

Chapter 49

Approach to Hypoglycemia in the ICU



49.1 Introduction

Hypoglycemia in the intensive care unit (ICU) is a critical condition that can lead to severe neurological impairment and other life-threatening complications if not managed promptly. It is common in patients with diabetes and may also affect nondiabetic patients due to critical illnesses, medication interactions, or metabolic disturbances. A standardized, tiered approach to hypoglycemia management enhances patient safety and helps prevent recurrence, especially in high-risk ICU settings [1, 2]. [Ref: Algorithm 49.1].

49.2 Classification of Hypoglycemia Severity

Hypoglycemia can be classified using the three-tiered approach defined by the International Hypoglycemia Study Group, which provides structured guidelines for the diagnosis and treatment based on severity:

1. Level 1 Hypoglycemia: Blood glucose <70 mg/dL but ≥ 55 mg/dL. This level typically allows for self-treatment if the patient is conscious and cooperative.
2. Level 2 Hypoglycemia: Blood glucose <55 mg/dL, which requires prompt intervention to raise blood glucose levels due to the increased risk of adverse effects on cognitive function and physical stability.
3. Level 3 Hypoglycemia (Severe): Severe hypoglycemia associated with neuroglycopenic symptoms (e.g., confusion, seizures, unconsciousness) that require external assistance.

Differentiating between neurogenic (autonomic) symptoms, like sweating, tremors, and palpitations, and neuroglycopenic symptoms, such as confusion, slurred speech, and drowsiness, helps with rapid assessment and informs treatment urgency.

49.3 Addressing Specific Risk Factors for ICU Patients

In the ICU, certain risk factors make patients more susceptible to hypoglycemia. Recognizing and monitoring these can prevent episodes and mitigate risks:

1. Common Risk Factors: These include diabetes treatments (insulin and insulin secretagogues), critical illness, adrenal insufficiency, and sepsis, all of which can disrupt glucose regulation. Highlighting these risks during admission or transfer to the ICU can allow for tailored glucose monitoring protocols in high-risk individuals.
2. Counter-Regulatory Deficits: Patients with autonomic neuropathy, a history of severe hypoglycemia, or hypoglycemia unawareness may have impaired counter-regulatory responses, putting them at higher risk for undetected hypoglycemia. These patients require more frequent blood glucose checks, potentially continuous glucose monitoring, and close observation for any atypical signs of hypoglycemia [3].

49.4 Diagnostic Workup for Nondiabetic Hypoglycemia

In nondiabetic ICU patients experiencing hypoglycemia, a thorough diagnostic workup is essential to determine the underlying cause:

1. Comprehensive Diagnostic Approach: During hypoglycemic episodes, assess plasma glucose, insulin, C-peptide, proinsulin, and β -hydroxybutyrate levels. This aids in identifying causes like endogenous hyperinsulinism (e.g., insulinoma, nesidioblastosis), adrenal insufficiency, or metabolic syndromes.
2. Use of Provocative Testing: When hypoglycemia cannot be observed spontaneously, consider controlled testing, such as supervised fasting or postprandial monitoring, to identify endogenous insulin overproduction or other metabolic abnormalities.

49.5 Interprofessional Management and Patient Education

An effective hypoglycemia management strategy in the ICU relies on collaboration across the healthcare team and proactive patient and caregiver education:

1. Role of Inter-professional Teams: ICU staff, dietitians, pharmacists, and endocrinologists should coordinate to develop individualized care plans for patients at risk. Regular team discussions and medication reviews are essential to adjust therapy and reduce hypoglycemia risk.
2. Education on Hypoglycemia Awareness and Prevention: Educate patients and their families on recognizing hypoglycemia symptoms, understanding its potential triggers, and responding effectively. For patients with recurrent hypoglycemia, involve family or support persons in education about rapid response measures, such as glucose or glucagon administration.

49.6 Prophylactic and Treatment Strategies

Preventing hypoglycemia recurrence in high-risk ICU patients requires both careful monitoring and structured treatment protocols:

1. Enhanced Prophylactic Measures: Continuous glucose monitoring (CGM) can be highly beneficial for ICU patients at high risk of hypoglycemia, as it provides real-time alerts for declining glucose levels. For patients with a history of severe hypoglycemia, glucagon kits should be readily available, and caregivers should be trained on their administration.
2. Treatment Dosage and Timing: For immediate treatment, administer glucose with attention to dosage to avoid rebound hyperglycemia. Once blood glucose stabilizes, provide a 15 g carbohydrate snack plus protein if the next meal is over an hour away. This combination helps maintain glucose levels until the next scheduled meal and prevents rapid glucose fluctuations.

49.7 Management Algorithm

49.7.1 Initial Glucose Monitoring

The first step is to monitor the patient's blood glucose levels. If the glucose level is ≥ 70 mg/dL, continue routine monitoring without immediate intervention. However, if the glucose level falls below 70 mg/dL, this indicates hypoglycemia and warrants further evaluation and management. Early detection is crucial in preventing complications, especially in the ICU where patients may not display typical symptoms of hypoglycemia due to sedation, intubation, or other conditions that limit their ability to communicate [4].

49.7.2 Assessing Whipple's Triad

If hypoglycemia is detected (glucose <70 mg/dL), the next step is to assess Whipple's Triad, which confirms clinically significant hypoglycemia. Whipple's Triad includes three elements: (1) the presence of hypoglycemic symptoms, (2) a low plasma glucose concentration, and (3) the resolution of symptoms once glucose levels are corrected. If the triad is not present, continue glucose monitoring as part of routine care. However, if Whipple's Triad is confirmed, it validates that the hypoglycemia is indeed symptomatic and clinically relevant, necessitating prompt intervention.

49.7.3 Evaluating Diabetes Status and Medication Use

If Whipple's Triad is confirmed, assess whether the patient has diabetes or is currently using insulin or insulin secretagogues, such as sulfonylureas. If the patient is diabetic or on such medications, it is likely that hypoglycemia is due to their diabetes treatment regimen. This step is critical because it helps differentiate between diabetic and nondiabetic hypoglycemia, directing the clinician toward appropriate management tailored to the patient's underlying condition.

49.7.4 Diabetic Hypoglycemia Management

For diabetic patients, hypoglycemia management involves a detailed assessment of recent insulin administration, timing, dosing adjustments, renal function, and oral intake. These factors can all influence glucose levels. For instance, renal impairment may reduce insulin clearance, leading to prolonged hypoglycemia. Reviewing medication timing and ensuring consistent oral intake are crucial steps in stabilizing glucose levels. Adjusting insulin or medication doses based on this assessment helps prevent further hypoglycemic events.

49.7.5 Nondiabetic Hypoglycemia Investigation

In cases where the patient does not have diabetes and is not on insulin or insulin secretagogues, investigate other possible causes of hypoglycemia. Order specific lab tests, including plasma glucose, insulin, C-peptide, and β -hydroxybutyrate, to identify underlying conditions such as insulinoma, adrenal insufficiency, or sepsis. This comprehensive approach is essential in nondiabetic patients to uncover any metabolic or endocrine disorders that may be contributing to hypoglycemia, ensuring appropriate and targeted treatment.

49.7.6 Immediate Treatment

Regardless of the underlying cause, immediate treatment is necessary for all cases of confirmed hypoglycemia. Administer glucose orally if the patient is conscious and able to swallow, or via intravenous (IV) route if the patient is unconscious or at risk of aspiration. In certain cases, glucagon (1 mg glucagon intramuscularly, subcutaneously, or intravenously; repeat in 15 min) may be administered as an alternative or adjunct to glucose, especially when IV access is challenging. Prompt treatment stabilizes glucose levels, alleviates symptoms, and prevents progression to severe hypoglycemia. Nasal spray of 3 mg glucagon in a single nostril can also be tried as an alternative.

49.7.7 Address Underlying Cause

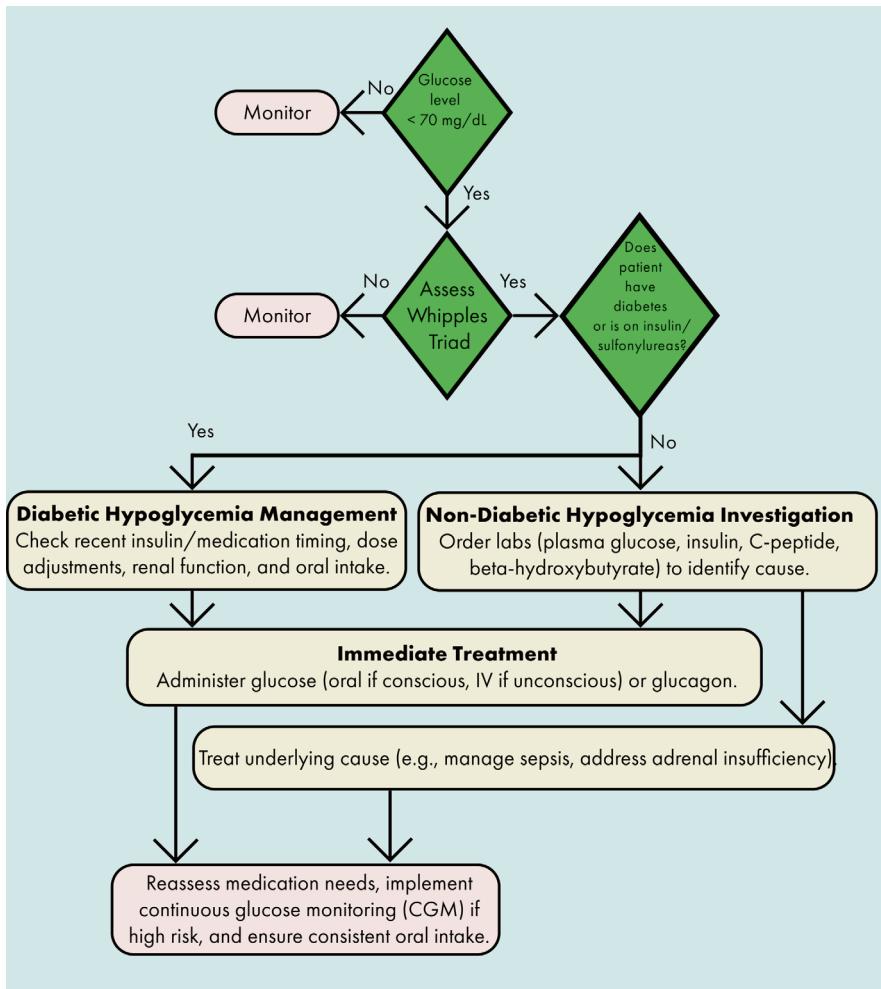
Once initial treatment has stabilized the patient, address any underlying conditions contributing to the hypoglycemia. For instance, if sepsis or adrenal insufficiency is identified, initiate appropriate treatment for these conditions to prevent recurrent hypoglycemic episodes. Managing the root cause is essential for long-term glucose stability and reduces the risk of future hypoglycemic events.

49.7.8 Reassessment and Long-Term Monitoring

After stabilizing the patient and addressing any underlying causes, reassess the need for continued glucose monitoring and adjust medication regimens as needed. High-risk patients, especially those with recurrent hypoglycemia, may benefit from continuous glucose monitoring (CGM) to detect and prevent further episodes. Additionally, ensure that the patient has a consistent oral intake schedule to maintain stable glucose levels. This ongoing management is vital for preventing hypoglycemia and improving patient outcomes in the ICU setting [5].

49.8 Conclusion

Managing hypoglycemia in the ICU requires a proactive, tiered approach that includes monitoring high-risk patients, educating patients and caregivers, and using structured diagnostic protocols for nondiabetic hypoglycemia. Adopting standardized treatment guidelines, informed by hypoglycemia severity and patient risk factors, can improve outcomes and reduce the likelihood of severe hypoglycemic events in critical care settings.

Algorithm 49.1: Approach to hypoglycemia in the ICU


Bibliography

1. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee, et al. Hypoglycemia. *Can J Diabetes*. 2013;37(Suppl 1):S69–71.
2. Diabetes Canada Clinical Practice Guidelines Expert Working, et al. Hypoglycemia in adults. *Can J Diabetes*. 2023;47(7):548–59.

3. Cryer PE, Axelrod L, Grossman AB, Heller SR, Montori VM, Seaquist ER, et al. Evaluation and management of adult hypoglycemic disorders: an endocrine society clinical practice guideline. *J Clin Endocrinol Metab.* 2009;94(3):709–28.
4. Mezquita-Raya P, Reyes-Garcia R, Moreno-Perez O, Munoz-Torres M, Merino-Torres JF, Gorgojo-Martinez JJ, et al. Position statement: hypoglycemia management in patients with diabetes mellitus. Diabetes mellitus working Group of the Spanish Society of endocrinology and nutrition. *Endocrinol Nutr.* 2013;60(9):517.
5. Reyes-Garcia R, Mezquita-Raya P, Moreno-Perez O, Munoz-Torres M, Merino-Torres JF, Marquez Pardo R, et al. Executive summary: position document: evaluation and management of hypoglycemia in the patient with diabetes mellitus 2020. Diabetes mellitus working Group of the Spanish Society of endocrinology and nutrition. *Endocrinol Diabetes Nutr (Engl Ed).* 2021;68(4):270–6.