

AT THE BEDSIDE

Glucose Meters In the ICU

By Brad S. Karon, MD, PhD

The subject of glucose meter accuracy for use in monitoring critically ill patients on glycemic control protocols has received an incredible amount of attention lately. Some of the issues surrounding this controversy are summarized here.

Glycemic Control

Prior to 2001, the “state of the art” in critical care was to monitor glucose levels in critically ill patients and intervene (with insulin administration) only if glucose levels exceeded 200 mg/dL.

In 2001, Van den Berghe and colleagues published the first of their studies on glycemic control. They found that maintaining blood glucose levels close to the normal range (80-110 mg/dL) in critically ill patients resulted in an enormous decrease in mortality and morbidity (e.g., renal failure, bloodstream infections, etc.) compared to conventional glycemic control (maintaining blood sugar less than 200 mg/dL).¹

To achieve this level of glycemic control, intravenous insulin must be administered to patients, which creates the need for frequent (usually hourly) glucose monitoring. Even with frequent monitoring, this study and most others have found a significantly higher rate of severe hypoglycemia (glucose <40 mg/dl) in patients on these “tight glycemic control” protocols compared to patients treated in the conventional manner.

Despite the increased incidence of severe hypoglycemia, Van den Berghe’s initial study was heralded as a breakthrough in the care of critically ill patients, and many hospitals instituted tight glycemic control (TGC) protocols based on these findings.

However, follow-up studies did not always confirm these findings, with the most recent being the NICE-SUGAR multicenter trial, which found that a more moderate glucose target (<180 mg/dL) was more beneficial than a tighter target of 81-108 mg/dL.²

Although the various studies are not directly comparable for a number of reasons (e.g., protocols used, patient population studied, etc.), concern is growing that the adverse effects of severe hypoglycemia may undo the beneficial effects of TGC for critically ill patients.

Glucose Meters

As controversy surrounding TGC has emerged, lab experts have begun to investigate whether limitations in the accuracy of glucose monitors contribute to adverse events during TGC by higher incidence of severe hypoglycemia as a result of inaccurate assessment of glucose levels, leading to inappropriate insulin dosing.

This debate is fueled by two primary issues: the fact that the most successful study of glycemic control (Van den Berghe’s first study) used more accurate blood gas equipment (rather than handheld glucose meters) to monitor glucose levels and the fact that glucose meter accuracy criteria today were developed before tight glycemic control was implemented, and may not reflect levels of accuracy required for safe intensive insulin dosing.

In January 2009, experts in laboratory medicine wrote an editorial in *Clinical Chemistry* questioning whether the current generation of glucose meters is adequate for managing patients on TGC.³ And in March 2010, the FDA held an open forum for the public and healthcare professionals to comment on whether guidelines for glucose meter accuracy are adequate for these devices within the hospital and/or ICU.⁴ While individuals overwhelmingly agreed that guidelines were not sufficient for ICU use, few agreed on what level of accuracy is needed for glucose monitors for critically ill patients.

Future

Accuracy requirements/recommendations for glucose monitors in hospitals will change, though it is not clear what the new recommendations will be. This will challenge labs and point-of-care programs to reassess how glucose monitoring is performed and assumptions underlying needed levels of accuracy for devices.

Handheld glucose meters offer speed and convenience and are used extensively for this purpose; however, many may not meet new accuracy recommendations when released. Newer generation glucose meters may offer improved accuracy and less interference by hematocrit and other patient variables. Yet, hospitals may be challenged to justify changing glucose meters without outcome data to show improved results and better patient outcomes. Portable blood gas analyzers offer greater accuracy and fewer interferences than glucose meters, but workflow and staffing (e.g., determining who should perform testing, etc.) issues may challenge hospitals wishing to replace glucose meters with blood gas equipment.

Finally, performing all glucose measurements in the central or stat laboratory using plasma samples may be an option for some hospitals, but this could impede turnaround time and workflow. ■

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