Glycemic Levels in Critically Ill Patients: Are Normoglycemia and Low Variability Associated with Improved Outcomes?

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Abstract

Background:

Critically ill patients often experience high levels of insulin resistance and stress-induced hyperglycemia, which may negatively impact outcomes. In 2001, Van den Berghe and coauthors used intensive insulin therapy (IIT) to control blood glucose (BG) to normal levels and reported a reduction in intensive care unit (ICU) mortality from 8% to 4.6%. Many studies tried to replicate these results, with some showing reduced mortality, others failing to match these results, and many seeing no clinically significant difference. The interpretation of results is important when drawing conclusions about the benefits and risks of IIT. There is the potential for negative results to be falsely negative due to unintended patient crossover or cohort overlap.

Aim:

The aim of this study was to investigate the association between the amount of time each critically ill patient experiences good glucose control and hospital mortality.

Methods:

This study uses BG data from 784 patients admitted to the Christchurch Hospital ICU between January 2003 and May 2007. For each of the 5 days of analysis, all patients with BG data were pooled together in a single cohort before being stratified into two subcohorts based on glycemic performance, determined by cumulative time in band (cTIB). The cTIB metric is calculated per patient/per day and defined here as the percentage of time the patient's BG levels have been cumulatively in a specific band (72–126 mg/dl) up to and including the considered day. Subcohort A had patients with cTIB \geq threshold and subcohort B had patients with cTIB < threshold. Three cTIB thresholds were tested: 0.3 (30%), 0.5 (50%), and 0.7 (70%). The odds of living (OL) were then calculated for each subcohort and day, forming the basis of comparison between the subcohorts. A second analysis was run using only the 310 patients with BG data for 5 days or more to assess the impact of patient dropout.

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Abbreviations: (BG) blood glucose, (cTIB) cumulative time in band, (ICU) intensive care unit, (IIT) intensive insulin therapy, (OL) odds of living, (TGC) tight glycemic controle

Keywords: critically ill, glycemic variability, intensive care unit, intensive insulin therapy, mortality, tight glycemic control

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Abstract cont.

Results:

Results show that, across all three cTIB threshold levels (0.3, 0.5, and 0.7) and all 5 days of analysis, patients with a cTIB \geq threshold have a higher OL than patients with a cTIB < threshold. A cTIB threshold of 0.7 showed the strongest separation between the subcohorts, and on day 5, the OL for subcohort A was 4.4 versus 1.6 for subcohort B. The second analysis showed that patient dropout had little effect on the overall trends. Using a cTIB threshold of 0.7, the OL for subcohort A was 0.8 higher than the OL for subcohort B on day 1, which steadily increased over the 5 days of analysis.

Conclusions:

Results show that OL are higher for patients with $cTIB \ge 0.3-0.7$ than patients with cTIB < 0.3-0.7, irrespective of how cTIB was achieved. A cTIB threshold of 0.5 was found to be a minimum acceptable threshold based on outcome. If cTIB is used in similar BG studies in the future, $cTIB \ge 0.7$ may be a good target for glycemic control to ensure outcomes and to separate patients with good BG control from patients with poor control.

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