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Can the Calculator Clinic Deter Hypoglycemia, Prevent Hypoglycemia in Hemodialysis Patients, and Reduce D40% Use?

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Abstract

Introduction
Hypoglycemia is a common complication in diabetic nephropathy (DN) patients undergoing hemodialysis. Early detection is essential to prevent adverse outcomes. A calculator-based clinical tool (cyclic hypoglycemia calculator) was developed to estimate hypoglycemia risk and guide additional glucose needs. This study aimed to analyze the effect of using the calculator on preventing hypoglycemia during hemodialysis.

Methods
A quasi-experimental pre–post test control group design was conducted among hemodialysis patients at Dr. Moewardi Hospital (March–July 2024). Samples were selected via simple random sampling: odd medical record numbers for the control group and even numbers for the intervention group. The intervention group received hypoglycemia-risk calculation and glucose adjustment recommendations, while the control group followed standard procedures. Blood glucose levels were measured before and after 4-hour hemodialysis using a standardized glucometer. Data were homogeneous (P=0.903) and non-normally distributed (P=0.00), so the Mann–Whitney test was applied.

Results
There was no significant difference in blood glucose levels between groups (P=0.811). Pre-dialysis glucose levels were similar (115.45 vs. 114.71 mg/dL), and post-dialysis levels remained comparable (99.39 vs. 98.21 mg/dL). In the control group, 33% experienced increased glucose, 3% remained unchanged, and 64% decreased, with an average reduction of 33.67 mg/dL. In the intervention group, 36% increased and 64% decreased, with an average reduction of 24.5 mg/dL.

Conclusions
The hypoglycemia-deterrent calculator did not produce significant differences in glucose levels compared with standard care. However, its use showed 75% efficiency in reducing unnecessary D40% administration. Further studies are recommended to refine D40% dosing strategies during hemodialysis based on individualized risk scoring.

Keywords: **calculator clinic deterred hypoglycemia, D40%, hemodialysis, hypoglycemia**

Introduction

Diabetes is the primary *Chronic Kidney Disease* (CKD) and accounts for 50% of cases disease end-stage kidney disease. (Hamza & Burton, 2023). Every year, the prevalence of diabetes is increasing, and so are the complications, micro and macrovascular, as well as the incidence of therapy for Hemodialysis in diabetic patients. Controlling optimal glycemic control can reduce the risk of CKD progression and mortality related to diabetes mellitus in patients who are experiencing failing kidneys. (Ling et al., 2022).

Diabetic Nephropathy (DN) is damage to the function of the kidneys secondary to diabetes. DN is a serious and dangerous complication of diabetes. Patients with DN who experienced failed kidney stage must be treated with therapy replacement kidneys, including hemodialysis. (Ravi Iyengar, Jennifer Franzese and Roma Gianchandani, 201).

Hypoglycemia is one of the most common complications in diabetic nephropathy patients who experience failing kidneys during hemodialysis (Zhang et al., 2023). Hypoglycemia in DN patients during hemodialysis occurs in 53.5%-80% (Bally et al., 2019;

Kazempour-Ardebili et al., 2009; Zhang et al., 2023). Report from Chu et al., (2017) State that 19.18% of patients experience at least one episode of hypoglycemia during 1 1-year period before starting dialysis. When hypoglycemia during hemodialysis occurs in patients with DN, not only influence the function of the kidney patients, but also improves the risk of cognitive disturbance, has a negative impact on the quality of hemodialysis, and increases the risk of death (Chu et al., 2017).

Report from Burmeister et al., (2015) State that the use of solution dialysis with free glucose or low in glucose causes a risk of hypoglycemia during dialysis in patients with diabetic kidneys. Meanwhile, the dialysis solution used at Dr Moewardi Regional Hospital in Central Java, namely acid bicarbonate, contains glucose. Report Tentori et al., (2013) The " acid " concentrate contains electrolytes, glucose, and 2–8 mEq /L acetate (metabolized as bicarbonate in the liver) to prevent sedimentation. Calcium has been metabolized during the hemodialysis process. Conditions: This potential cause can result in patients experiencing hypoglycemia while undergoing hemodialysis.

Very important for patients with DN to prevent hypoglycemia during hemodialysis. Need an effective method to detect and diagnose hypoglycemia during dialysis. (Elsayed et al., 2023). The moment this research about hypoglycemia during hemodialysis in DN patients has a big focus on the effects of medical or nursing interventions. (Alsahli M & Gerich JE, 2017)Temporary, there is little focus on predicting the risk of hypoglycemia during hemodialysis. Identification of early risk hypoglycemia during hemodialysis in DN patients and assessment of risk hypoglycemia in patients are very important for the prevention of proper hypoglycemia and effective management. (Maekawa et al., 2017).

One of the efforts made to prevent hypoglycemia during hemodialysis is the use of a risk calculator for hypoglycemia. Report Zhang et al., (2023) Show the prediction model risks in research. This has good prediction results. Calculations of automatic prediction for hypoglycemia developed using this model can be used to predict the risk of hypoglycemia in DN patients during hemodialysis and also help identify those who have risky hypoglycemia during hemodialysis.

A preliminary study was conducted from 1-31 March 2024, on 349 observed patients. Of the 171 patients were found to have experienced hypoglycemia symptoms, and an action was taken. D40% administration condition. There needs to be risk screening improvements for hypoglycemia, so that the incidence of hypoglycemia during Hemodialysis Can be prevented. Application calculator clinic deterrent hypoglycemia (cyclic hypoglycemia) for overcoming hypoglycemia during hemodialysis, potentially can finish the problem, efforts to prevent hypoglycemia during a patient undergoing therapy for Hemodialysis. No, a nurse recommends that the patient eat during the hemodialysis process. It will, but some permanent patients experience hypoglycemia. The patient will be given D40% therapy when the patient experiences symptoms of hypoglycemia. Application Calculator Clinic Preventive Hypoglycemia (Sikal Hypoglycemia) can potentially predict the risk of hypoglycemia so that preventive action can be taken before Hemodialysis.

Methods

A quantitative *quasi-experiment* is something experimental research intervention to a group subject with or without group comparator but no randomization in election sample. The population affordable in the study. This is all patients on hemodialysis at Dr Moewardi Surakarta Regional Hospital, period March 2024, namely 349 people. However, researchers' own limitations limit the time they have to study, so they can not use the entire sample. The population that can be covered is 40 people. Determination sample based on the Slovin formula.

The sample size for the group control was 33 people, and the sample size for the group treatment was 28. Samples use a simple random *sampling* technique: patients with odd medical numbers become the group control, whereas patients with even medical numbers become the group treatment. At the time of implementation research, samples obtained in the group control did not meet the calculation target, namely, 33 people in the group treatment. Rationale: fewer than five people became respondents in the group intervention. These respondents cannot finish their time on hemodialysis due to a decline or worsening condition, so they are removed from the list of respondents.

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Place study, namely in the space of Hemodialysis at Dr. Moewardi Regional Hospital, Province of Central Java. Research was done for 3 months from May to July 2024. Research will be done every day by selecting samples randomly for 3 months. Study This use tool Therumo brand glucometer Medicare with glucosetics with the same brand For measuring the glucose level in patients' blood. The application calculator clinic will deter hypoglycemia by operating on an Android cellphone. Calculation of automatic clinical hypoglycemia during risk hemodialysis in patients with diabetic nephropathy has validity and reliability tests, and its effectiveness is evaluated by Zhang et al., (2023). The following is an indicator evaluation of the risk of hypoglycemia in patients undergoing hemodialysis :

Predictor	Indicator	Score
Duration Hemodialysis	1-4 years	0
	5-7 years	0
	8-21 years	6
Have Hypotension during the final of hemodialysis	Yes	3
	No	0
Have hyperglycemia at night before hemodialysis	Yes	2
	No	0
Blood potassium	< 3.5 mmol/L or > 5.5 mmol/L	2
	3.5 mmol/L - 5.5 mmol/L	0
Albumin	< 35 g/L	5
	>35 g/L	0

Table 1. Risk instruments for hypoglycemia in patients on hemodialysis

Conclusion:

1. Risk Very tall grades 14-18
2. Risk 10-13
3. Risk Medium 6-9
4. Risk Low 0-5

Incident hypoglycemia during hemodialysis is high in DN patients. Prediction model risks in research. This has resulted in good predictions. Calculation of automatic prediction of hypoglycemia developed using this model can be used to predict the risk of hypoglycemia in DN patients during hemodialysis, and also helps identify those at risk of experiencing hypoglycemia during hemodialysis. Calculation of automatic patient hemodialysis with DN built based on logistic regression and has good predictive performance. In calculation automatically, total scores 14-18, 10-13, 6-9, and 0-5, respectively, relate to severe risk of hypoglycemia during hemodialysis, high, medium, and low during hemodialysis (Zhang et al., 2023).

Application This developed from the study Zhang et al. (2023), where indicator calculation and score are in the form of duration of hemodialysis, history of hypotension, history of hyperglycemia, potassium levels, and blood albumin. Application This consists of 2 main data sets containing demographic data records of patients in the form of age, type, gender, and diagnosis of medical patients.

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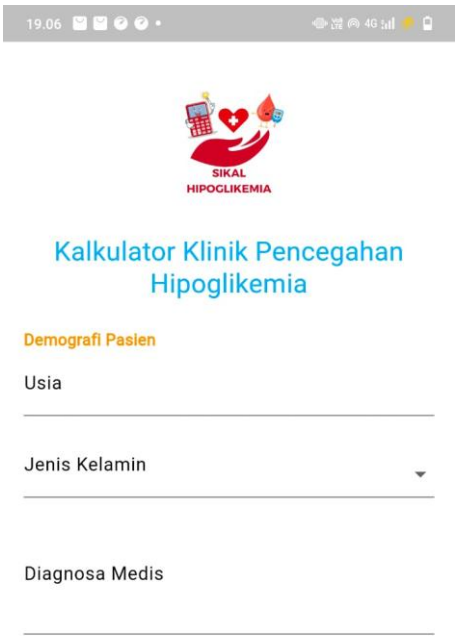

Figure 1. Demographic Data Calculator Clinic Preventive Hypoglycemia

Respondents will be recorded, moreover, in accordance with Figure 2.1 on demographic data calculator clinic deterrent hypoglycemia about age , type, gender, and medical conditions experienced by patients. This data will become a data based characteristic analysis patient and beneficial as a triggering factor occurrence hypoglycemia when done Hemodialysis .

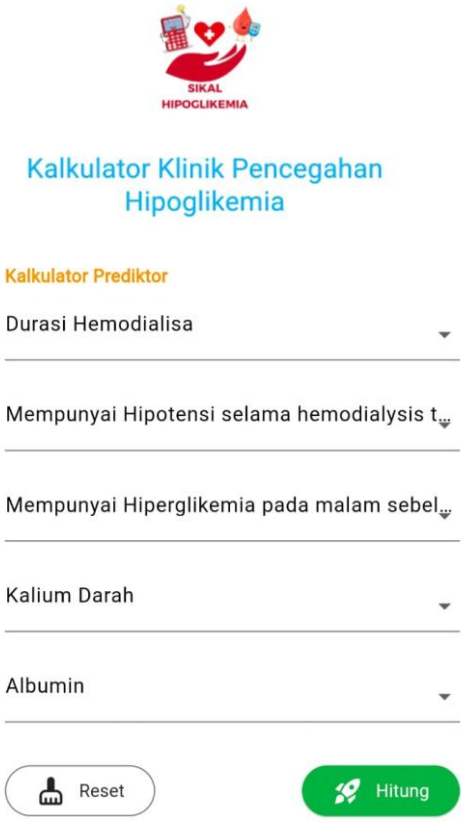

Figure 2. Predictor Calculator Clinic Preventive Hypoglycemia

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In Figure 2, about the predictor calculator clinic deterrent hypoglycemia, respondents will input data in the form of duration of Hemodialysis, history of hypotension, history of hyperglycemia before HD, blood potassium, and albumin levels. The scoring technique is in Table 1, Risk Instrument for Hypoglycemia in patients Hemodialysis

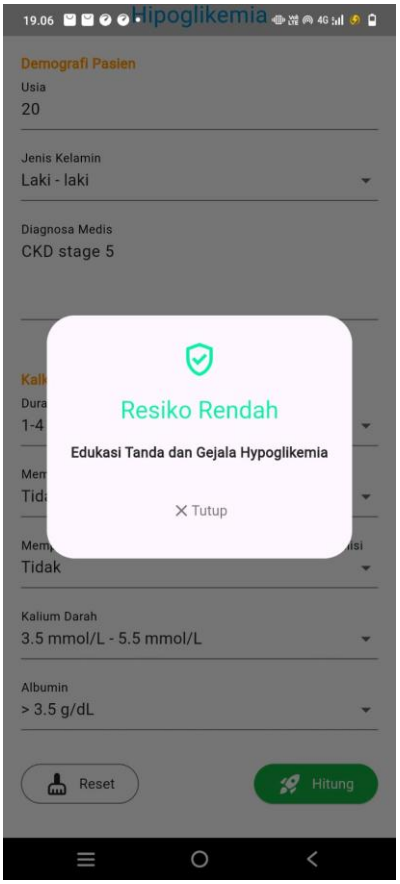

Figure 3. Conclusions and Recommendations Calculator Clinic Preventive Hypoglycemia

After it is done calculation so will appear results in accordance with the value that has been input previously like depicted in Figure 3 Conclusions and Recommendations Calculator Clinic Preventive Hypoglycemia.

From the test of 10 respondents the data obtained from 7 respondents Already undergo hemodialysis 1 – 4 years , 1 respondent 5 – 7 years and 2 respondents 8 – 21 years . No There is respondents who experienced hypotension , no There is respondents who experienced hyperglycemia at night day . There were 2 respondents with potassium value < 3.5 – 5.5 > and 8 respondents with potassium value 3.5 – 5.5. For albumin value < 3.5 there were 5 people and value > 3.5 there were 5 respondents . At the time application Sikal used scores obtained score 0b as many as 3 respondents , score 2 as many as 4 respondents , score 6 as many as 1 respondent , score 8 as many as 1 respondent and score 10 as many as 10 respondents . Only respondents with a score of 10 get an additional D40% 25 ml during post-procedure hemodialysis because their blood sugar level declines to less <50 mg/dl. These data prove the suitability of the application Sikal Hypoglycemia in overcoming the possibility of hypoglycemia during ongoing hemodialysis.

Data analysis for test difference level glucose post- intervention blood in the group control and group intervention use *Unpaired T-Test* or Unpaired T-Test Paired If normal distribution and homogeneous data , if the data is not normal then using the Mann-Whitney test. This test is used to determine the difference in glucose blood levels between the control group and the treatment group. Data normality test using Shapiro Wilk, data homogeneity test using Levene's test.

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Result

Research results started with the presentation of characteristic data respondents covering age, occupation, duration of hemodialysis, and history of disease, like depicted in Table 2: Characteristics respondents :

Table 2 Characteristics Respondents

Variables	Group Control	Group Treatment
Age in year		
- **Mean**	52.91	48.29
- **Min**	8	24
- **Max**	72	75
Work		
- **Workers , Farmers**	5	2
- **housewife**	7	7
- **Private**	7	11
- **Self-employed**	9	3
- **Civil**	3	3
Servants/Indonesian	2	1
National Armed	0	1
Forces		
- **Students**		
- **No Work**		
Hemodialysis Duration		
- **1-4 years**	26	19
- **5-7 years**	4	5
- **8-21 years**	3	4
History Disease		
- **DM + Hypertension**	11	5
- **Hypertension**	19	22
- **Cyst**	1	1
- **Rock kidney**	1	0
- **DM**	1	0
Blood Potassium		
- **< 3.5 or > 5.5**	12	7
- **3.5-5.5**	21	21
Albumin		
- **< 3.5**	9	8
- **> 3.5**	24	20

Table 2. Characteristics Respondents

Research results show that the average age in the group control and group treatment is no different Far, where the group average age control respondents were 52.91 years old, and the group control respondents were 48.29 years old. The age of the patient was lowest in the group control, namely 8 years, and the highest was 72 years, while in the group treatment, the lowest was 24 years, and the highest was 75 years.

The job variable in both groups is dominated by the private sector, with Mrs. House household and self-employed as the highest respondents. Some big respondents in the 2 groups have undergone hemodialysis for 1-3 years, followed by having undergone hemodialysis for 4-5 years in sequence 2. Hypertension has become the most history disease, followed by diabetes mellitus with complications of hypertension.

Part large potassium levels in patients in the group control and intervention own potassium levels 3.5-5.5 (normal), and also respondents second group part big own albumin levels > 3.5. Research results show that before the intervention, the average blood glucose control rate in the group treatment was relatively the same, that is, 115.45 VS 114.71 mg/dl. On examination, the average intervention rate of blood glucose in the control group and the treatment group was relatively the same, namely 99.39 VS 98.21 mg/dl. In general general characteristics level glucose blood type control and treatment The same Where minimum value of 70 mg/dl in the group control VS 68 mg/dl in the group treatment before intervention and a maximum of 236 in the group control VS 304 in the group treatment.

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Administration of D40	Group Control (N=33)	Group Treatment (N=28)
Pre HD	36	7
2nd hour	12	3
3rd hour	0	1
Post HD	32	9
Total	80	20

Table 3. Total Administration of D40%

Interesting thing from the study: This is the efficient use of D40, where the group treatment only used 20 D40 flashes, while the group control spent 80 D40 flashes. Regarding Table 3 Examination Results, Glucose Blood Patient shows that glucose blood type control and group treatment are relatively the same before the average intervention rate, namely 115.45 VS 114.71 mg/dl. On examination, the average intervention rate of blood glucose type control and group treatment were relatively the same namely 99.39 VS 98.21 mg/dl. Difference test results comparison between group control and treatment shows P 0.811. It can be concluded that there is a different level of blood glucose between the control group and the treatment group.

Discussion

Research results show that before the intervention, the average blood glucose control rate in the group treatment was relatively the same, namely 115.45 VS 114.71 mg/dl. On examination, the average intervention rate glucose blood type control and group treatment were relatively the same, namely 99.39 VS 98.21 mg/dl. In general general characteristics level glucose blood type control and treatment The same Where minimum value of 70 mg/dl in the group control VS 68 mg/dl in the group treatment before intervention and a maximum of 236 in the group control VS 304 in the group treatment.

Research results after action hemodialysis show that the group control, 11 respondents (33%), had a rise in blood glucose, 1 respondent (3%) remained the same, and 21 respondents (64%) had a decrease in blood glucose post hemodialysis . The average decrease in the level of blood glucose in the patient group was 33.67 mg/dl. In the control group treatment level glucose blood pressure increased in 10 respondents (36%), and decreased in 18 respondents (64%). The average decrease in the level of blood glucose in the patient group treated 24.5 mg/dl.

Interesting thing from the study: This is the efficient use of D40, where the group treatment only used 20 D40 flashes, while the group control spent 80 D40 flashes. If referring to Table 3 Examination Results, Glucose Blood Patient shows that before the average intervention rate glucose blood type control and group treatment relatively the same, namely 115.45 VS 114.71 mg/dl. On examination after done average intervention rate glucose blood type control and group treatment relatively the same , namely 99.39 VS 98.21 mg/dl.

Risk Score VS D40 Administration VS Glucose Level Blood

Risk score assessment results for hypoglycemia in the control group show that 24 respondents (73%) were at risk of low risk, and 8 respondents (24%) were at moderate risk. In the group treatment 21 respondents (75%) were found to be at risk low , and 6 respondents (21%) were at risk moderate . It should be patients at risk low-medium No get D40, where only done education sign hypoglycemia at risk low , and observation of patients with risk moderate . However the way study data obtained in the group control given 36 pre HD D40 flashes and 32 post HD D40 flashes . If compared to with group treatment Where only 7 pre HD D40 flashes and 9 post HD D40 flashes, then can concluded that group treatment with count risk can give **efficiency D40 usage is 75%.**

If seen from amount decline level glucose blood after done action hemodialysis show the group control 11 respondents (33%) glucose blood glucose rose, 1 respondent (3%) remained the same and 21 respondents (64%) glucose his blood post hemodialysis with an average of 33.67 mg/dl. In the group treatment level glucose Blood pressure increased in 10 respondents (36%), and decreased in 18 respondents (64%), with an average decrease of 24.5 mg/dl.

Research result This in line with report that decline level glucose blood in DN patients during hemodialysis occurred 53.5%-80% (Bally et al., 2019; Kazempour-Ardebili et al., 2009; Zhang et al., 2023). The decline level glucose blood is one of the complications most

common in diabetic nephropathy patients who experience fail kidney during hemodialysis (Zhang et al., 2023). Part big patient experience decline level glucose blood caused by Because when Hemodialysis (HD) induces several physiological changes that can affect plasma glucose levels in diabetic patients and in turn reduce level glucose they (Bomholt et al., 2023). The low hemoglobin levels in patients allegedly potential lower HbA1c binding in patients , so that cause hypoglycemia during Hemodialysis (Kazempour-Ardebili et al., 2009).

Effect Test Application Calculator Clinic Preventive Hypoglycemia (Sical Hypoglycemia) For Overcome Hypoglycemia During Hemodialysis

Difference test results comparison between the group control and treatment shows P 0.811. It can be concluded that there is a different level of blood glucose between the control group and group treatment . These results obtained Because There are a number of factors affecting the speed response body in produce insulin, nutrition , QB, QD, and UFG, which are not the same.

Conclusion

Research results show that before the intervention, the average blood glucose control rate in the group treatment was relatively the same, namely 115.45 VS 114.71 mg/dl. On examination after done average intervention rate of blood glucose type control and group treatment relatively the same , namely 99.39 VS 98.21 mg/dl. In general, the characteristics level glucose blood type control and treatment. The same, where the minimum value of 70 mg/dl in the group control VS 68 mg/dl in the group treatment before intervention, and a maximum of 236 mg/dl in the group control VS 304 mg/dl in the group treatment. Research results after action hemodialysis show that the group control 11 respondents (33%) had a rise in blood glucose, one respondent (3%) remained the same, and 21 respondents (64%) had a decrease in blood glucose post hemodialysis The average decrease in the level of blood glucose in the patient group was 33.67 mg/dl. In the control group, the treatment level glucose blood pressure increased in 10 respondents (36%), and decreased in 18 respondents (64%). The average decrease in the level of blood glucose in the patient group treated 24.5 mg/dl. Different test results comparison between the group control and treatment shows P 0.811. It can be concluded that there is a different level of blood glucose between the control group and the treatment group. Counting the risk of hypoglycemia, Sikal Hypoglycemia can give an efficiency D40% usage is 75%.

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