B-ICON Proceeding

Proceeding Paper

POTASSIUM LEVELS IN TYPE II DIABETES MELLITUS PATIENTS IN THE TELAGA DEWA HEALTH CENTER

Rayhannah Rahmatika Putri[1], Putri Widelia Welkriana[1*], Gani Asa Dudin[1], Ahmad Jaiz[2]

[1]*Department of Medical Tecnology Laboratory, Poltekkes Kemenkes Bengkulu, Bengkulu, Indonesia*

[2]*Department of Medical Tecnology Laboratory, Akademi Analis Kesehatan Harapan Bangsa, Bengkulu, Indonesia*

** putriwidelia@poltekkesbengkulu.ac.id*

Presented at the 4th Bengkulu International Conference on Health (B-ICON), Bengkulu-Indonesia, September 24-26th, 2024

Published: December 31st, 2024

ISSN: 2986-027X

Abstract

Type II Diabetes Mellitus (DM) patients have a higher risk of cardiovascular disease and serious complications such as heart rhythm disturbances and hypertension. Maintaining potassium levels in normal conditions, especially in type II DM patients, helps increase insulin sensitivity, supports kidney function, keeps heart and blood vessel function, and maintains body fluid balance, thereby reducing the risk of heart attack and stroke. An overview of serum potassium levels in type II DM sufferers in the Telaga Dewa Community Health Center working area is necessary to determine the risk factors of potassium deficiency (hypokalemia) and excess potassium (hyperkalemia). A total of 30 serum samples from type II DM patients in the working area of the Telaga Dewa Community Health Center, Bengkulu City were examined for potassium levels using the Ion Selective Electrode (ISE) method, demographic data such as gender and age were recorded as supporting data. Respondents were dominated by women (76.66%) and men (23.33%). Based on age, patients are dominated by those of productive age (90%) and the rest are elderly (10%). The results of measuring potassium levels, 90% of respondents (27 patients) had normal potassium levels with an average of 3.9 mmol/l, three respondents (10%) had low potassium levels (hypokalemia) all of whom were female and of productive age levels potassium averaged 3.4 mmol/l.

Keywords: *potassium, diabetes mellitus type II, hypokalemia and hyperkalemia*

INTRODUCTION

Potassium is predominantly found in 98% intracellular and 2% extracellular compartments, and it is one of the main intracellular ions responsible for maintaining cellular function (Mutia Pratiwi et al, 2019) Hypokalemia or hyperkalemia can occur due to small changes in this distribution A potassium level less than 35 mmol/L is called hypokalemia, and a potassium level greater than 53 mmol/L is

called hyperkalemia Potassium functions as a cofactor in several cellular metabolic pathways The body's potassium homeostasis process is influenced by the balance of intake and excretion, as well as the distribution of potassium between Extra Cellular Fluid (ECF) and Intra Cellular Fluid (ICF) (Rasyid dan Usman, 2019). For diabetes patients, potassium is very important because it increases insulin-exocytosis sensitivity during the insulin secretion phase, thus ensuring smooth blood sugar release (Sasmita et al., 2021). Potassium can also help diabetic patients reduce the risk of hypertension and heart disease The body's potassium homeostasis process is influenced by the balance of potassium intake and excretion, as well as the distribution of potassium between extracellular fluid (ECF) and intracellular fluid (ICF) Several other hormonal and non- hormonal components that are crucial for this regulation include insulin, aldosterone, catecholamines, and acid-base variables (Ningrum dan Apriani, 2021)

Hyperkalemia is most commonly caused by acute or chronic kidney failure, as the excretion of potassium in large amounts over a short period is not possible without proper renal homeostasis function Conversely, hypokalemia can be caused by two factors: significant depletion of potassium reserves or intracellular potassium shifting to extracellular (Adiwardhana & Wreksoatmodjo, 2023). Hypokalemia can be a predisposing condition for the development of various ventricular arrhythmias, including ventricular fibrillation If the potassium balance is disrupted, it can lead to disturbances in cardiac electrical conduction, including cardiovascular dysrhythmias and even sudden death (Tajuddin et al., 2022)

In Indonesia, cardiovascular disease ranks fourth as a cause of death after stroke, hypertension, and diabetes mellitus Epidemiological and prospective studies have observed frequent coexistence between coronary heart disease (CHD) and diabetes mellitus (Latifah et al., 2020). Patients with diabetes, especially type II DM, are at risk for coronary heart disease because the pancreas still produces insulin, but not enough to meet the body's needs, leading to insulin resistance Insufficient endocrine activity in adipose tissue can cause dyslipidemia and endothelial dysfunction (Soebandi et al., 2020)

The Health Department of Bengkulu City reports that in 2022, there were 3,087 cases of diabetes in the city The highest incidence of diabetes occurred at Telaga Dewa Community Health Center, with 395 cases in 2022 However, this number decreased by 48% in 2023, reaching 204 cases Therefore, potassium testing is necessary to detect the risk of hypokalemia and hyperkalemia.

MATERIALS AND METHODS

The research type is a descriptive method that describes health issues in a specific community In this study, the author aims to understand the correlation between potassium levels in type II DM patients in the Puskesmas Bengkulu Telaga Dewa working area in 2023 and the risk of hypokalemia and hyperkalemia. Patients have a right to privacy thus; all studies should be conducted with informed consent.

RESULTS AND DISCUSSION

Table 1 Distribution of potassium frequency in type II DM patients

Potassium levels	Number (people)	Percentage (%)
<3,5	3	10
3,5 – 5,5	27	90
Total	30	100

Based on the results of the potassium examination, the majority of respondents (90%) have normal potassium levels, 10% have low potassium levels (hypokalemia), and there are no patients with above-normal potassium levels (hyperkalemia).

The average age of type II DM patients in the Telaga Dewa Community Health Center's working area

Table 2. The average age of type II DM patients in the Telaga Dewa Primary Health Center's working area

Age (years)	Frequency	Mean
36-79	30	53

Based on the average age of respondents with diabetes, is 53 years old.

Distribution of patients based on gender

Table 3. Distribution of Patients Based on Age and Gender

All Samples	Total Sample N (%)	Potassium Levels	
	30	< 3.5	3.5 - 5.5
Man	7 (23.33%)	-	7 (100%)
Woman	23 (76,66%)	3 (13.04%)	20 (86.95%)

Based on gender, the sample was dominated by women (76.66%) and the rest were men (23.33%). Of the total 23 female samples, most had normal. Potassium levels (86.95%), only three (13.04%) had low potassium levels (hypokalemia). Researchers used a random method to gather respondents from the productive age group, which includes individuals aged 15 to 64 years Based on the results of this study, it was found that there were no cases of hyperkalemia or high potassium levels among 30 respondents, while low potassium levels or hypokalemia occurred in a small percentage of respondents (10%) Overall, patients with below-normal potassium levels were aged fifty years and above (51, 56, and 57 years) According to Coregliano-Ring (2022), hypokalemia is often found in patients with diabetes mellitus, with a prevalence ranging from 10% to 12%, and is generally seen in individuals over 55 years old This prevalence is even higher in individuals with chronic kidney disease and increases with age (Coregliano-Ring et al., 2022). The use of diuretics is one of the main risk factors associated with hypokalemia; 10 to 50% of patients receiving this type of medication may experience hypokalemia Jiménez-Marrero et al., 2020). Other drugs that contribute to hypokalemia in individuals with diabetes are insulin, beta-2 agonists (through the activation of the sodium- potassium ATPase [Na+-K+-ATPase] pump), antiarrhythmic agents, glucocorticoids and mineralocorticoids, antibiotics (penicillin and aminoglycosides), antifungals (amphotericin B), and excessive use of laxatives (Coregliano-Ring et al., 2022). Hypokalemia can occur due to insufficient potassium intake in daily food, medication use, and insulin therapy In patients with diabetes mellitus, insulin administration causes glucose to enter cells, followed by potassium entry into cells, resulting in decreased potassium levels.

Except in cases of overdose or excessive insulin dosage, hypokalemia caused by insulin administration is usually temporary and rarely a clinical problem Hypokalemia in patients with hyperglycemic crisis is caused by elevated blood sugar levels exceeding the renal glucose threshold, leading to glucose being excreted in urine and resulting in massive osmotic diuresis, electrolyte loss, and dehydration Rachmawati, 2021). Patients with diabetes can experience hypokalemia due to

osmotic diuresis, acondition that causes increased potassium excretion through urine Potassium depletion can also occur if the patient's blood sugar levels rise, and it can become severe if the patient has several conditions that may affect blood sugar (Syamsudduha et al., 2018).

Three samples with low potassium levels: the first has a blood glucose level of 300 mg/dL, consumes sweets 1-3 times a day, engages in moderate physical activity, and has a family history of diabetes The second patient has a blood glucose level of 268 mg/dL, rarely consumes sweets, has light physical activity, and no family history of diabetes Lastly, the third patient with low potassium levels has a blood glucose level of 388 mg/dL, consumes sweets 1-3 times a day, engages in heavy physical activity, and has no family history of diabetes.

From a simple analysis of the three patients, the GDS levels are quite high, ranging from 286-388 mg/dL Therefore, elevated GDS levels may affect potassium levels Theoretically, hypokalemia occurs in patients experiencing hyperglycemic crisis, as blood sugar levels rise above the renal glucose threshold, leading to glucose being excreted in the urine and causing massive osmotic diuresis, resulting in electrolyte loss (Rachmawati, 2021).

Based on the physical activity of the three respondents with low potassium levels, some engage in moderate, light, and heavy activity Theoretically, prolonged and intense physical activity should also be avoided as it can trigger repeated potassium loss, thereby increasing the risk of hypokalemia (Adiwardhana & Wreksoatmodjo, 2023). Based on genetic factors, one of the three respondents has a genetic factor for diabetes, while the other two do not have any genetic factors Therefore, genetic inheritance does not have an impact, and there is a possibility of other factors causing low potassium levels.

The normal potassium levels in type 2 diabetes patients may be influenced by the absence of other underlying illnesses affecting potassium levels Patients also monitor their food intake and regularly control their blood sugar levels to prevent complications The amount of potassium in the body is a balance between intake and excretion, and dietary potassium intake depends on the quantity and type of food consumed. In patients with type 2 diabetes, controlling food intake and regularly monitoring blood sugar levels will maintain potassium function, which enhances insulin sensitivity This is beneficial because efficient blood sugar removal processes do not disrupt potassium levels in the bloodstream Normal potassium levels are observed in diabetes patients treated with insulin Although insulin can cause hypokalemia, it rarely becomes the sole cause This is because patients can control potassium intake through food to compensate for insulin-related potassium deficiencies, and kidney function remains effective in regulating potassium levels (Syamsudduha et al., 2018).

Because the patient's blood sugar levels are not controlled, potassium levels can decrease or increase if the patient has other conditions that may affect potassium levels in the blood Therefore, it is important to provide adequate food or fluid intake to balance potassium and to regular monitor blood sugar levels to keep potassium within normal levels The causes of hypokalemia in people with diabetes can vary, but the most common are increased ketone acid production, kidney dysfunction, and medication use It is important for people with diabetes to regularly monitor their blood potassium levels to prevent hypokalemia.

This research is in line with research conducted by Desyana Ningrum (2021) which stated that among 60 type 2 diabetes patients, half of type 2 diabetes patients had normal potassium levels (50%) and 19 (32%) had normal potassium levels. Lower levels Only 11 people (18%) had higher potassium levels (Ningrum & Apriani, 2021).

A similar study was conducted by Rasyid and Muawanah (2019), electrolyte parameters were carried out using sodium, potassium, and chloride because these three are the most common macro electrolytes and correlate with Diabetes Mellitus. Serum electrolyte levels (Na+, K+, Cl) for control are all within the normal range (Rasyid & Usman, 2019).

In addition, this study is similar to Nur Signa Aini (2018), Based on the findings, more than 50% of type 2 diabetics in Purwogado are women, with the largest age group being the age group 55-64 years (41%), the highest level of education is high school (40%), and most of the people with type 2 diabetes. The duration of suffering from diabetes is less than 5 years (49%), most have no family history of diabetes (61%), and most patients receive treatment regularly (87%) and take medication regularly (81%) (Gumilas et al., 2018).

CONCLUSION

Based on the results of the research and discussion that has been carried out, the following conclusions can be drawn: It is known that the frequency distribution of potassium levels in patients with type II DM in the working area of the Telaga Dewa Health Center. Most (90%) have normal potassium levels and a small number (10%) have low potassium levels (hypokalemia) and are not found in patients with levels above normal (hyperkalemia). It is known that the average age of patients with type II DM in the working area of the Telaga Dewa Health Center is related to the risk of hypokalemia and hyperkalemia, the average age of respondents who suffer from DM is 53 years. It is known that the frequency distribution of gender of people with type II diabetes in the working area of the Telaga Dewa Health Center is related to the risk of hypokalemia and hyperkalemia, the sample is mostly dominated by women (76.66%) and a small part of men (23.33%). Of the total 23 female

samples, most had normal potassium levels (86.95%), and only three (13.04%) had low potassium levels (hypokalemia).

Acknowledgements

We would like to thank all respondents who are willing to participate in this activity. Thank you also to the Telaga Dewa Health Center, Dr. Dr. M. Yunus Hospital Laboratory, and all colleagues who supported and assisted this process.

Declaration of Interest Statement

This research have no conflit with others.

REFERENCES

Adiwardhana, J., & Wreksoatmodjo, B. R. (2023). Efek Neurologis Hiperkalemia dan Hipokalemia. *Cermin Dunia Kedokteran*, *50*(10), 555–561. https://doi.org/10.55175/cdk.v50i10.1077 Coregliano-Ring, L., Goia-Nishide, K., & Rangel, É. B. (2022). Hypokalemia in Diabetes Mellitus Setting. *Medicina (Lithuania)*, *58*(3), 1–18. https://doi.org/10.3390/medicina58030431 Gumilas, N. S. A., Harini, I. M., Samodra, P., & Ernawati, D. A. (2018). Karakteristik Penderita Diabetes Melitus (Dm) Tipe 2 Di Purwokerto. *Jurnal Kesehatan*, *1*(2), 14–15.

Jiménez-Marrero, S., Cainzos-Achirica, M., Monterde, D., Garcia-Eroles, L., Enjuanes, C., Yun, S., Garay, A., Moliner, P., Alcoberro, L., Corbella, X., & Comin-Colet, J. (2020). Real- World Epidemiology of Potassium Derangements Among Chronic Cardiovascular, Metabolic and Renal Conditions: A Population-Based Analysis. *Clinical Epidemiology*, *12*, 941–952. https://doi.org/10.2147/CLEP.S253745

Latifah, N., Herdiansyah, D., & Nasyithoh, A. A. (2020). Edukasi Kesehatan Diabetes Mellitus Di Rw.004 Kelurahan Benda Baru Kota Tangerang Selatan. *AS-SYIFA : Jurnal Pengabdian Dan Pemberdayaan Kesehatan Masyarakat*, *1*(1), 23. https://doi.org/10.24853/assyifa.1.1.23-27

Ningrum, D., & Apriani, A. (2021). Gambaran Kadar Kalium Darah Pada Penderita Diabetes Mellitus Tipe 2 Di Rumah Sakit Rawa Lumbu Bekasi. *Journal of Safety and Health*, *1*(2), 36–40. http://ojs.ukb.ac.id/index.php/josh/article/view/37.9

Rachmawati, D. (2021). Manajemen Hipokalemia Pada Pasien Dengan KrisisHiperglikemia. *Journal of Borneo Holistic Health*, *4*(1), 73–84. https://doi.org/10.35334/borticalth.v4i1.1950

Rasyid, N. Q., & Usman, M. (2019). Study of Electrolyte Levels in Diabetic Patients. *Jurnal Akta Kimia Indonesia (Indonesia Chimica Acta)*, *12*(1), 1. https://doi.org/10.20956/ica.v12i1.5630

Sasmita, P. C., Yonata, A., & Larasati, T. A. (2021). Peran Diet Kalium sebagai Pencegahan Resistensi Insulin. *Medula*, *11*(4), 357–361.

Soebandi, J. K., Pada, K., Yang, P., Di, B., & Jantung, P. (2020). *Jurnal Kesehatan dr. Soebandi*.*8*(1).https://doi.org/10.36858/jkds.v8i1.169

Syamsudduha, A., Sembiring, S. V, & Pakasi, R. D. (2018). Perbandingan Antara Kadar Kalium Serum Dengan Atau Tanpa Terapi Insulin Pada Pasien Diabetes Mellitus Tipe 2. *Indonesian Journal of Clinical Pathology and Medical Laboratory*, *15*(3),95–97. https://doi.org/10.24293/ijcpml.v15i3.972

Tajuddin, H., Wahyudin, E., Djabir, Y. Y., Nainu, F., & Rahman, L. (2022). Insulin Therapy Increases the Risk of Hypokalemia and Arrhythmia in Diabetic Patients with Coronary Heart Disease: A Retrospective Study in Wahidin Sudirohusodo General Hospital. *Jurnal Farmasi Galenika (Galenika Journal of Pharmacy) (e- Journal)*,*8*(2),97–108.https://doi.org/10.22487/j24428744.2022.v8.i2.1 5930