
Factors Influencing the Incidence of Hypoglycemia in Diabetic Hemodialysis Patients

Hongyan Peng^{*}, Rui Cao, Yaping Huang, Chazhen Li

Hemodialysis Center, The First Affiliated Hospital of Jinan University, Guangzhou, China

Email address:

Penhongyan01@163.com (Hongyan Peng)

*Corresponding author

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Abstract: Objective: To explore factors influencing the incidence of hypoglycemia in diabetic hemodialysis patients. Methods: we recorded the valid data from 557 patient from May 2017 to February 2021. This study consists of 3 steps, including collecting step, screening step and analysis step. In collecting step, our mainly task was collecting the data from the eligible patients. In screening step, we assigned patients to hypoglycemia and non-hypoglycemia based on whether they had a hypoglycemic event or not. Also, we will exclude ineligible patient data at this stage. In analysis step, we use software to analyze the data, and analyze related factors by multivariate Logistic regression analysis. Result: Compared with non- hypoglycemia group, we found that four factor of hypoglycemia group affect hypoglycemia event, they were significantly difference, including albumin, BMI, age, and hs-CRP ($p < 0.05$). Other factors were no significantly difference between hypoglycemia group and non- hypoglycemia group. In further analysis, the result displays that albumin, BMI, age, and hs-CRP were independent risk factors for hypoglycemia event ($p < 0.05$). Conclusion: albumin, BMI, age, and hs-CRP were impact factors of hypoglycemia in diabetic hemodialysis patients. Furthermore, the independent risk factors of hypoglycemia event included albumin, BMI, age, and hs-CRP. Of those, albumin and BMI can be control or affected by drugs or patient behaviors.

Keywords: Hypoglycemia, Diabetes, Hemodialysis

1. Introduction

The most common complication of Diabetes Mellitus (DM) be considered as hypoglycemia, and its most common cause is the use of anti-DM agents [1, 2]. Hypoglycemia had different standard in different, such as blood glucose level of lower than 70 mg/dl in American and blood glucose level of lower than 60 mg/dl in European [3]. Base on the report, approximately 30% of type 1 diabetes mellitus (T1DM) patients had hypoglycemia complication [4]. In hypoglycemia cases, hypoglycemia event was associated with subsequent adverse cardiac outcomes and mortality of patients [5, 6]. Thus, there is an urgency to identify the factors which can affect hypoglycemia in diabetic patients, which could indicate whether measures should be taken to avoid hypoglycemia in treatment.

According to some reports, poor glyceic control was associated with higher mortality in DM patients on hemodialysis (HD) [7-9]. In addition, the patients undergoing

diabetic hemodialysis had high risk of hypoglycemia in hemodialysis process [10, 11]. The hemodialysis also is associated with an increased risk of mortality [12]. Therefore, these patients should control their glyceic index, and avoid hypoglycemia event.

In present study, we hypothesized that some patient characteristics or some index of blood correlate with incidence of hypoglycemia in patient with diabetic hemodialysis during dialysis. Base on above hypothesis, we designed a retrospective study to explore the factors which can influencing the incidence of hypoglycemia in diabetic hemodialysis patients during dialysis by comparison of incidence of hypoglycemia in different factor groups. The aim of this study was to explore the factors which can influencing the incidence of hypoglycemia in diabetic hemodialysis patients.

2. Methods

2.1. Source of Data and Outcome

To assess the Factors which can affect the incidence of hypoglycemia in diabetic hemodialysis patients, we collected related factors from 600 patients with diabetic hemodialysis, but we lack necessary information of 43 patients, so we only recorded the valid data from 557 patient from May 2017 to February 2021. This study consists of 3 steps, including collecting step, screening step and analysis step. In collecting step, our mainly task was collecting the data from the eligible patients. The inclusion criteria included: (1) The patients were diagnosed as diabetes mellitus; (2) The patients undergoing hemodialysis; (3) Their ages were ≥ 14 years old; (4) The information in their medical records is complete. In screening step, we assigned patients to hypoglycemia and non-hypoglycemia based on whether they had a hypoglycemic event or not. Hypoglycemia was defined as a blood glucose level of 3.9mmol/L or less. Also, we will exclude ineligible patient data at this stage. The exclusion criteria included: (1) The patient loses contact or dies; (2) The patient had severe comorbidities during treatment; (3) The patient's lack of necessary information stems from the error of the investigator or patients. In analysis step, we use software to analyze the data, and analyze related factors by multivariate Logistic regression analysis.

The ethics committee of the Guangdong approved this study and waived the need for informed consent given the anonymity of the data. The study was performed in accordance with the

ethical principles of the Declaration of Helsinki.

2.2. Data Analyses

Patient demographics and characteristics are presented as numbers and percentages. We use t test or X^2 test to assess the relationship between factors and hypoglycemia event, that the t test evaluated continuous variables, and X^2 test evaluated categorical variables. Also, the statistical significance was observed at level of 0.05.

3. Result

To assess the risk factors of hypoglycemia in diabetic hemodialysis patients, we established a cross-sectional survey for incidence of hypoglycemia. We collected the valid data from 557 patients with diabetic hemodialysis, that the valid data included gender, age, induced hemodialysis status, hemodialysis mode, duration of diabetes mellitus, systolic blood pressure, triglyceride, total cholesterol, hemoglobin, serum creatinine, albumin, Body Mass Index (BMI), Hypersensitive C-reactive protein (hs-CRP). Compared with non- hypoglycemia group, we found that four factor of hypoglycemia group affect hypoglycemia event, they were significantly difference, including albumin, BMI, age, and hs-CRP ($p < 0.05$). Other factors were no significantly difference between hypoglycemia group and non-hypoglycemia group. Therefore, we assessed the possible relationship between hypoglycemia event and these factors, as shown in Table 1 and Table 2.

Table 1. Comparison of common data in diabetic hemodialysis patients between hypoglycemia group and non- hypoglycemia group (X^2 test) [n (%)].

Item	hypoglycemia group (n = 97)	non- hypoglycemia group (n = 460)	X^2	P value
Gender			1.632	0.442
Female	66 (68.0%)	321 (69.8%)		
Male	31 (32.0%)	159 (30.2%)		
induced hemodialysis status			3.694	0.169
Yes	54 (55.7%)	277 (60.2%)		
No	43 (44.3%)	183 (39.8%)		
hemodialysis mode			3.920	0.150
high flux	64 (66.0%)	318 (69.1%)		
Low flux	33 (34.0%)	142 (30.9%)		

Table 2. Comparison of common data in diabetic hemodialysis patients between hypoglycemia group and non- hypoglycemia group (T test) (Mean \pm SD).

Item	hypoglycemia group (n = 97)	non- hypoglycemia group (n = 460)	t	P value
Duration of diabetes mellitus (year)	6.84 \pm 3.96	6.77 \pm 4.13	0.254	> 0.05
systolic blood pressure (mm Hg)	151.64 \pm 11.75	153.44 \pm 10.98	0.581	> 0.05
Triglyceride (mmol/L)	1.31 \pm 0.74	1.44 \pm 0.83	0.431	> 0.05
total cholesterol (mmol/L)	6.45 \pm 2.77	6.81 \pm 3.03	0.167	> 0.05
Hemoglobin (mmol/L)	90.70 \pm 17.62	84.55 \pm 16.90	0.218	> 0.05
serum creatinine (μ mol/L)	580.2 \pm 204.7	643.5 \pm 241.2	0.586	> 0.05
Albumin (g/L)	37.72 \pm 5.41	30.2 \pm 5.84	14.718	< 0.005
BMI	19.21 \pm 3.77	21.41 \pm 2.72	4.317	0.016
hs-CRP (mg/L)	5.66 \pm 3.19	8.91 \pm 4.18	7.413	< 0.005
Age (year)	70.69 \pm 10.82	62.14 \pm 11.14	5.327	0.007

hs-CRP = Hypersensitive C-reactive protein

After comparing with common data, we attempt to analyze the data which were significantly difference between the two groups by multivariate Logistic regression analysis. Table 3 displays that albumin, BMI, age, and

hs-CRP were independent risk factors for hypoglycemia event ($p < 0.05$). Therefore, medical staffs should pay more attention to the patients who had these factors in hemodialysis treatment.

Table 3. Multivariate Logistic regression analysis of hypoglycemia in diabetic hemodialysis patients.

	Regression coefficient	Standard error	X ²	P value	OR value	95% CI for OR values
Albumin (increase)	1.403	0.673	4.334	0.037	4.037	1.090~15.347
Age (increase)	0.072	0.036	4.227	0.040	1.079	1.000~1.160
hs-CRP (reduce)	1.388	0.594	5.455	0.020	4.001	1.258~12.784
BMI (increase)	-0.253	0.100	6.342	0.012	0.776	0.643~0.950

4. Discussion

In this study, we demonstrated that albumin, BMI, age, and hs-CRP were impact factors of hypoglycemia in diabetic hemodialysis patients. To assess the impact factors for hypoglycemia event in diabetic hemodialysis patients, we performed a cross section study, that we collected the valid data from medical records of hospital, and we analyzed every factor of patient by software. We show incidence of hypoglycemia were associated with albumin, BMI, age, and hs-CRP in hemodialysis treatment.

As shown in Table 1 and Table 2, we found that some factors can affect the hypoglycemia event in diabetic hemodialysis patients, such as albumin, BMI, age, and hs-CRP. Therefore, we have identified the impact factors of incidence of hypoglycemia, and further analyze the impact of these factors based on these impact factors. As shown in Table 3, the independent risk factors of hypoglycemia event included albumin, BMI, age, and hs-CRP. Of those, albumin and BMI can be control or affected by drugs or patient behaviors. In possible reasons why these factors can affect hypoglycemia event, people with a low BMI are more likely to have low blood sugar due to poor nutrition, regardless of disease. Also, older people have worse metabolic systems than younger people so that older people had higher incidence of hypoglycemia. The patients with high hs-CRP index had systemic inflammation so that it can affect hypoglycemia event. Low albumin can lead patient to malnutrition so that patients undergoing hypoglycemia.

Several studies in related fields clearly demonstrated that people with lower BMI had higher risk of hypoglycemia as they have not enough nutrition, and they have low blood sugar levels [13, 14]. Likewise, albumin also can improve hypoglycemia event, so patients can control their blood sugar by changing their diet and increasing the amount of food they eat [15, 16].

Therefore, nurses should provide prevention for patients with low BMI, high hs-CRP, high age, and low albumin. Nurses also can reduce incidence of hypoglycemia by control BMI, albumin and hs-CRP.

In limitation, our subject were diabetic hemodialysis patients, so it is not known whether our results are application to the patients with other diseases or other treatment. Also, we did not analyze patient's diet structure, the result of this study may have been due to chance by different diet structure of patients.

5. Conclusion

In conclusion, albumin, BMI, age, and hs-CRP were impact

factors of hypoglycemia in diabetic hemodialysis patients. Furthermore, the independent risk factors of hypoglycemia event included albumin, BMI, age, and hs-CRP. Of those, albumin and BMI can be control or affected by drugs or patient behaviors.

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