

Managing Acute Diabetic Complications

Diabetes mellitus (DM) is a chronic disease that can have very serious acute and life-threatening complications from hypo or hyperglycemia. Diabetic ketoacidosis (DKA), an acute hyperglycemic crisis, is a common presentation for a new diagnosis of Type 1 diabetes. Use this reference guide to assist you in the management of patients experiencing hypoglycemic (low blood glucose) and hyperglycemic (high blood glucose) emergencies.

Hypoglycemia

Hypoglycemia is reduced plasma glucose to a level that may induce symptoms of altered mental status and/or sympathetic nervous system stimulation. The blood glucose level that defines hypoglycemia varies in each patient; a level less than 70 mg/dL (3.9 mmol) is considered hypoglycemia in patients with diabetes.

Levels of Hypoglycemia (American Diabetes Association, 2022)

- Level 1: glucose level 54-70 mg/dL (3.0-3.9 mmol/L)
- Level 2: glucose less than 54 mg/dL (3.0 mmol/L)
- Level 3: severe event characterized by altered mental status and/or physical status requiring assistance.

| Symptoms of Hypoglycemia | | |
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| Mild | Moderate | Severe |
| Shakiness | Headache | Seizures |
| Weakness | Behavior changes | Unresponsiveness |
| Hunger | Blurred, impaired, double vision | |
| Dizziness | Irritation | |
| Lightheadedness | Confusion | |
| Palpitations | Difficulty talking | |
| Diaphoresis | | |
| Anxiety | | |

Causes of hypoglycemia in patients with diabetes include:

- Too much insulin
- Delayed or insufficient food intake, eating less carbohydrate than usual, or a missed meal or snack
- Exercise without adequate adjustment in food or insulin

A hypoglycemia management protocol is recommended and should include:

- A standardized, nurse-initiated hypoglycemia treatment protocol to immediately address blood glucose levels less than 70 mg/dL (3.9 mmol/L)
- A plan to prevent and treat hypoglycemia for each patient
- Reassessment of the insulin treatment plan if blood glucose drops below 70 mg/dL (3.9 mmol/L)
- Tracking and documentation of each episode in the medical record

| Management of Hypoglycemia | |
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| Glucose level | Treatment |
| Less than or equal to 70 mg/dL (3.9 mmol/L) | <p>“15-15 Rule”</p> <ul style="list-style-type: none"> ● Administer 15 gm rapidly digested carbohydrate. <ul style="list-style-type: none"> ○ For patients that can tolerate oral intake: <ul style="list-style-type: none"> ▪ 4 ounces (120 mL) juice or regular soda ▪ 1 tablespoon of sugar, honey or corn syrup ▪ Glucose gel (follow instructions) ▪ Glucose tablets (follow instructions) ○ For patients that are NPO or cannot tolerate oral intake: <ul style="list-style-type: none"> ▪ 50 mg (25 g) dextrose 50% I.V. slowly into large vein, or glucagon injection I.M. ● If mental status is altered, position patient on right side to prevent aspiration from vomiting. ● Recheck blood glucose 15 minutes after treatment. ● If levels remain low, re-treat patient until levels have stabilized. ● No meals until blood glucose has risen to an acceptable level. |
| Severe hypoglycemia (Less than 54 mg/dL [2.2 mmol/L]) | <ul style="list-style-type: none"> ● Administer 30 gm rapidly digested carbohydrate. ● Follow algorithm above. |

Hyperglycemia

Hyperglycemia is an abnormally high blood glucose level. In a hospitalized patient, hyperglycemia is a level greater than 140 mg/dL (7.8 mmol/L). Early signs include frequent urination, increased thirst, weight loss, blurred vision, fatigue, and headache. Stress from infection, acute illness, or surgery can also cause hyperglycemia (Lippincott Procedures, 2021).

Treatment (American Diabetes Association, 2022)

- Insulin therapy should be started to treat persistent hyperglycemia greater than or equal to 180 mg/dL (10.0 mmol/L).
- Once initiated, target glucose range of 140-180 mg/dL (7.8-10 mmol/L) is recommended for the majority of critically and non-critically ill patients.
- More stringent goals (less than 140 mg/dL) may be appropriate for selected patients if it does not result in severe hypoglycemia.

Hyperglycemic Emergencies

If hyperglycemia goes untreated, toxic acids (ketones) build up in the blood (ketoacidosis) and urine (ketonuria). Two hyperglycemic emergencies are diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic state (HHS) also known as hyperosmotic hyperglycemic nonketotic state (HHNK). Management goals are similar and include restoring circulatory volume, euglycemia, and correction of electrolyte imbalance and acidosis. It is important to rapidly identify and treat any correctable underlying cause of DKA or HHS.

| Comparing DKA and HHS | | |
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| | DKA | HHS |
| Definition | Severe, uncontrolled diabetes characterized by hyperglycemia, ketoacidosis and ketonuria | Severe, uncontrolled diabetes characterized by hyperglycemia, hyperosmolarity and severe dehydration |
| Plasma glucose | Greater than 250 mg/dL (13.9 mmol/L); often in the 350 to 500 mg/dL (19.4 to 27.8 mmol/L) range and less than 800 mg/dL (44.4 mmol/L) | Greater than 600 mg/dL (33.3 mmol/L); may exceed 1000 mg/dL (56 mmol/L) |
| Arterial pH | Less than 7.30 | Greater than 7.30 |
| Serum bicarbonate | Less than 18 | Greater than 18 |
| Urine ketones | Positive | Small/None |
| Serum ketones | Positive | Small/None |
| Serum ketones by beta hydroxybutyrate assay (normal is less than 0.6 mmol/L) | Mild: 3-4 mmol/L Moderate: 4-8 mmol/L Severe: greater than 8 mmol/L | Less than 0.6 mmol/L |
| Serum osmolality | Variable | Greater than 320 mOsm/kg |
| Anion gap | Greater than 10 | Variable |
| Mental status | Drowsy, stupor/coma | Stupor/coma |
| BUN/Creatinine | Elevated | Elevated |
| Onset | Rapid (Less than 24 hours) | Slow, over days |
| Affects | Both type 1 and 2 DM, but occurs most often in type 1 | Both type 1 and 2 DM, but occurs most often in type 2 and elderly |

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| Signs & symptoms | <ul style="list-style-type: none"> • Kussmaul respirations, hyperventilation (rapid, shallow breathing) • Severe dehydration • “Fruity”, acetone breath • Malaise, weakness, fatigue • Nausea, vomiting, abdominal pain • Cardiac arrhythmias, tachycardia • Hypotension • Mild disorientation | <ul style="list-style-type: none"> • Similar signs and symptoms as DKA • Polyuria, polydipsia, weight loss • Dehydration • Tachycardia • Hypotension • Mental status changes, lethargy, obtundation, coma • Fever • Loss of vision • Hallucinations |
| Precipitating factors (Hirsch & Emmett, 2022) | <ul style="list-style-type: none"> • Infection (i.e., pneumonia or urinary tract infection) • New-onset type 1 diabetes mellitus • Insufficient insulin therapy or poor compliance • Acute major illness (i.e., myocardial infarction, cerebrovascular event, sepsis, pancreatitis) • Medications: glucocorticoids, higher-dose thiazide diuretics, sympathomimetic agents (i.e., dobutamine and terbutaline), second-generation “atypical” antipsychotic agents, sodium-glucose co-transporter 2 (SGLT2) inhibitors | |
| Treatment, as ordered | <ul style="list-style-type: none"> • Assess airway, breathing, circulation • Address mental status • Correct fluid deficit per prescriber orders based on degree of hypovolemia and serum Na⁺. • Replace electrolytes, particularly potassium (K⁺) until level is between 3.3 – 5.3 mEq/L. • Sodium bicarbonate IV is recommended for a pH less than 6.9. • Administer regular insulin to reduce glucose level to 150-200 mg/dL per orders and facility policy. • Identify underlying cause | <ul style="list-style-type: none"> • Assess airway, breathing, circulation • Address mental status • Correct fluid deficit per prescriber orders based on degree of hypovolemia and serum Na⁺. • Replace electrolytes based on adequate renal function. • Administer regular insulin to reduce glucose level to 250-300 mg/dL (0.1 units/kg bolus followed by continuous IV infusion @ 0.1 units/kg/hour), per orders and facility policy. • Identify underlying cause |
| Signs of resolution | <ul style="list-style-type: none"> • Blood glucose level less than 200 mg/dL • Presence of two of the following: <ul style="list-style-type: none"> ○ Serum bicarbonate | <ul style="list-style-type: none"> • Osmolality is normal. • When mental status is back to baseline, patient may start clear liquid diet and transition to subcutaneous insulin. |

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| | <ul style="list-style-type: none"> level 15 mEq/L or higher ○ pH greater than 7.3 ○ Anion gap 12 mEq/L or lower | |
| Potential complications of treatment | <ul style="list-style-type: none"> ● Fluid overload due to aggressive fluid replacement ● Hypokalemia due to inadequate potassium replacement, or administration of bicarbonate ● Hypoglycemia due to aggressive insulin treatment ● Cerebral edema due to excessive hydration and rapid intracellular fluid shifts <ul style="list-style-type: none"> ○ Preventive strategies involve a gradual rather than rapid correction of fluid and sodium deficits. ○ Maintain a slightly elevated serum glucose until the patient is stable. ● Hypoxemia and noncardiogenic pulmonary edema | |
| Nursing considerations | <ul style="list-style-type: none"> ● Monitor blood glucose every hour until stable. ● Monitor hemodynamics, intake/output, electrolytes (Na⁺, K⁺, Mg⁺, PO₄), serum osmolality, BUN, and creatinine every 2-4 hours until stable, per your facility policy. ● Assess cardiac, renal, and mental status. ● If hypokalemic, delay insulin treatment until serum K⁺ is greater than 3.3 mEq/L. ● Monitor arterial blood gas (ABG) and serial basic metabolic panel to determine if acidosis is resolving and anion gap closing ● For DKA patients, when the ketoacidosis and anion gap have resolved and the patient is able to eat, begin a multiple-dose (basal-bolus), subcutaneous insulin schedule. ● For HHS patients, IV insulin infusion can be tapered and a multiple-dose (basal-bolus), subcutaneous insulin schedule may be started when the serum glucose falls below 250-300 mg/dL (13.9 to 16. mmol/L). ● IV insulin should continue for 2 to 4 hours after the first dose of subcutaneous insulin administration to avoid hyperglycemia. | |

References:

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