Glycemic Control in The ICU

What Is Optimal Glycemic Control in the Intensive Care Unit (ICU)?

› The topic of optimal glycemic control for patients in the ICU is controversial. Hyperglycemia and insulin resistance are common for critically ill patients and often result in poor outcomes, regardless of prior history of diabetes. National organizations such as the American Diabetes Association have recommended blood glucose guidelines of 140-180 mg/dL for the majority of critically ill patients (American Diabetes Association, 2016). However, strict blood glucose goals (110-140 mg/dL) may be appropriate for certain patients, as long as there is no significant risk for hypoglycemia.

• What: The main goals for critically ill patients admitted to the ICU include avoiding hyperglycemia, hypoglycemia, volume depletion, and electrolyte imbalances; and meeting nutritional needs (American College of Physicians, 2007). During hospitalization, multiple factors can affect glycemic control, including illness/infection, diet during hospitalization (including enteral/parenteral nutrition and meal timing), insulin timing, and other medication side effects (e.g., corticosteroids).

• How: Insulin therapy is the preferred method of glycemic control in the hospital setting, with the use of a sliding insulin scale strongly discouraged (American Diabetes Association, 2016). Insulin should be provided to ICU patients through a basal-bolus insulin regimen or insulin drips.

• Where: This guide focuses on glycemic control for critically ill patients in the ICU.

• Who: Medication management typically is performed by the physician, nurse, or pharmacist. The registered dietitian (RD) may make recommendations for changes to medication regimens, diet modifications (including enteral/parenteral nutrition), meal timing, or oral supplements/snacks.

What Is the Desired Outcome of Optimizing Glycemic Control in the ICU?

› The desired outcome for optimizing glycemic control in the ICU is to reduce incidences of hypoglycemia and hyperglycemia, patient mortality, ICU length of stay, hospital length of stay (American College of Physicians, 2007), and costs of hospitalization (Newton & Young, 2006).

Why Is Glycemic Control in the ICU Important?

› Acute and chronic complications can arise from poorly controlled blood sugar (American College of Physicians, 2007). Improved patient outcomes can result by providing optimized glycemic control (Newton & Young, 2006). Patients may be admitted to the ICU with diabetic ketoacidosis, hyperglycemic hyperosmolar state, or hypoglycemia, which may all be life-threatening metabolic complications of diabetes.

• Diabetic ketoacidosis (DKA) occurs when a patient’s plasma glucose is elevated with arterial pH less than 7.3, serum bicarbonate less than 16 mEq/L, and moderate ketonuria and/or ketonemia (Mensing, 2011). DKA results in dehydration; electrolyte imbalances of sodium, potassium, and phosphate; ketosis; acidosis; and increased osmolality. The patient may complain of weakness, headache, malaise, or lethargy.
• Hyperglycemic hyperosmolar state (HHS) refers to elevated blood glucose and elevated serum osmolality (American College of Physicians). HHS may manifest as severe hyperglycemia, dehydration, neurologic changes, and absence of significant ketosis (Mensing, 2011).

• Hypoglycemia occurs when blood glucose levels drop below 70 mg/dL (American College of Physicians). The patient may experience shakiness, palpitations, anxiety, hunger, headaches, or diaphoresis. At lower blood sugar levels, the patient may experience irritability, difficulty concentrating/remembering, blurred vision, confusion, seizures, or personality changes.

Facts and Figures

› Hyperglycemia in the ICU is common, ranging from 40-90% of patients in the intensive care unit (depending on the value used to define hyperglycemia). In a large survey of 126 United States hospitals (and over 12 million blood glucose results), 46% of blood sugar readings in the ICU and 31.7% of blood sugar readings for non-critically ill patients were hyperglycemic (greater than 180 mg/dL) (Cook et al., 2009; Viana et al., 2014).

› Hyperglycemia can lead to poor outcomes in cardiac surgery patients. In an observational study, researchers examined 3,184 noncardiac surgery patients admitted to Emory University Hospital and found that perioperative hyperglycemia (greater than 150 mg/dL) was associated with increased length of stay, complications, and mortality. Patients with diabetes have been shown to have even higher perioperative mortality rates, wound infections, strokes, and longer hospital length of stay (Schmeltz, 2011; Frisch, et al., 2010).

What You Need to Know Before Optimizing Glycemic Control in the ICU

› Glycemic control involves avoiding episodes of hyperglycemia and hypoglycemia in the critical care setting. Strive to keep blood sugar between 140 and 180 mg/dL for the majority of critically ill patients, and between 110 and 140 mg/dL if there is no significant risk for hypoglycemia (American Diabetes Association, 2016). For perioperative patients, blood glucose should range between 80-180 mg/dL. Insulin therapy should be initiated/provided for blood glucose greater than or equal to 180 mg/dL.

› Prior to completing a nutrition assessment, the RD should review the patient’s medical record and take into account past medical history, food/nutrition history, anthropometric values, laboratory data/tests/procedures, nutrition-focused physical findings, and any relevant personal/social history (Academy of Nutrition and Dietetics, 2016).

› Possible causes for hypoglycemia in critically ill patients include excessive/improper dosing of insulin or use of hypoglycemia agents, nonhypoglycemic agents (e.g., beta-blockers, ACE inhibitors), polypharmacy, if the patient is NPO (nothing by mouth) for procedures, or poor appetite/oral intake on an oral/liquid diet or poor tube-feeding provision. Additionally, other factors increasing the risk for hypoglycemia include older age, previous history of hypoglycemia, sleep, recent or frequent hospitalizations, and comorbidities including renal failure, congestive heart failure, sepsis, hepatic failure, mechanical ventilation, and malignancy (Hulkower, Pollack, & Zonszein, 2014).

› Hyperglycemia in the ICU may result from uncontrolled diabetes, the body’s response to stress/inflammation, medications (e.g., glucocorticoids), overfeeding, excess dextrose infusion, dialysis solutions, insufficient insulin, or volume depletion (Hsu, 2012).

How to Optimize Glycemic Control in the ICU Patient

› Avoiding Hyperglycemia

• The RD should follow facility screening guidelines to determine which patients will be assessed. This will determine within what timeframe a patient will need to be seen. The RD should follow the nutrition care process for nutrition assessment, diagnosis, intervention, monitoring, and evaluation (Academy of Nutrition and Dietetics, 2016). Documentation should follow the RD’s facility protocol. If the patient is receiving nutrition, try to minimize the dextrose/glycemic load provided to the patient by recommending the appropriate therapeutic diet, tube-feeding formula, or dextrose solution for peripheral/total parenteral nutrition infusions. You may also discuss initiation of an insulin regimen with the patient’s physician if one has not already been started.

For patients admitted with DKA, the first goal is to rehydrate the patient by providing adequate fluids (Mensing, 2011). With adequate provision, hydration status should be corrected after 48 hours. The second goal is to provide an insulin infusion to restore glycemic control (normally, using rapid-acting/regular insulin through IV infusion is the preferred route). Any corrections to electrolyte abnormalities or acidosis will need to be done, paying close attention to possible hypokalemia or hypophosphatemia (and replacing as needed). Additional glucose should be provided to prevent both hypoglycemia and sudden drops in blood glucose, which is associated with cerebral edema. Last, there should be a focus on patient/family education and follow-up in the outpatient setting to prevent repeat hospitalizations.
For patients admitted with HHS, treatment goals are similar to those for DKA (Mensing, 2011). Treatment goals for HHS include rehydration, correcting electrolyte deficits, providing the patient with insulin to control hyperglycemia, preventing complications (i.e., changes to blood pressure, fluid and electrolyte balance, and blood glucose levels), treating the underlying medical condition, and providing patient/family education and outpatient follow-up to prevent future occurrences.

Avoiding Hypoglycemia

- The RD should follow facility screening guidelines to determine which patients will be assessed. This will determine within what timeframe a patient will need to be seen. The RD should follow the nutrition care process for nutrition assessment, diagnosis, intervention, monitoring, and evaluation (Academy of Nutrition and Dietetics, 2016). Documentation should follow the RD’s facility protocol. Hypoglycemia can be treated by providing intravenous dextrose, glucose tablets, or carbohydrate-containing foods by mouth (Mensing, 2011). Determine if cause of hypoglycemia resulted from diet or medication regimen. Recommend dietary changes if appropriate.

- When charting a nutrition note in the patient’s medical record, be sure to include past medical history, any relevant lab values to indicate the patient’s blood sugar control and electrolyte status (e.g., blood glucose, A1C, potassium, phosphorus, sodium), nutritionally pertinent medications (e.g. glucocorticoids, insulin, dextrose infusions), prescribed diet and tolerance (e.g., NPO, tube-feeding, TPN), and any other factors which may influence blood glucose control in the ICU. Document your intervention, which may include diet changes or patient education. Update the patient's plan of care and determine monitoring/evaluation criteria, as appropriate.

Other Nutritional Interventions That May Be Necessary Before or After Optimizing Glycemic Control in the ICU Patient

- Once the patient is stabilized and transitioned to a non-critical floor, blood sugar should be less than 140 mg/dL before meals and less than 180 mg/dL from random fingersticks (Mensing, 2011).
- Prior to discharge, emphasis should be placed on education and prevention (Mensing, 2011). A patient’s health literacy level should be assessed and health information and resources provided accordingly.
- In addition, provide ongoing outpatient care and follow up to ensure glycemic control.

What to Expect After Optimizing Glycemic Control in the ICU Patient

- After the patient’s assessment is completed, continue to monitor/evaluate nutrition intervention according to facility’s protocol. Provide diet education if desired by the patient/family.
- After hospitalization, patients should have improved glycemic control, be able to recognize signs and symptoms of hyperglycemia/hypoglycemia, and understand how to treat these respective alterations correctly.
- Patients should routinely follow up with their primary care provider after discharge.

Red Flags

- When treating hyperglycemia, closely monitor potassium and phosphorus levels for sudden drops (Mensing, 2011).
- Identify and treat episodes of hypoglycemia.
- Identify cerebral edema early and discuss with healthcare team for treatment; once the patient is symptomatic, there is a large chance for mortality (greater than 70% mortality rate, with 7-14% of patients recovering completely) (Mensing, 2011). This may be done through frequent mental status assessments (every 1-2 hours) and provision of IV dextrose to prevent large drops in blood glucose (to be added once serum glucose levels reach approximately 250 mg/dL).

What Do I Need to Tell the Patient/Patient’s Family?

- Patients should be educated on the signs and symptoms of hyperglycemia/hypoglycemia, sick day glycemic management (including how to adjust medication when sick, use of sugar-free foods, when to contact the physician, and what information to provide), how to review tests for ketones, how to check blood sugar and interpret results, how to treat hypoglycemia using the “Rule of 15” (consuming 15g of carbohydrate, testing blood sugar after 15 minutes, and then repeating if blood sugar has not been corrected), and correct medication usage (American College of Physicians, Mensing, 2011).
- Additionally, patients should be educated to moderate glycemic control through meal planning. This may include information on carbohydrate counting, the plate method, or glycemic index. The role of carbohydrates in glycemic management should also be discussed.
- The patient’s family and caregivers should also be educated on signs and symptoms of hyperglycemia/hypoglycemia and available treatment options (Mensing, 2011).
References


