

Model-Based Insulin Sensitivity as a Sepsis Diagnostic in Critical Care

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Abstract

Background:

Timely diagnosis and treatment of sepsis in critical care require significant clinical effort, experience, and resources. Insulin sensitivity is known to decrease with worsening condition and could thus be used to aid diagnosis. Some glycemic control protocols are able to identify insulin sensitivity in real time.

Methods:

Receiver operating characteristic curves and cutoff insulin sensitivity values for diagnosing sepsis were calculated for model-based insulin sensitivity (S_I) and a simpler metric (SS_I) that was estimated from glycemic control data of 30 patients with sepsis and can be calculated in real time without use of a computer. Results were compared to the insulin sensitivity profiles of a general intensive care unit population of 113 patients without sepsis and 30 patients with sepsis, comprising a total of 26,453 patient hours. Patients with sepsis were identified as having sepsis based on a sepsis score (ss) of 3 or higher ($ss = 0-4$ for increasing severity). Patients with type I or type II diabetes were excluded. Ethics approval for this study was granted by the South Island Regional Ethics Committee.

Results:

Receiver operating characteristic cutoff values of $S_I = 8 \times 10^{-5}$ liter $mU^{-1} \min^{-1}$ and $SS_I = 2.8 \times 10^{-4}$ liter $mU^{-1} \min^{-1}$ were determined for $ss \geq 3$. The model-based S_I fell below this value in 15% of all patient hours. The S_I test had a negative predictive value of 99.8%. The test sensitivity was 78% and specificity was 82%. However, the positive predictor value was 2.8%. Slightly lower sensitivity (68.8%) and specificity (81.7%), but equally good negative prediction (99.7%), were obtained for the estimated SS_I .

Conclusions:

Insulin sensitivity provides a negative predictive diagnostic for sepsis. High insulin sensitivity rules out sepsis for the majority of patient hours and may be determined noninvasively in real time from glycemic control protocol data. Low insulin sensitivity is not an effective diagnostic, as it can equally mark the presence of sepsis or other conditions.

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Abbreviations: (APACHE II) Acute Physiology and Chronic Health Evaluation II, (EGP) endogenous glucose production, (ICU) intensive care unit, (IL) interleukin, (ROC) receiver operating characteristic, (S_I) insulin sensitivity [model-based metric], (SS_I) simple insulin sensitivity [hand-calculated metric], (ss) sepsis score, (SIRS) systemic inflammatory response syndrome, (SPRINT) specialized relative insulin and nutrition tables

Keywords: blood glucose, critical care, diagnosis, hyperglycemia, ICU, insulin sensitivity retrospective studies, sepsis, SPRINT

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