

WEEK 4: Nursing care for patients with endocrine system disorders

Hyperglycemia

Hyperglycemia, also known as high blood sugar, is a condition where there is an excessive amount of glucose circulating in the blood plasma. It is a significant indicator and complication of diabetes. Generally, blood sugar levels higher than 11.1 mmol/L (200 mg/dL) are considered hyperglycaemic, though symptoms might not manifest until levels reach 13.9–16.7 mmol/L (250–300 mg/dL). Chronic hyperglycaemia can lead to serious organ damage over time, especially if blood glucose levels consistently exceed 10–12 mmol/L (180–216 mg/dL).

Signs and Symptoms

Hyperglycaemia can present with varying degrees of severity and symptoms. Initially, it might be asymptomatic, but chronic elevated glucose levels can lead to diverse complications. Classic symptoms include frequent hunger (polyphagia), excessive thirst (polydipsia), and increased urination (polyuria). Additional symptoms might include blurred vision, fatigue, restlessness, weight changes, poor wound healing, dry mouth, dry or itchy skin, tingling in feet or heels, erectile dysfunction, recurrent infections, delayed gastric emptying, cardiac arrhythmia, stupor, coma, and seizures.

Complications

Untreated hyperglycaemia can lead to diabetic ketoacidosis, characterized by symptoms such as deep, rapid breathing (Kussmaul hyperventilation), confusion, dehydration, fruity-smelling breath, nausea, vomiting, abdominal pain, and impaired cognitive function. Chronic hyperglycaemia is strongly associated with heart attacks and death, even in patients without a history of heart disease or diabetes. It can cause nonketotic hyperosmolar syndrome and is linked to increased susceptibility to infections due to impaired immune function, particularly affecting neutrophil activity. Chronic inflammation and biochemical changes can further increase vulnerability to respiratory infections like tuberculosis, flu, and COVID-19.

Causes

Hyperglycaemia is most commonly caused by diabetes mellitus due to low insulin levels or insulin resistance. Other endocrine disorders, sepsis, infections, intracranial diseases, convulsions, terminal diseases, prolonged surgeries, stress, and excessive carbohydrate intake can also cause hyperglycaemia.



Group aerobic exercises can help manage hyperglycaemia by using accumulated glucose.

Endocrine Disorders

Various hormones such as cortisol, catecholamines, growth hormone, glucagon, and thyroid hormones can increase blood glucose levels when present in excess, leading to conditions like Cushing's syndrome, pheochromocytoma, acromegaly, hyperglucagonaemia, and hyperthyroidism.

Insulin Resistance

Obesity contributes significantly to insulin resistance, making it difficult to manage blood glucose levels. Insulin resistance prevents glucose from being converted into glycogen, thus elevating blood sugar levels.

Medications

Certain medications, including corticosteroids, beta blockers, thiazide diuretics, and antipsychotics, can increase the risk of hyperglycaemia.

Stress

Stress-induced hyperglycaemia can occur due to stroke, myocardial infarction, or other acute stressors, increasing mortality risk. Hormonal changes and increased proinflammatory cytokines can interrupt carbohydrate metabolism, leading to excessive glucose production.

Diagnosis

Monitoring blood glucose levels is very important. Levels are measured in either millimoles per litre (mmol/L) or milligrammes per deciliter (mg/dL). Normal fasting levels are about 4 to 6 mmol/L (80 to 110 mg/dL). Chronic hyperglycaemia can be measured via the HbA1c test, whereas acute hyperglycaemia can range from 8 to 15 mmol/L (144 to 270 mg/dL).

Treatment



Replacing white bread with whole wheat options can help reduce hyperglycaemia.

Treatment involves addressing the underlying cause, such as diabetes, through lifestyle modifications, diet, and medication. Acute hyperglycaemia is often treated with insulin, while chronic cases may require oral hypoglycaemic therapy and lifestyle changes. Increasing aerobic exercise and adopting diets high in unsaturated fats and whole wheat carbohydrates, such as the Mediterranean diet, can help control blood glucose levels. Medications like sulphonylureas, metformin, and dipeptidyl peptidase-4 inhibitors may also be prescribed.

Epidemiology

Hyperglycaemia is more prevalent in low to middle-income groups due to limited access to education and healthy food. Physical inactivity and high-calorie consumption contribute to the increasing incidence of hyperglycaemia, with non-whites showing higher susceptibility.

Self-assessment MCQs (select the best answer)

1. What is hyperglycaemia?

- a. Low blood sugar
- b. High blood sugar
- c. Normal blood sugar
- d. Low blood pressure
- e. High blood pressure

2. What are the classic symptoms of hyperglycaemia?

- a. Frequent hunger, excessive thirst, increased urination
- b. Frequent hunger, excessive thirst, low blood pressure
- c. Excessive thirst, low blood sugar, frequent hunger
- d. Increased urination, low blood sugar, dry mouth
- e. Blurred vision, fatigue, rapid breathing

3. Which serious condition can untreated hyperglycaemia lead to?

- a. Diabetic ketoacidosis
- b. Hypertension
- c. Hypoglycaemia
- d. Hyperthyroidism
- e. Sepsis

4. Which hormone is NOT associated with increasing blood glucose levels?

- a. Cortisol
- b. Catecholamines
- c. Growth hormone
- d. Insulin
- e. Glucagon

5. Which of the following is a common cause of hyperglycaemia?

- a. Low carbohydrate intake
- b. Hypothyroidism
- c. High insulin levels
- d. Diabetes mellitus
- e. Low body weight

6. What measurement indicates chronic hyperglycaemia?

- a. HbA1c test
- b. Fasting blood sugar test
- c. Oral glucose tolerance test
- d. Random blood sugar test
- e. Lipid profile test

7. Which lifestyle modification can help manage hyperglycaemia?

- a. Decreasing protein intake
- b. Increasing aerobic exercise
- c. Reducing water intake
- d. Increasing sedentary behaviour
- e. Decreasing fibre intake

8. Which medication is NOT typically used to treat hyperglycaemia?

- a. Sulphonylureas
- b. Metformin
- c. Dipeptidyl peptidase-4 inhibitors
- d. Corticosteroids
- e. Insulin

9. What dietary change can help reduce hyperglycaemia?

- a. Replacing whole wheat options with white bread
- b. Increasing saturated fats
- c. Adopting a Mediterranean diet
- d. Reducing protein consumption
- e. Increasing sugar intake

10. Which group is more susceptible to hyperglycemia?

- a. High-income groups
- b. Low to middle-income groups
- c. All income groups equally
- d. Only those with diabetes
- e. Only elderly individuals

Hypoglycemia

Hypoglycaemia, also known as low blood sugar, is a condition characterized by a fall in blood sugar to levels below 70 mg/dL (3.9 mmol/L). This condition is particularly important for medical professionals, including dentists, to understand due to its rapid onset and potential severity. The condition can cause symptoms ranging from mild discomfort to life-threatening complications.

Signs and Symptoms

Hypoglycaemic symptoms are categorized into neuroglycopenic symptoms and adrenergic symptoms. Neuroglycopenic symptoms result from low glucose levels in the brain and include headache, blurred vision, tiredness, unusual behavior, confusion, lightheadedness, difficulty speaking, seizures, and loss of consciousness. Adrenergic symptoms are caused by the body's reaction to low glucose in the brain and include fast heart rate, pounding heartbeat, sweating, clamminess, tremors, nervousness, hunger, irritability, nausea, pins and needles sensation, and pale skin color.

Diagnosis

The diagnosis of hypoglycaemia relies on Whipple's triad: the presence of hypoglycaemic symptoms, a blood glucose measurement below 70 mg/dL (3.9 mmol/L), and resolution of

symptoms after blood glucose levels return to normal. For those without a history of diabetes, further blood tests, including insulin, C-peptide, proinsulin levels, and an oral hypoglycaemic agent screen, may be necessary.

Causes

Diabetics

For diabetics, hypoglycaemia is most commonly caused by medications used to treat diabetes, such as insulin, sulfonylureas, and biguanides. Other contributing factors include fasting, increased physical activity, alcohol consumption, and kidney disease. Recurrent episodes can lead to hypoglycaemic unawareness, where symptoms present at dangerously low blood glucose levels.

Non-Diabetics

In non-diabetics, causes include serious illnesses (e.g., sepsis, liver, and kidney failure), medications, surreptitious insulin use, alcohol misuse, hormone deficiencies, inborn errors of metabolism, insulinomas, non-B cell tumours, post-gastric bypass postprandial hypoglycaemia, autoimmune hypoglycaemia, and neonatal hypoglycaemia.

Treatment and Nursing Management

Self-Treatment

For conscious individuals, self-treatment involves consuming 10–20 grammes of a carbohydrate to raise blood glucose levels to a minimum of 70 mg/dL (3.9 mmol/L). Suitable options include glucose tablets or gel, sugary juice, soft drinks, candy, or honey. Blood glucose should be measured after 15–20 minutes to ensure levels have normalized.

Assistance by Family, Friends, or Co-Workers

Family, friends, and co-workers of diabetics should be educated on recognising hypoglycaemia and administering quick treatments. If the hypoglycaemic person is unconscious, a glucagon kit may be used, and emergency services should be called immediately.



A glucagon kit used to treat severe hypoglycaemia.

Nursing Management

In healthcare settings, treatment depends on symptom severity and intravenous access. Conscious patients may receive food, drink, or glucose tabs or gel. Intravenous access allows for the administration of 25 grammes of 50% dextrose. Without intravenous access, intramuscular or intranasal glucagon may be used.

Prevention

Diabetics

For diabetics, prevention strategies include patient education on recognising symptoms, adjusting medication doses, and frequent blood glucose monitoring. Continuous glucose monitors and insulin pumps can significantly improve blood glucose control and help prevent hypoglycaemia.



An insulin pump used to deliver appropriate levels of insulin.

Non-Diabetics

Prevention in non-diabetics depends on the underlying cause. Hormone replacement, tumour resection, or dietary adjustments may be necessary. Medications like diazoxide and octreotide can help manage certain conditions that lead to hypoglycaemia.

Epidemiology

Hypoglycaemia is common in type 1 diabetics and those with type 2 diabetes on certain medications. Type 1 diabetics typically experience two mild episodes per week and one severe episode per year. Mortality due to hypoglycaemia occurs in 6–10% of type 1 diabetics. Hypoglycaemia is less common in type 2 diabetics not taking insulin, glinides, or sulfonylureas.

History

James Collip first discovered hypoglycaemia while working on insulin purification in 1922. He observed that excessive doses of insulin caused convulsions, coma, and death in rabbits, which helped him define insulin activity.

Self-assessment MCQs (select the best answer)

- 1. What blood glucose level defines hypoglycaemia?**
 - a. Below 90 mg/dL (5.0 mmol/L)
 - b. Below 80 mg/dL (4.4 mmol/L)
 - c. Below 70 mg/dL (3.9 mmol/L)
 - d. Below 60 mg/dL (3.3 mmol/L)
 - e. Below 50 mg/dL (2.8 mmol/L)
- 2. Which of the following is a neuroglycopenic symptom of hypoglycaemia?**
 - a. Fast heart rate
 - b. Sweating
 - c. Tremors
 - d. Confusion
 - e. Hunger

- 3. What is the first step in diagnosing hypoglycaemia according to Whipple's triad?**
 - a. Elevated insulin levels
 - b. Presence of hypoglycaemic symptoms
 - c. Blood glucose measurement above 70 mg/dL
 - d. Blood glucose measurement below 50 mg/dL
 - e. Presence of ketones in urine

- 4. Which medication is commonly associated with hypoglycaemia in diabetics?**
 - a. Metformin
 - b. Glucagon
 - c. Insulin
 - d. Aspirin
 - e. Levothyroxine

- 5. What is the recommended self-treatment for a conscious individual experiencing hypoglycaemia?**
 - a. Consuming 10–20 grammes of protein
 - b. Consuming 10–20 grammes of carbohydrate
 - c. Consuming 10–20 grammes of fat
 - d. Injecting glucagon
 - e. Drinking water

- 6. What should be done if a hypoglycaemic person is unconscious?**
 - a. Offer them food
 - b. Administer insulin
 - c. Call emergency services and use a glucagon kit
 - d. Provide sugary drinks
 - e. Apply a cold compress

- 7. What is a common prevention strategy for diabetics to avoid hypoglycaemia?**
 - a. Consuming more protein
 - b. Frequent blood glucose monitoring
 - c. Avoiding all carbohydrates
 - d. Increasing physical activity
 - e. Drinking more water

- 8. Which of the following is NOT a cause of hypoglycaemia in non-diabetics?**
 - a. Insulinomas
 - b. Sepsis
 - c. Sulfonylureas
 - d. Liver failure
 - e. Post-gastric bypass postprandial hypoglycaemia

- 9. How many severe hypoglycaemic episodes per year does a typical type 1 diabetic experience on average?**

- a. Zero
- b. One
- c. Two
- d. Three
- e. Four

10. Who discovered hypoglycaemia while working on insulin purification?

- a. Frederick Banting
- b. Charles Best
- c. John Macleod
- d. James Collip
- e. Leonard Thompson

Diabetic Ketoacidosis

Diabetic ketoacidosis (DKA) is a potentially life-threatening complication of diabetes mellitus, primarily affecting individuals with type 1 diabetes but also occurring in those with other types. DKA is characterized by the rapid onset of symptoms such as vomiting, abdominal pain, deep gasping breathing, increased urination, weakness, confusion, and occasionally loss of consciousness. A specific "fruity" smell on a person's breath may also be detected.



Dehydration may be severe in diabetic ketoacidosis, and intravenous fluids are usually needed as part of its treatment.

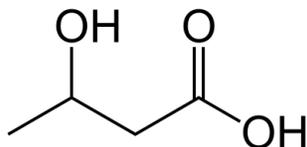
Signs and Symptoms

The symptoms of DKA typically evolve over about 24 hours and include nausea, vomiting, pronounced thirst, excessive urine production, and severe abdominal pain. In severe cases, breathing becomes rapid and deep (Kussmaul breathing), and there may be confusion or a marked decrease in alertness, including coma. Physical examination often reveals dehydration, a dry mouth, decreased skin turgor, rapid heart rate, and low blood pressure. A "ketotic" odour, described as fruity or like pear drops, is often present due to the presence of acetone.

Causes

DKA usually occurs in individuals with type 1 diabetes but can also be the first presentation in those previously undiagnosed. Common triggers include infection, inadequate insulin

administration, myocardial infarction, stroke, and certain medications like steroids. SGLT2 inhibitors, used in type 2 diabetes, have been associated with "euglycaemic DKA" where blood sugars may not be significantly elevated.



β -hydroxybutyrate (the conjugate base of β -hydroxybutyric acid, drawn above) despite chemically containing a carboxylate group instead of a ketone, is the principal "ketone body" in diabetic ketoacidosis.

Mechanism

DKA arises from a lack of insulin, leading to increased glucose release by the liver and osmotic diuresis. This results in dehydration, polyuria, and polydipsia. Concurrently, free fatty acids are converted into ketone bodies, leading to metabolic acidosis. Compensatory mechanisms include hyperventilation to lower blood carbon dioxide levels. The condition is further exacerbated by increased levels of counterregulatory hormones and cytokines.

Diagnosis

DKA is diagnosed by demonstrating hyperglycaemia, ketones in blood or urine, and acidosis. A pH measurement is performed to detect acidosis, and ketones can be measured in the urine (acetoacetate) and blood (β -hydroxybutyrate). Additional tests include measuring urea, creatinine, electrolytes, markers of infection, and acute pancreatitis. In suspected cerebral oedema, computed tomography may be performed.

Treatment

Fluid Replacement

Fluid replacement depends on the degree of dehydration. Severe dehydration or shock requires rapid saline infusion, while moderate dehydration allows for calculated rehydration. Mild cases may be treated with oral rehydration and subcutaneous insulin.

Insulin

Insulin is administered to reduce blood sugars and suppress ketone production. Guidelines differ on the initial bolus dose and the subsequent insulin infusion rates based on blood glucose levels.

Potassium

Potassium levels need continuous monitoring due to fluctuations during treatment. Potassium is added to intravenous fluids once levels fall below 5.3 mmol/L. If levels drop below 3.3 mmol/L, insulin administration may be paused.

Sodium Bicarbonate

The use of sodium bicarbonate is controversial and generally discouraged unless the pH is extremely low (<6.9). It may worsen intracellular acidosis and increase complications.

Cerebral Oedema

Cerebral oedema requires intensive care, potentially including artificial ventilation and medications like mannitol or hypertonic saline to reduce swelling.

Prevention

DKA can be prevented by adherence to "sick day rules," which include taking extra insulin when sugar levels are uncontrolled, maintaining a diet rich in salt and carbohydrates, treating infections, and seeking medical help when necessary. Monitoring ketone levels when unwell is also recommended.

Nursing Management

The main aim in the treatment of DKA is to replace lost fluids and electrolytes while suppressing high blood sugars and ketone production with insulin. Admission to an ICU may be necessary for close observation.

Self-assessment MCQs (select the best answer)

- 1. Which type of diabetes is most commonly associated with Diabetic Ketoacidosis (DKA)?**
 - a. Type 1 diabetes
 - b. Type 2 diabetes
 - c. Gestational diabetes
 - d. Prediabetes
 - e. MODY (Maturity Onset Diabetes of the Young)

- 2. What is a distinct characteristic smell on the breath of someone with DKA?**
 - a. Metallic
 - b. Fruity
 - c. Sulfuric
 - d. Bitter
 - e. Odourless

- 3. What is the primary cause of DKA?**
 - a. Excessive carbohydrate intake
 - b. Lack of insulin
 - c. Excessive exercise
 - d. Overhydration
 - e. High-fat diet

- 4. Which of the following is NOT a common symptom of DKA?**
 - a. Vomiting
 - b. Abdominal pain
 - c. Increased urination
 - d. Muscle hypertrophy
 - e. Confusion

- 5. What is the principal "ketone body" in diabetic ketoacidosis?**
- Acetoacetate
 - Acetone
 - β -hydroxybutyrate
 - Lactic acid
 - Pyruvate
- 6. What type of breathing is often observed in severe cases of DKA?**
- Shallow breathing
 - Kussmaul breathing
 - Apnoea
 - Cheyne-Stokes respiration
 - Biot's breathing
- 7. Which of the following is a common trigger for DKA?**
- Overhydration
 - Inadequate insulin administration
 - Excessive sleep
 - Low carbohydrate intake
 - Mild exercise
- 8. What immediate treatment is often required for severe dehydration in DKA?**
- Oral rehydration
 - Intravenous fluids
 - High-protein diet
 - Physical therapy
 - Rest and relaxation
- 9. Why is potassium monitoring essential during the treatment of DKA?**
- To prevent hyperglycaemia
 - To avoid cardiac complications
 - To ensure proper kidney function
 - To increase insulin production
 - To maintain blood pressure
- 10. What is a controversial treatment option for DKA that is generally discouraged unless pH is extremely low?**
- Insulin
 - Potassium
 - Sodium bicarbonate
 - Mannitol
 - Hypertonic saline