

Nutritional Therapy in Hyperosmolar Hyperglycemic State Patients with Severe Malnutrition: A Case Report

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Hyperosmolar Hyperglycemic State (HHS) is a complication of Diabetes Mellitus (DM). Hyperglycemia can lead to weight loss due to glycosuria. If this problem is not resolved, this can lead to malnutrition. A 34-year-old woman presented with complaints of weakness, fever, pain during urination, decreased food intake, nausea, and vomiting. The patient has a history of DM. She was diagnosed with HHS, urinary tract infection, and electrolyte imbalance. Nutritional assessment showed a body mass index of 14.2 kg/m² with a weight loss of 11.1%. The patient has severe malnutrition. Nutritional therapy was provided with a target energy of 1,900 kcal/day and 50 grams of protein/day. Starting with a soft diet and then regular diet, ONS (low glycemic index), vitamin B6, and curcuma. According to ESPEN guidelines, patients with DM and malnutrition should receive a high-energy and high-protein diet. ONS should contain lower carbohydrate levels to reduce the glycemic index and provide high protein. In this case, the patient received ONS containing protein and complex carbohydrates with a low glycemic index. Vitamin B6 was given to support insulin and glucagon secretion in the pancreas and increase immunity, while curcuma was given to lower fasting blood sugar and protect the gastrointestinal tract. Implementation of a diabetic diet with a low glycemic index, combined with high energy and high protein for malnutrition, resulted in significant clinical improvement. The patient's blood glucose level decreased from 994 mg/dL to 176 mg/dL.

Keywords: Diabetes mellitus, hyperosmolar hyperglycemic state, malnutrition, nutritional therapy

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1. Introduction

Diabetes Mellitus (DM) is a chronic disease characterized by elevated blood glucose levels due to impaired insulin production and function. Insulin and glucagon are hormones that play a vital role in maintaining balanced blood glucose levels and are produced by cells β and cells α in the islets of Langerhans in the pancreas. When insulin production or function is disrupted, blood glucose levels become uncontrolled, leading to diabetes mellitus. Uncontrolled hyperglycemia is a key characteristic of DM, with blood glucose levels >180 mg/dL and fasting blood glucose levels ≥ 126 mg/dL associated with impaired glucose homeostasis (1).

Diabetes mellitus is a global health problem that continues to increase. According to data from the World Health Organization (WHO), in 2022, approximately 830 million people worldwide will be living with diabetes mellitus. The prevalence of DM in adults aged 18 years and older increased to 14% in 2022, compared to 7% in 1990. Furthermore, in 2021, diabetes mellitus was the direct cause of approximately 1.6 million deaths worldwide, with approximately 47% of deaths occurring before the age of 70 (2).

Most cases of diabetes mellitus are type 2 diabetes mellitus, which is associated with insulin resistance and impaired insulin secretion. Persistent hyperglycemia can lead to various complications, both microvascular and macrovascular. Therefore, controlling blood glucose levels is a crucial part of diabetes mellitus management to prevent more severe and life-threatening complications (3).

Hyperglycemia is a major cause of complications in patients with diabetes mellitus. Uncontrolled hyperglycemia can progress to an acute hyperglycemic state that requires immediate treatment. Diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic state (HHS) are two of the most serious and life-threatening acute hyperglycemic states in patients with type 1 and type 2 diabetes mellitus (4).

Hyperosmolar Hyperglycemic State(HHS) is characterized by severe hyperglycemia, increased plasma osmolality, severe dehydration, and impaired consciousness with minimal ketonemia or acidosis. This condition can develop due to various triggering factors, one of which is infection. In a study in the United States, 38% of hospitalizations for hyperglycemia were due to DKA, 35% to HHS, and 27% were due to a combination of DKA and HHS. In patients with type 2 diabetes, the incidence of hyperglycemic crises reaches 3.2 per 1,000 people per year (5).

Hyperglycemia in patients with diabetes mellitus can lead to weight loss. This occurs due to glycosuria, which causes the body to lose calories through urine. Furthermore, impaired skeletal muscle metabolism due to decreased insulin function can also contribute to decreased body mass. If this condition is not promptly addressed, ongoing energy and nutrient loss can lead to malnutrition in patients with diabetes mellitus (6).

According to the European Society for Clinical Nutrition and Metabolism (ESPEN), malnutrition is a condition resulting from inadequate nutrient intake or absorption, leading to changes in body composition, primarily in the form of decreased fat-free mass and body cell mass. This condition can lead to decreased physical and mental function and worsen clinical outcomes of disease. Malnutrition can result from inadequate nutrient intake, with or without increased catabolism triggered by inflammatory conditions in acute and chronic diseases (7).

Malnutrition has a significant impact on a patient's clinical condition. This condition can lead to a decreased quality of life, increased morbidity, increased risk of infection, delayed wound healing, impaired immune system function, decreased muscle strength, increased mortality, and prolonged hospitalization. According to WHO data from 2022, approximately 390 million adults worldwide are underweight, indicating that malnutrition remains a global health concern (8).

Malnutrition is also common in patients with chronic diseases, including diabetes mellitus. Malnutrition occurs in approximately 30% of the general population and is more common in older adults with multiple conditions. Furthermore, the prevalence of diabetes mellitus continues to increase with age and has reached more than 800 million adults worldwide. This situation indicates the potential for increasingly complex nutritional problems in patients with diabetes mellitus (9).

The risk of poor clinical outcomes increases when patients with diabetes mellitus experience malnutrition. Malnutrition can be found in approximately 60–80% of patients undergoing hospitalization. In patients with type 2 diabetes mellitus, the overall prevalence of malnutrition reaches approximately 33%, while the risk of malnutrition reaches 44%. Malnutrition is an additional burden that can increase the risk of morbidity and mortality in patients with diabetes mellitus and patients with stress-induced hyperglycemia (10).

Therefore, the prevention and management of malnutrition in patients with diabetes mellitus, particularly those with severe hyperglycemia such as HHS, requires special attention. Malnutrition must be detected early and promptly so that interventions to improve nutritional status can be implemented promptly. Management should not only focus on meeting energy and nutrient needs, but also consider the patient's disease condition, food tolerance, and the factors causing and contributing to malnutrition (11).

Nutritional therapy is an important part of the management of HHS patients with malnutrition. Providing appropriate nutritional therapy is expected to help meet energy and protein needs, maintain or improve nutritional status, support the recovery process, and help control blood glucose levels. The reported case

describes a patient with HHS who experienced severe malnutrition accompanied by a urinary tract infection. This case report discusses the provision of nutritional therapy to an HHS patient with severe malnutrition and is expected to provide an overview of the importance of nutritional therapy as part of the management of HHS patients with malnutrition (12).

2. Literature Review and Problem Statement

Hyperosmolar Hyperglycemic State (HHS)

Hyperosmolar Hyperglycemic State(HHS) is an acute complication of diabetes mellitus characterized by severe hyperglycemia, increased plasma osmolality, severe dehydration, and impaired consciousness. This condition generally occurs due to relative insulin deficiency, which causes a significant increase in blood glucose levels. Severe hyperglycemia causes increased glucose excretion in the urine, resulting in osmotic diuresis and significant fluid and electrolyte loss. This condition can progress to severe dehydration and organ dysfunction if not promptly and appropriately treated. HHS can be triggered by various conditions, particularly infection, non-compliance with diabetes therapy, acute illness, use of certain medications, and conditions that increase insulin requirements. Infection is one of the most common triggering factors because it can increase counterregulatory hormones, worsening hyperglycemia. Clinical manifestations of HHS can include excessive thirst, polyuria, weakness, weight loss, dehydration, electrolyte disturbances, changes in mental status, and even decreased consciousness. Management of HHS requires a comprehensive approach with the primary goals of addressing dehydration, correcting electrolyte disturbances, controlling hyperglycemia, and addressing precipitating factors. In addition to medical therapy, the patient's nutritional status also needs to be monitored, as severe hyperglycemia can increase energy and nutrient loss. Therefore, nutritional therapy is a crucial part of the recovery process for HHS patients, especially those who have experienced malnutrition.

Malnutrition in Diabetes Mellitus Patients

Malnutrition is a condition where the body's nutritional needs are not adequately met, resulting in changes in body composition and decreased physiological function. In patients with diabetes mellitus, malnutrition can occur due to decreased food intake, increased nutrient loss, metabolic disorders, or increased energy requirements during acute illness. Persistent hyperglycemia can lead to glycosuria, resulting in the loss of some of the body's energy through urine.

Patients with HHS are at higher risk of malnutrition because severe hyperglycemia accompanied by osmotic diuresis can cause significant fluid, electrolyte, and energy loss. This condition can be exacerbated by decreased appetite, nausea, vomiting, and comorbidities such as infections. If prolonged, this condition can lead to weight loss and muscle mass loss, further deteriorating the patient's nutritional status. Malnutrition in patients with diabetes mellitus can negatively impact the healing process and prognosis. Energy and protein deficiencies can lead to decreased muscle mass, impaired immune function, increased risk of infection, delayed healing, and prolonged hospitalization. Therefore, early identification of nutritional status and provision of nutritional interventions are necessary to prevent worsening of the patient's condition.

Nutritional Therapy in HHS Patients with Malnutrition

Nutritional therapy for HHS patients with malnutrition aims to meet energy and protein needs without exacerbating hyperglycemia. Nutritional support should be tailored to the patient's clinical condition, nutritional status, metabolic status, and energy and protein needs. In patients with severe malnutrition, meeting energy and protein needs is crucial to maintain body mass and support recovery. Nutritional support can be provided gradually according to patient tolerance. For patients experiencing nausea, vomiting, or decreased ability to tolerate food, soft foods can be introduced initially, followed by regular

meals once the patient's condition improves. Food selection should also consider carbohydrate quality, prioritizing complex carbohydrate sources and foods with a low glycemic index to better control elevated blood glucose levels. For patients whose dietary intake is insufficient to meet energy and protein needs, oral nutritional supplements (ONS) may be considered. ONS given to diabetic patients should contain appropriate carbohydrates, using carbohydrate sources with a low glycemic index and sufficient protein. Providing ONS can help increase energy and protein intake, thus more easily meeting the nutritional needs of malnourished patients.

The Role of Vitamin B6 and Turmeric in Nutritional Therapy

In addition to energy and protein intake, micronutrients and specific foods can be part of nutritional therapy support for malnourished diabetes mellitus patients. Vitamin B6 plays a role in various metabolic processes in the body, including protein and carbohydrate metabolism. Vitamin B6 is also associated with nervous and immune system function, making adequate intake of this vitamin crucial for supporting patients' recovery. Curcumin is a food ingredient containing active compounds, particularly curcumin, which has various biological activities. Curcumin is known to have antioxidant and anti-inflammatory activity and has the potential to provide benefits in controlling glucose metabolism. In the context of nutritional therapy, curcumin can be used as part of a patient's diet while still considering their clinical condition and overall nutritional needs. Therefore, comprehensive nutritional therapy for HHS patients with severe malnutrition requires attention to blood glucose control while meeting energy and protein needs. A combination of a diabetes-appropriate diet, selecting low-glycemic carbohydrate sources, adequate protein intake, and the use of ONS and micronutrient support can help improve nutritional status and support clinical recovery.

3. Method

This study used a case study method to provide an in-depth description of the implementation of nutritional therapy in patients with Hyperosmolar Hyperglycemic State (HHS) and severe malnutrition. The case study was conducted on a 34-year-old female patient admitted with a diagnosis of HHS, urinary tract infection, and electrolyte imbalance. Data collection included an assessment of the patient's clinical condition, medical history, physical examination, laboratory tests, and nutritional status assessment.

Nutritional status assessment was conducted by assessing weight, height, body mass index (BMI), weight changes, food intake, and clinical conditions related to the patient's nutritional status. Based on the assessment results, the patient had a BMI of 14.2 kg/m² and experienced 11.1% weight loss, thus categorizing her as severely malnourished. Data on blood glucose levels, electrolytes, gastrointestinal complaints, and the patient's ability to tolerate food were also used as a basis for determining nutritional therapy interventions.

Nutrition therapy interventions are administered in stages according to the patient's condition and tolerance, with a target energy intake of 1,900 kcal/day and protein intake of 50 grams/day. Nutrition begins with a soft diet and continues with a regular diet after the patient's condition improves, along with the administration of low-glycemic oral nutritional supplements (ONS), vitamin B6, and turmeric. Evaluation is carried out by monitoring the progress of food intake, diet tolerance, clinical condition, nutritional status, and changes in blood glucose levels during treatment to assess the patient's response to nutrition therapy.

4. Results and Discussion

Results

A 34-year-old woman with the initials DBM came to the emergency room of Bali Mandara Regional Hospital on April 6, 2026, with a primary complaint of weakness that had been present for seven days prior to

admission, worsening on the day of arrival. The weakness was persistent, accompanied by a feeling of inability to perform activities. The patient also complained of fever, pain during urination, decreased appetite, and nausea and vomiting since seven days prior to admission. The patient had a history of Diabetes Mellitus (DM) since 2020. One month prior, the patient had been treated at Prof. Dr. IGNG Ngoerah Regional General Hospital with the same complaint and received insulin therapy for home use, but the patient did not comply with the therapy. Before the illness, the patient's weight was around 36 kg and had decreased to 32 kg within one month.

On initial physical examination, the patient appeared weak with *compos mentis* consciousness (E4V5M6). Blood pressure was 110/80 mmHg, pulse rate 103 beats/minute, temperature 37.3°C, respiratory rate 22 breaths/minute, and oxygen saturation 97% on room air. Anthropometric examination results showed a body weight of 32 kg and a height of 150 cm with a body mass index (BMI) of 14.22 kg/m² and a weight loss of 11.1% in one month. Physical examination did not show abdominal distension or increased bowel sounds. The acral area was warm and no edema was found in the extremities.

Based on clinical and laboratory examinations, the patient was diagnosed with Hyperosmolar Hyperglycemic State (HHS) with a random blood sugar (GDS) level of 994 mg/dL and negative ketones, urinary tract infection with leukocytes +3, and electrolyte disturbances in the form of sodium 111 mmol/L and potassium 2.7 mmol/L. The results of the nutritional assessment using Subjective Global Assessment (SGA) showed category C, indicating severe malnutrition. This condition was supported by a BMI of 14.22 kg/m² and a weight loss of 11.1% in one month.

Initial medical therapy was given in the form of fluid resuscitation with a loading of 1,000 cc of NaCl followed by 20 drops/minute, a bolus of 5 units of Insulin Aspart intravenously followed by a drip of 5 IU/hour of Insulin Aspart, Ceftriaxone 2 grams intravenously once daily, Omeprazole 40 mg intravenously once daily, and a drip of 50 mEq of Potassium Chloride. Blood sugar checks were performed periodically to monitor the response to therapy. Nutritional therapy was given with a target energy of 1,900 kcal/day and 50 grams of protein/day.

For the first two days, patients were given soft foods with chopped side dishes three times a day along with two 150 kcal oral nutritional supplements (ONS). The patient's intake during the first two days reached approximately 70% of the requirement. On the third day, the patient was still given soft foods with chopped side dishes three times a day and two 200 kcal ONS with a low glycemic index, with an intake of approximately 70%. On the fourth to seventh days, the patient was given regular food three times a day along with two 200 kcal ONS with a low glycemic index. Intake increased to approximately 75% of the requirement. The patient also received vitamin B6 supplementation of two 25 mg and turmeric three 100 mg.

The patient underwent seven days of treatment at Bali Mandara Regional Hospital and showed gradual clinical improvement. Complaints of weakness and painful urination disappeared, while gastrointestinal symptoms improved. Electrolyte disturbances also showed improvement, with sodium levels increasing from 111 mmol/L to 126 mmol/L and potassium levels from 2.7 mmol/L to 5.2 mmol/L. Blood sugar levels gradually decreased from 994 mg/dL on admission to 176 mg/dL on the sixth day of treatment.

Discussion

Diabetes mellitus is a chronic metabolic disease characterized by elevated blood glucose levels due to impaired insulin secretion, insulin action, or both. Under normal conditions, insulin produced by pancreatic beta cells plays a role in lowering blood glucose levels, while glucagon produced by alpha cells helps maintain glucose levels by increasing glucose production by the liver. Persistent hyperglycemia can lead to various acute and chronic complications in patients with diabetes mellitus (8).

One of the acute complications of severe hyperglycemia is Hyperosmolar Hyperglycemic State (HHS), which is characterized by severe hyperglycemia, increased serum osmolarity, dehydration, and minimal or no ketosis. HHS commonly occurs in patients with type 2 diabetes mellitus and can be triggered by infections, especially urinary tract infections or pneumonia, as well as discontinuation or non-compliance with insulin therapy. In this case, the patient experienced HHS with a random blood glucose level of 994 mg/dL, negative ketones, accompanied by a urinary tract infection and a history of not using previously prescribed insulin (9).

Severe hyperglycemia in HHS is also closely associated with weight loss and malnutrition. Elevated blood glucose levels cause glucosuria, resulting in calorie loss through urine. Furthermore, insulin deficiency or low effectiveness can increase the breakdown of fat and protein, including muscle mass, for energy. If this condition persists for a period of time, it can lead to significant weight loss and worsen the patient's nutritional status (10).

In this case, the patient's weight decreased from 36 kg to 32 kg within one month, representing a decrease of 11.1%. With a height of 150 cm, the patient's body mass index was 14.22 kg/m², indicating severe underweight. The Subjective Global Assessment (SGA) results indicated a category C, indicating severe malnutrition. This condition indicates that the patient not only experienced metabolic disorders due to HHS but also had nutritional problems requiring comprehensive intervention (11).

Malnutrition in patients with diabetes mellitus can increase the risk of physical weakness, decreased muscle mass, immune system disorders, infections, delayed recovery, and increased length of hospital stay. Therefore, treatment of diabetic patients with malnutrition should not only focus on controlling blood glucose levels, but must also address meeting energy and protein needs to maintain or improve the patient's body mass and physical function (8).

Nutritional therapy for diabetic patients with malnutrition needs to be individualized based on clinical condition, nutritional status, eating ability, food tolerance, and comorbidities. In malnourished patients, energy and protein needs must be adequately provided while still paying attention to blood glucose control. A diet containing low-glycemic index carbohydrates can be chosen to help control post-meal blood glucose spikes, while adequate protein is needed to help maintain muscle mass (12).

In this case, the patient's nutritional needs were set at 1,900 kcal per day, with a protein requirement of 50 grams per day. Feeding was carried out in stages, using a soft diet with chopped side dishes three times daily on the first and second days, then continuing with a regular diet starting on the fourth day. Changes in food texture were made taking into account the patient's condition, which was experiencing decreased appetite, nausea, and vomiting before admission. The gradual feeding process aims to increase patient tolerance while helping meet energy and protein needs (13).

In addition to main meals, patients are given oral nutritional supplements (ONS) with a low glycemic index. Providing ONS to diabetic patients with malnutrition can help increase energy and protein intake when nutritional needs cannot be met through main meals alone. ONS with a lower carbohydrate content and a low glycemic index can be used to help meet energy needs without causing too rapid a rise in blood glucose (14).

Patient intake during treatment increased from approximately 70% on the first to second day to 75% on the fourth to seventh day. This increase in intake indicates improved food tolerance and the patient's clinical condition. Meeting intake close to target requirements is important in malnourished patients because prolonged energy and protein deficiency can exacerbate muscle loss and hinder recovery (14).

In addition to dietary interventions and ONS, patients receive vitamin B6 twice daily, 25 mg each. Vitamin B6 is a water-soluble vitamin that acts as a coenzyme in various metabolic reactions of carbohydrates,

proteins, and fats. This vitamin is also involved in amino acid metabolism, immune system function, and various enzymatic processes that support the body's metabolism. In diabetic patients, adequate micronutrient intake is crucial for supporting metabolic health and recovery (15).

Patients also received 3 x 100 mg of curcumin as part of nutritional therapy. Curcumin, particularly its curcuminoids and other bioactive compounds, has antioxidant and anti-inflammatory activities that have the potential to support metabolic health. Several studies have shown that curcumin supplementation can affect blood glucose levels, although its use should be considered as a supportive therapy and not a substitute for primary diabetes therapy (16).

The patient's clinical condition improved during the seven days of treatment, evident in reduced weakness, the disappearance of painful urination, and improved gastrointestinal symptoms. Sodium levels increased from 111 mmol/L to 126 mmol/L, while potassium levels increased from 2.7 mmol/L to 5.2 mmol/L. These electrolyte improvements indicate a response to medical therapy and correction of electrolyte disturbances during treatment.

The patient's blood glucose levels also decreased significantly, from 994 mg/dL upon admission to 176 mg/dL on the sixth day. This decrease indicates an improvement in hyperglycemia during treatment. However, the change in glucose levels cannot be attributed solely to nutritional therapy, as the patient also received insulin, fluid therapy, electrolyte correction, and antibiotics to address the precipitating factor, a urinary tract infection (9).

Overall, gradual nutritional therapy with adequate energy and protein, a low-glycemic index diet, ONS, and vitamin B6 and turmeric supplementation are supporting components in the recovery process for HHS patients with severe malnutrition. Nutritional interventions should be carried out in conjunction with primary medical therapy and regular monitoring of glucose levels, electrolytes, food intake, dietary tolerance, and nutritional status development (8,12).

5. Conclusion

Patients with Diabetes Mellitus who experience Hyperosmolar Hyperglycemic State (HHS) accompanied by malnutrition require comprehensive management including general condition stabilization, glycemic control, and adequate nutritional therapy. Hyperglycemia can cause weight loss through glycosuria, which results in urinary calorie loss, skeletal muscle metabolic disorders due to decreased insulin action, and increased protein degradation compared to protein synthesis, ultimately leading to muscle mass loss. Therefore, nutritional screening and assessment, as well as the provision of appropriate nutritional therapy, are essential in the management of patients with HHS and malnutrition.

Overall, the provision of a diabetes mellitus diet with attention to a low glycemic index and a high energy and protein diet in malnourished patients showed improvement in the patient's clinical condition. Blood glucose levels, which were initially 994 mg/dL upon hospital admission, gradually decreased to 176 mg/dL on the sixth day of treatment. This case demonstrates that nutritional interventions provided in an integrated manner with medical therapy can support improvements in the clinical condition and nutritional status of patients with diabetes mellitus with HHS accompanied by malnutrition. Further research is needed to evaluate the effectiveness and safety of this nutritional therapy in the long term.

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