

E01: Hypoglycemia and Hyperglycemia

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Introduction

Diabetes mellitus (DM) is a common disease affecting the endocrine system. DM can be classified into Type 1, Type 2, and gestational diabetes. These diseases produce complications that are commonly encountered in the prehospital environment, including hypoglycemia, hyperglycemia, diabetic ketoacidosis (DKA), and hyperglycemic hyperosmolar state (HHS). Disruptions in blood glucose levels are the hallmark of all diabetic emergencies. A typical blood glucose level is between 4.0 mmol/L and 7.0 mmol/L, and may be slightly higher after meals. A blood glucose measurement below 4.0 mmol/L is considered hypoglycemia, and should be corrected.

The goals of care include early recognition of abnormal blood glucose levels, followed by the immediate correction of hypoglycemia. Paramedics should investigate the underlying cause of hypoglycemia, and treat concurrent illnesses. Patients with hyperglycemia, diabetic ketoacidosis, or hyperglycemia hyperosmolar states require immediate transport and supportive care, often including fluid replacement.

Essentials

- Early recognition of abnormal BG levels and identification of underlying pathologies
- Hypoglycemic patients who are able to swallow and follow commands should be given oral glucose preferentially
- Hypoglycemic patients who are unable to follow commands should receive intravenous dextrose or intramuscular glucagon
- Hyperglycemic patients, and those with suspected diabetic ketoacidosis or hyperglycemic hyperosmolar states should be transported urgently and evaluated for possible fluid replacement

Additional Treatment Information

- Diabetic emergencies often involve an alteration in a patient's level of consciousness. Ensure the airway is patent and manage as required.
- Patients experiencing an episode of hypoglycemia who are able to follow directions can be encouraged to eat long-acting carbohydrates (e.g., a sandwich or fruit) when available. This provides a more sustained correction of blood glucose and may be preferred over other interventions provided paramedics do not suspect any other underlying problems (such as infection).
- Blood glucose levels should be retested to measure the effectiveness of treatment, and to confirm adequate reversal of hypoglycemia.
- During IV administration of dextrose solutions ensure IV is patent, as extravasation causes tissue necrosis.
- Fluid therapy may be necessary during diabetic emergencies. Assess for signs of dehydration and provide IV fluid if required. Patients in hyperglycemic states often become dehydrated, and diabetic ketoacidosis and hyperglycemic hyperosmolar states can cause profound hypotension.
- Paramedics must consider other causes of altered levels of consciousness, particularly in those patients whose blood glucose levels have been corrected but remain obtunded.

Referral Information

Adult patients who experience an explained hypoglycemic episode that is fully resolved may wish to decline transport. This can be supported, in relative safety, under certain circumstances. Paramedics must establish the proximate cause of the hypoglycemic episode, and ensure there is no underlying illness that will require additional care. Patients who elect to not be transported must:

- Not have a concurrent acute illness
- Not have suffered a drug overdose, nor consumed excessive alcohol
- Not be taking oral hypoglycemic medications

- Not have experienced another hypoglycemic episode requiring treatment within the past 24 hours
- Not have any abnormal vital signs, including blood pressure and Glasgow Coma Score
- Not be febrile
- Have fully recovered from their hypoglycemic episode, with a return to normal mentation. Post-recovery blood glucose shall be 4.0 mmol/L or higher.
- Have a clearly identified explanation for the hypoglycemic episode
- Be attended to by a responsible adult who will stay with the patient for at least four hours
- Have completed the appropriate waivers and demonstrated, to the paramedic's satisfaction, that they understand the recommendations for follow-up care

General Information

- Causes of hypoglycemia (< 4.0 mmol/L) include: missed meals, an overdose of insulin or oral hypoglycemic agent, recent changes in medications, higher than normal amounts of physical activity, underlying illness (particularly infections), alcohol consumption, or other physiological stressors.
- Signs and symptoms of hyperglycemia include: thirst and polydipsia, polyphagia, excessive urine production, blurred vision, dehydration, and nausea. Common causes include: infection, medication changes or mismanagement, changes in diet, increased emotional stress, or a reduction in physical activity. Hyperglycemia is sometimes the initial finding prior to a diagnosis of diabetes.
- Diabetic ketoacidosis is a life-threatening emergency primarily affecting Type 1 diabetics. It may represent a first-time presentation of diabetes (25% of patients who present in diabetic ketoacidosis have no prior diagnosis of diabetes).
 - It is typically the result of an insulin deficiency and a surge in counter-regulatory hormones, and can be triggered by a variety of causes. Diabetic ketoacidosis results in hyperglycemia, ketosis from fatty acid breakdown, dehydration, metabolic acidosis, and electrolyte disturbances. Patients commonly present with altered levels of consciousness, nausea and vomiting, an elevated blood glucose level, abdominal pain, and a "fruity" or ketone odor on their breath.
 - The increase in ketone body production causes a metabolic acidosis, which in turn drives a compensatory hyperventilation (Kussmaul's respirations). This ventilatory rate is intended to lower PaCO₂ and counteract the decrease in pH.
- Hyperglycemic hyperosmolar states, formerly known as hyperglycemic hyperosmolar nonketotic coma, are a similar to diabetic ketoacidosis, though it is more common in Type 2 diabetics. Patients experience an extreme elevation in blood glucose levels and significant dehydration, but do not experience the same acidosis and ketosis as would be seen in diabetic ketoacidosis.
- Gestational diabetes has a similar pathogenesis as Type 2 diabetes, and is the cause of glucose intolerance in pregnancy. It can be managed in the same way as diabetes mellitus, and affects approximately 7% of pregnancies.

Interventions

First Responder

- Position patient in lateral position if unconscious
- Evaluate for stroke signs and symptoms
- Assess and maintain airway patency
 - → [B01: Airway Management](#)
- Provide supplemental oxygen therapy as required
 - → [A07: Oxygen and Medication Administration](#)
- Correct suspected or confirmed hypoglycemia
 - Apply glucose gel to oral mucosa if altered. Maintain vigilance over the airway.

Emergency Medical Responder – All FR interventions, plus:

- Provide supplemental oxygen therapy in patients with clinical signs of hypoxemia or to maintain SpO₂ ≥ 94%.
 - → [A07: Oxygen and Medication Administration](#)

- Provide safe and expeditious transport
- Consider higher level of care intercept

Primary Care Paramedic – All FR and EMR interventions, plus:

- Obtain vascular access.
 - [→ D03: Vascular Access](#)
- Correct confirmed hypoglycemia:
 - [10% dextrose in water](#) (D10W) IV: 10 to 25 g (100-250 mL)
 - [Glucagon](#) if unable to obtain IV access
- Correct hypotension. Target systolic blood pressure of 90 mmHg.

Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:

- In suspected DKA/HHS:
 - Obtain and interpret 12-lead ECG
 - [→ PR16: 12 Lead ECG](#)
- Perform continuous cardiac monitoring en route to hospital. Electrolyte disturbances may produce arrhythmia.
- Exercise caution in diabetic ketoacidosis when performing advanced airway procedures: tachypnea is the main compensatory mechanism to control acidosis. If intubation is required, select a higher than normal ventilatory rate (use patient's intrinsic rate as a guide).

Evidence Based Practice

[Hypoglycemia](#)

[Hyperglycemia](#)

References

1. Alberta Health Services. AHS Medical Control Protocols. 2020. [\[Link\]](#)
2. Ambulance Victoria. Clinical Practice Guidelines: Ambulance and MICA Paramedics. 2018. [\[Link\]](#)
3. American Diabetes Association. Gestational diabetes mellitus. 2004. [\[Link\]](#)
4. Marx JA, et al., editors. Rosen's emergency medicine: Concepts and clinical practice. 8th edition. 2014.
5. Norris TL, et al. Porth's pathophysiology: Concepts of altered health states. 10th edition. 2019.
6. Pasquel FJ, et al. Hyperosmolar hyperglycemic state: A historic review of the clinical presentation, diagnosis, and treatment. 2014. [\[Link\]](#)
7. Tintinalli JE, et al. Tintinalli's emergency medicine: A comprehensive study guide. 9th edition. 2019.

