EFFECT OF ZINC SUPPLEMENTATION ON FASTING BLOOD GLUCOSE CONTROL IN BURN INJURY PATIENTS WITH TYPE 2 DIABETES MELLITUS: A CASE REPORT

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Abstract

Burn injury is the second leading cause of injury in Indonesia. Patients with burn injury may develop zinc deficiency due to loss of exudate and decreased carrier proteins, leading to impaired glucose regulation and inadequate wound healing. Jayawardena et al. showed that zinc supplementation can help regulate blood glucose in patients with diabetes mellitus. This case aims to see the effect of zinc supplementation on fasting blood glucose control in burn injury patients with type 2 diabetes mellitus. A 47-year-old Male with diabetes mellitus and a history of COVID-19 presented with 34% second to third-degree burn injury. The patient was given short-acting insulin 6 IU thrice a day and long-acting insulin 10 IU once a day. Nutrition was increased gradually until it reached 30 kcal/kgBW with protein 1,2 g/kgBW on the 28th day of hospitalization, referring to a diabetes-specific formula, 6x300 kcal. The patient also received zinc sulfate supplementation, 40 mg per day. The patient's daily zinc intake was 47 mg/dL, and it was analyzed using Nutrisurvey. Fasting blood glucose in the first 28 days was not well-regulated (92-348 mg/dL). After 28 days of zinc supplementation, the patient's fasting blood glucose was stable. (140-180 mg/dL). Uncontrolled blood glucose leads to bacteremia, decreased skin graft takes, and increased mortality. Zinc deficiency can cause greater insulin resistance that can lead to hyperglycemia. Fasting blood glucose was stable after 28 days of zinc supplementation, similar to the previous study. Supplementation can help to regulate fasting blood glucose in burn patients with diabetes mellitus.

Keywords
Zinc Supplementation, Blood Glucose, Diabetes Mellitus Type II, Burn Injury

Introduction

Burn injury is the second leading cause of injury in Indonesia[1]. Patients with burn injury may develop zinc deficiency due to loss of exudate, increased urine excretion, and decreased carrier proteins, leading to impaired glucose regulation.[2] Comorbidities such as diabetes mellitus, especially inadequate blood glucose regulation, can lead to inadequate wound healing. Zinc is an essential trace element needed for enzymatic processes in the body that plays a vital role in protein synthesis, immune function, DNA replication, and wound healing. Zinc also helps in regulating blood glucose.[3] Uncontrolled glycaemic levels can worsen the condition of burn wounds. Jayawardena et al.[3] showed that zinc supplementation can help regulate blood glucose in patients with diabetes mellitus.

Case Report

A 47-year-old Male with diabetes mellitus and a history of COVID-19 presented with 34% second to third-degree burn injury. The patient's nutritional status is clinically moderate malnutrition, considering weight loss of 5 kg in 3 weeks and muscle wasting.

The patient denied any history of diabetes mellitus nor consuming any diabetic medicine prior to admission. During the hospitalization, the patient's blood glucose was not well-regulated, with HbA1C of 6.3%. The patient is diagnosed with type 2 diabetes mellitus. The patient got 6 IU of short-acting insulin thrice a day with a correctional dose and long-acting insulin 10 IU once a day.

During hospitalization, the nutrition was given via NGT. The nutrition was gradually increased until it reached 30 kcal/kgBW with protein 1,2 g/kgBW on the 28th day of hospitalization, referring to a diabetes-specific formula, 6x300 kcal. The patient was given micronutrients: vitamin B complex three times a day, vitamin C 250 mg twice a day, folic acid 1 mg once a day, and zinc 20 mg twice a day. The patient's daily blood glucose levels were strictly monitored. Based on the result of monitoring blood glucose levels, there was an increase in fasting blood glucose levels, especially on admission day-13, 14, and 24. On these days, the patient underwent excisional debridement, wound dressing, and split thickness skin graft, respectively. It is shown that fasting blood glucose in the first 28 days was not well-regulated (92-348 mg/dL). After 28 days of zinc supplementation, fasting blood glucose was stable between 140-180 mg/dL. The coefficient of glucose variance in the first 28 days was 38%. Meanwhile, the coefficient of glucose variance after the 28 days until the patient was discharged was 7%.

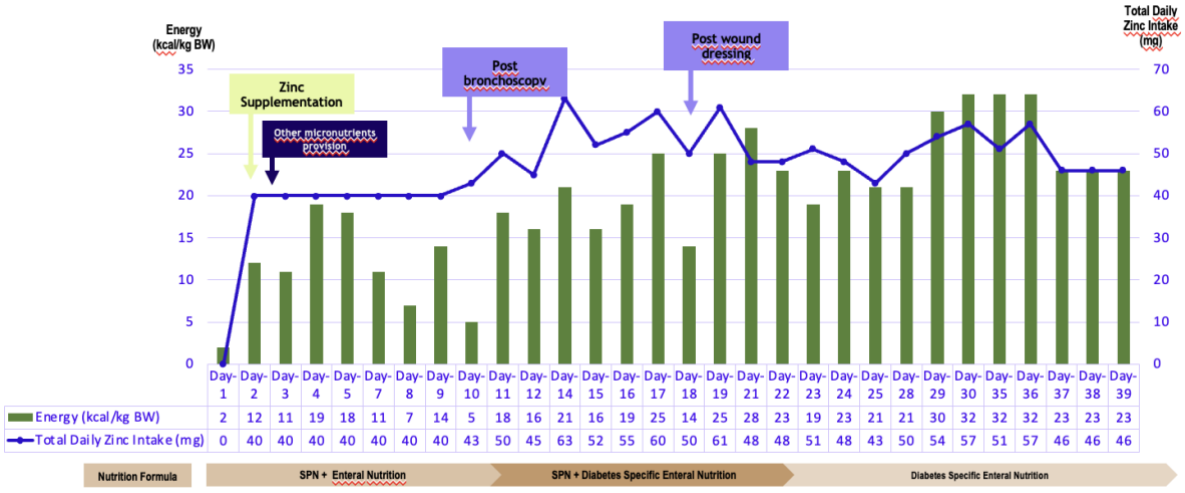

Figure 1. Daily Energy Intake and Total Daily Zinc Intake

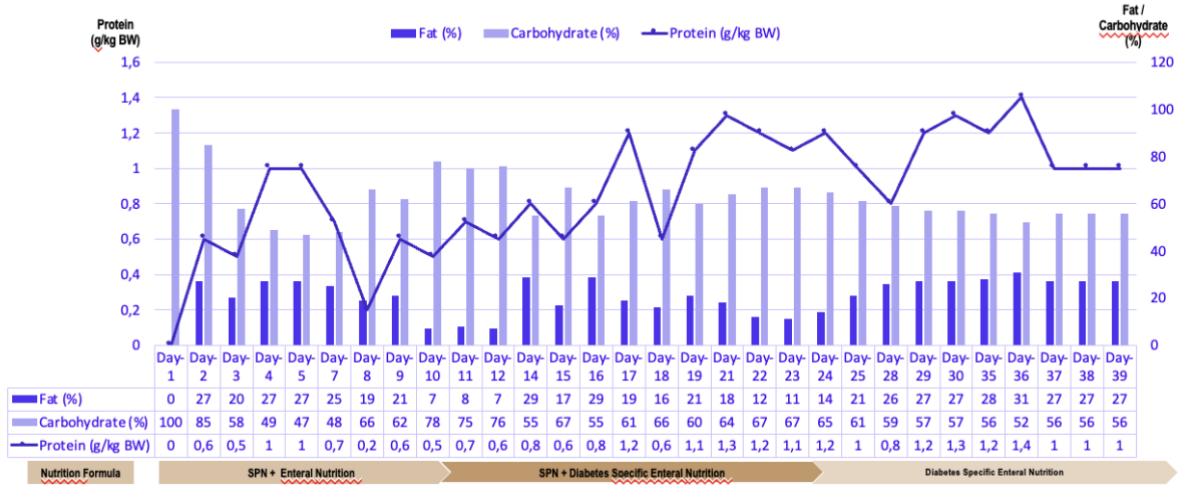

Figure 2. Daily Energy of Protein, Fat, and Carbohydrate

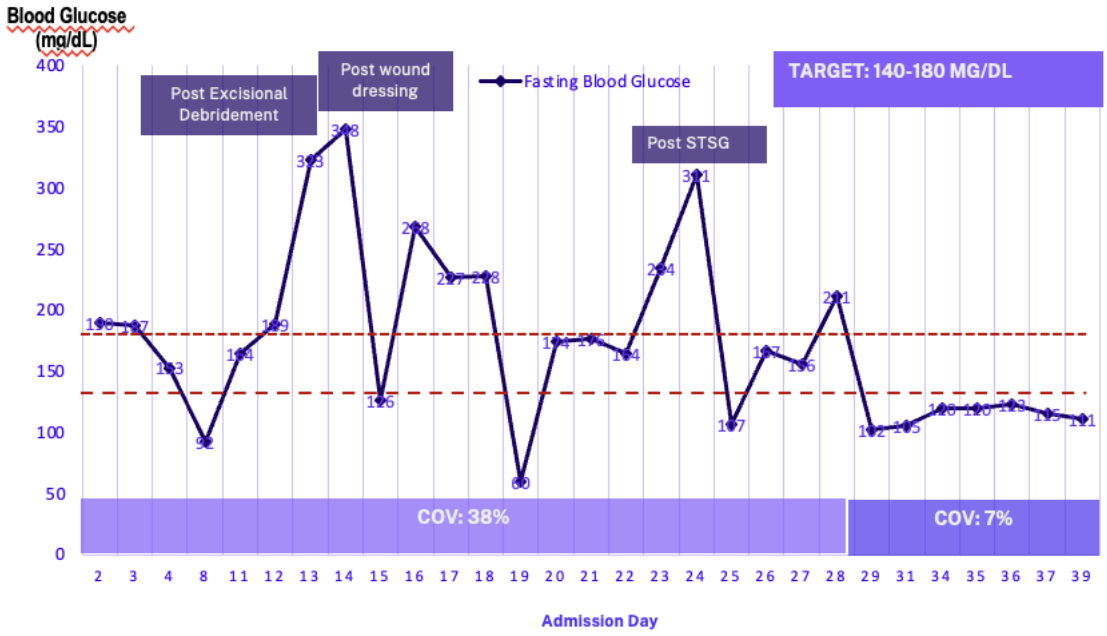

Figure 2. Fasting Blood Glucose

Discussion

Zinc has an important role in blood glucose regulation. Pancreatic β-cells have a higher zinc concentration than other cells. The structure of insulin is a hexamer with six molecules of insulin and two zinc molecules. Zinc-deficient mice have lower numbers of insulin granules in pancreatic β-cells, which can lead to greater exposure to oxidative stress and can cause cellular damage.[4] Zinc plays an essential role in the secretion of insulin. Zinc also regulates the glucose transporter GLUT4 translocation and glucose utilization.

Zinc supplementation has beneficial effects in regulating blood glucose and reducing the concentration of 2-hour postprandial glucose, fasting blood glucose, and HOMA-IR.[5] Oh et al.,[6] showed that zinc supplementation could increase insulin serum and C-peptide. This study also showed changes in fasting blood glucose in patients given zinc supplementation. A similar result was shown in a study from Jayawardena[3], in which zinc supplementation could reduce fasting blood glucose and HbA1C in patients with diabetes mellitus. Animal studies showed that zinc deficiency could cause greater insulin resistance in burn patients, leading to hyperglycemia.[7]

The coefficient of glucose variance is a parameter that can be used in predicting the mortality of critically ill patients with hyperglycemia. A higher coefficient of glucose variance can lead to an increasing mortality rate. Multivariate analysis from Lanspa[8] shows the coefficient of variation was still associated with mortality (OR 1.23 for every 10% increase, 95% CI = 1.16, 1.31, p <0,001). A study from Fong[9], also showed that the coefficient of glucose variation is associated with mortality, especially in patients without a history of diabetes mellitus.

In this case, fasting blood glucose was stable after 28 days of zinc supplementation at a daily intake of 47 mg/day, which was similar to a previous study from Jayawardena et al.[3] Zinc supplementation can help regulate fasting blood glucose in burn patients with diabetes mellitus and lowering coefficient of glucose variance.

Competing Interests

None declared.

Acknowledgments

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References

1. Hasibuan MIA, Moenadjat Y. Prognostic and Predictive Factors of Mortality in Burn Patients at dr. Cipto Mangunkusumo General Hospital, Indonesia. The New Ropanasuri Journal of Surgery. 2021; 6(2)
2. Olson LM, Coffey R, Porter K, Thomas S, Bailey JK, Jones LM, et al. The impact of serum zinc normalization on clinical outcomes in severe burn patients. Burns. 2020 May;46(3):589–95.
3. Jayawardena R, Ranasinghe P, Galappatthy P, Malkanthi R, Constantine G, Katulanda P. Effects of zinc supplementation on diabetes mellitus: a systematic review and meta-analysis. Diabetol Metab Syndr. 2012 Apr 19;4(1):13.
4. Żwierełło W, Styburski D, Maruszewska A, Piorun K, Skórka-Majewicz M, Czerwińska M, et al. Bioelements in the treatment of burn injuries – The complex review of metabolism and supplementation (copper, selenium, zinc, iron, manganese, chromium and magnesium). J Trace Elem Med Biol. 2020 Dec;62:126616.
5. Wang X, Wu W, Zheng W, Fang X, Chen L, Rink L, et al. Zinc supplementation improves glycemic control for diabetes prevention and management: a systematic review and meta-analysis of randomized controlled trials. Am J Clin Nutr. 2019 Jul 1;110(1):76–90.
6. Oh HM, Yoon JS. Glycemic control of type 2 diabetic patients after short-term zinc supplementation. Nutr Res Pract. 2008;2(4):283–8.
7. Hall K, Shahrokhi S, Jeschke M. Enteral Nutrition Support in Burn Care: A Review of Current Recommendations as Instituted in the Ross Tilley Burn Centre. Nutrients. 2012 Oct 29;4(11):1554–65.
8. Lanspa MJ, Dickerson J, Morris AH, Orme JF, Holmen J, Hirshberg EL. Coefficient of glucose variation is independently associated with mortality in critically ill patients receiving intravenous insulin. Crit Care. 2014 Apr 30;18(2):R86.

9. Fong KM, Au SY, Ng GWY. Glycemic control in critically ill patients with or without diabetes. BMC Anesthesiol. 2022 Jul 16;22(1):227.