</td>
<td>$2.42 \times 10^{-4}$</td>
</tr>
<tr>
<td>Mean S_I Variability</td>
<td>$1.00 \times 10^{-4}$</td>
<td>$4.99 \times 10^{-5}$</td>
<td>$4.22 \times 10^{-5}$</td>
</tr>
</tbody>
</table>

Predictive Models
Predictive models were built using attributes from hourly, patient-specific, model-based insulin sensitivity.

The methods used were classification trees and K-nearest neighbors. The efficacy of the models was assessed evaluating sensitivity, specificity and accuracy.

Accuracy = overall correct classification.
Sensitivity = proportion of real positives properly identified.
Specificity = proportion of real negatives properly identified.

Mortality
It was possible to predict mortality with 85% accuracy and 60% sensitivity after the first 15 hours. Positive test is good at confirming death (Positive predictive value = 85%).

Sepsis
Septic patients were predicted with 70% accuracy and increasing sensitivity within 20 hours.

Results

| New Patients entries | MODEL predicts outputs | Accuracy? | Sensitivity? | Specificity? |

Conclusion

A clinically validated model-based insulin sensitivity measure and its variability, may provide information about patient condition and possible outcome, despite modeling limitations. This study emphasized the potential of machine learning to provide information on degrading patient condition and worsened outcome, as an alert to provide more intensive care.