The Current Status of Blood Glucose Level in Patients with Hypertension Complicated with Diabetes Mellitus

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Abstract: Background: Hypertension, characterized by elevated systemic arterial blood pressure, can cause various complications. Type 2 diabetes mellitus (hereinafter referred to as diabetes) is the most common complication in patients with hypertension, and hypertension complicated with diabetes can increase the risk of cardiovascular disease. It is pointed out that the prevalence of hypertension complicated with diabetes in China is 24.3%~ 38.4%. Objective: To analyze the blood glucose level and its related influencing factors in patients with hypertension complicated with diabetes mellitus. Methods: A retrospective survey using self-designed questionnaires was carried out in patients diagnosed with hypertension plus diabetes mellitus hospitalized in the Department of Cardiology of a Grade III Level A hospital in Guangzhou from October 2015 to March 2016. The binary Logistic regression was used to analyze the influencing factors for blood glucose level. Results: A total of 437 patients with hypertension plus diabetes mellitus were included in the study. The standard-reaching rate of blood glucose was 24.3% which was of significant difference between different diabetic durations (P=0.007). The binary Logistic regression analysis showed that the duration of diabetes (OR: 1.094; 95% CI: 1.036, 1.155) was the independent risk factor for the standard-reaching rate of blood glucose. Conclusions: The standard-reaching rate of blood glucose in patients with hypertension complicated with diabetes mellitus was relatively low and the duration of diabetes was an important risk factor for standard-reaching rate of blood glucose.

Keywords: Hypertension, Diabetes Mellitus, Blood Glucose, Standard-Reaching Rate, Risk Factors

1. Introduction

Hypertension, a primary risk factor for cardiovascular and cerebrovascular diseases and also a major risk factor for chronic kidney disease, heart and kidney failure, disability and even death, is one of the most common chronic disease which has a serious impact on physical and mental health and survival quality. There are studies showing that the prevalence of hypertension among general population is 18.8% [1, 2], which suggests that there are about 200,000,000 hypertensive patients in China. Hypertension, characterized by elevated systemic arterial blood pressure, can cause various complications. It is a major risk factor for cardiovascular and microvascular complications and often results from nephropathy in type 1 diabetes. Hypertension may be present as part of metabolic syndrome (i.e., obesity, hyperglycemia, and dyslipidemia), which contributes to high rates of cardiovascular disease in type 2 diabetics. Type 2 diabetes mellitus (hereinafter referred to as diabetes) is the most common complication in patients with hypertension, and hypertension complicated with diabetes can increase the risk of cardiovascular disease.

Hypertension and type 2 diabetes are common comorbidities. Moreover, patients with hypertension often exhibit insulin resistance and are at greater risk of diabetes developing than are normotensive individuals. The major cause of morbidity and mortality in diabetes is cardiovascular disease, which is exacerbated by hypertension. It is pointed out that the prevalence of hypertension complicated with

diabetes in China is 24.3% ~ 38.4% [2-5]. This article examined the data and clinical index of 437 hypertensive diabetic patients and analyzed the risk factors for standard-reaching rate of blood glucose so as to provide a scientific basis for primary health care for patients with hypertension and diabetes mellitus.

2. Materials and Methods

2.1. Participants

A retrospective study was conducted on the 437 patients (219 males and 218 females with average age of 67.42±10.89) diagnosed with hypertension complicated with diabetes hospitalized in the Department of Cardiology of a Grade III Level A hospital in Guangzhou from October 2015 to March 2016. The diagnosis of diabetes and hypertension was based on the 1999 recommended standards by WHO. According to the definition in the China Guideline for Diabetes Prevention and Treatment, standard blood glucose level means fasting blood glucose ≥ 3.9mmol / L and ≤ 7.2mmol / L, non-fasting blood glucose ≤ 10.0mmol / L and HbA1c <7.0%, and if any one of these three conditions is failed to meet, the blood glucose level is nonstandard [6].

2.2. Methods

The hospitalized patients' demographic data (such as age, sex, nationality, marital status, education background, etc.), medical history (hypertensive and diabetic duration, medication, family history, concomitant disease, etc.), lifestyle (smoking and alcohol consumption), data of physical examination (height and weight) and laboratory indexes (FPG,

2hPG, HbA1c, TG, TC, LDL-C, HDL-C, creatinine, uric acid and proteinuria, etc.) were retrospectively researched and analyzed with the self-designed questionnaires by two trained researchers. The participants all fasted for over 8 hours and the fasting venous blood was obtained the next morning to monitor the laboratory indexes such as fasting blood glucose, TG CHOHDLLDL and so on.

2.3. Statistical Methods

All data was entered into the statistical software SPSS13.0 for analysis. The quantified data was demonstrated in the form of Mean ± SD and the qualified data was shown with constituent ratio (%). The independent sample T test and 2 test were employed for the comparison of quantified data and qualified data respectively and binary Logistic regression was adopted to analyze the risk factors.

3. Results

3.1. General Clinical Characteristics

Among 437 patients with hypertension complicated with diabetes, the diabetic duration, FPG, 2hPG, HbA1c, TG in patients of standard blood glucose level (standard group) are lower than those in patients of nonstandard blood glucose level (nonstandard group) ($P<0.05$) while the HDL-C in the standard group is higher than that in the nonstandard group ($P<0.05$). There is no significant difference in the age, sex, BMI, DBP, SBP, TC, LDL, creatinine, uric acid, family history of diabetes, smoking and alcohol consumption ($P>0.05$) between two groups. (Table 1).

Table 1. Comparison of General Data and Clinical Characteristics between Two Groups [x±s, n (%)].

	Standard group	Nonstandard group	t/χ^2	P
Age	67.14±11.75	66.94±10.28	0.235	0.948
Sex (male/female)	55/51	88/91	0.176	0.675
BMI (kg/m^2)	24.97±3.14	25.20±3.96	0.115	0.503
Duration of diabetes (year)	2.93±4.48	5.46±7.28	-4.566	0.000
SBP (mm/Hg)	143.09±22.87	147.85±23.84	0.592	0.619
DBP (mm/Hg)	80.57±15.43	80.90±16.15	0.959	0.486
FPG (mmol/L)	5.85±0.71	8.16±3.03	0.000	0.000
2hPG (mmol/L)	8.03±1.20	12.97±4.62	0.000	0.000
HbA1c	6.01±0.44	7.39±1.50	0.000	0.000
TC (mmol/L)	4.49±1.10	4.62±1.19	0.910	0.756
TG (mmol/L)	1.50±1.02	1.91±1.31	0.024	0.012
LDL (mmol/L)	2.64±0.90	2.70±0.91	0.313	0.568
HDL (mmol/L)	1.14±0.28	1.05±0.26	0.350	0.007
Creatinine (μmol/L)	79.31±26.05	85.08±43.66	0.014	0.056
Uric acid (μmol/L)	395.18±105.04	400.72±121.36	0.044	0.349
Family history (yes/no)	2/104	14/316	1.259	0.262
Smoking (yes/no)	17/89	52/279	0.006	0.936
Drinking (yes/no)	9/97	17/314	1.615	0.204

3.2. Comparison of Standard-Reaching Rates

Among all the included participants, the blood glucose concentration of 106 patients reaches the standard. So the standard-reaching rate is 24.3%. And of the 106 patients of standard blood glucose level, the standard-reaching rates in

the age between 35-49, 50-64 and ≥ 65 are 34.5%, 20.6%, 25.2% respectively. The standard-reaching rates of blood sugar in males and females are 25.2% and 23.4% respectively. There is no significant difference in the standard-reaching rate between different ages and sexes (p=0.245, and p=0.655 respectively). However, the standard-reaching rate of blood

glucose decreases as the duration of diabetes increases. When the diabetic duration is ≤ 1 year, > 1 year & ≤ 5 years，> 5 years & ≤ 10 years, > 10 years & ≤ 15 years and > 15 years, the standard-reaching rates are 31.2%, 22.3%, 19.4%, 9.1% and 6.1% respectively with significant difference between different duration subgroups (p=0.007) (Table 2).

Table 2. Comparison of Standard-reaching Rates between Subgroups.

	Standard-reaching rate	p
Age		0.245
35-49	34.5%	
50-64	20.6%	
≥65	25.2%	
sex		0.655
male	25.2%	
female	23.4%	
Duration of diabetes (year)		0.007
≤1	31.2%	

	Standard-reaching rate	p
<1≤5	22.3%	
<5≤10	19.4%	
<10≤15	9.1%	
>15	6.1%	

3.3. Non-conditional Logistic Regression Analysis

The correlation between standard-reaching rate of blood glucose and age, sex, diabetic duration, family history of diabetes, smoking, alcohol consumption, BMI, systolic pressure, diastolic pressure, 2hPG, HBA1c, TC, TG, LDL, HDL, creatinine, and uric acid was analyzed with binary Logistic regression, which indicated that the duration of diabetes (OR: 1.094; 95% CI: 1.036, 1.155) was the independent risk factor for reaching standard of blood glucose (Table 3).

Table 3. *Multi-factor Regression Analysis of the Risk Factors Associated with Standard-reaching Rate of Blood Glucose in Patients with Hypertension Complicated with Diabetes.*

	B	S.E.	Wald value	p	OR (95.0% CI)	
Age	-.015	.014	1.094	.296	.985	(0.958~1.013)
Sex	.269	.317	.720	.396	1.309	(0.703~2.437)
Duration of diabetes	.089	.028	10.345	.001	1.094	(1.036~1.155)
Family history	-1.215	1.064	1.304	.254	.297	(0.037~2.389)
Smoking	-.146	.414	.124	.725	.864	(0.384~1.947)
Alcohol consumption	.241	.550	.192	.661	1.273	(0.433~3.739)
BMI	-.002	.035	.003	.953	.998	(0.931~1.069)
Systolic pressure	.012	.008	2.166	.141	1.012	(0.996~1.027)
Diastolic pressure	-.012	.012	.970	.325	.988	(0.965~1.012)
TC	.015	.426	.001	.971	1.015	(0.440~2.341)
TG	.228	.181	1.585	.208	1.256	(0.881~1.791)
LDL	.120	.471	.065	.799	1.127	(0.448~2.836)
HDL	-.980	.656	2.232	.135	.375	(0.104~1.358)
Creatinine	.000	.005	.004	.950	1.000	(0.990~1.011)
Uric acid	.000	.001	.153	.695	1.000	(0.998~1.003)

4. Discussion

With the development of economy and change of life style, the number of people with hypertension plus diabetes in China is gradually rising [2, 7]. There are many researches on the prevalence of hypertension, diabetes and hypertension complicated with diabetes at home and abroad [5] while surveys on the current status of standard-reaching rate of blood glucose are few, especially among patients with hypertension plus diabetes. Standard blood glucose means that fasting blood glucose, blood glucose at 2h after meal and glycosylated hemoglobin all reach a set value. In this study, the standard-reaching rate of blood glucose in patients with hypertension complicated with diabetes is 24.3%. Some researches [8, 9] have pointed out that the ratio of HbA1c <7.0% in patients with elderly coronary heart disease complicated with hypertension plus diabetes is 23.5%, which is relatively consistent with the results of this study but the control of fasting blood glucose and blood glucose at 2h after meal have not been demonstrated in those researches. Thus it

can be concluded that the standard-reaching rate of blood glucose in patients with hypertension complicated with diabetes is relatively low. And the standard-reaching rate of blood glucose in different durations of diabetes is different. Usually the standard-reaching rate in patients with shorter diabetic duration is higher than that in patients with longer duration. It may be because patients with shorter duration pay more attention to blood glucose control, and are more positive in terms of accepting the disease and medical compliance behavior.

This study demonstrates that duration of diabetes is the independent risk factor for reaching the standard blood glucose level, which is consistent with previous researches [9-13]. Diabetic duration influences the standard-reaching rate of blood glucose in patients with hypertension complicated with diabetes. In conclusion, the standard-reaching rate of blood glucose in patients with hypertension complicated with diabetes is relatively low, and there is significant difference in the standard-reaching rate of blood glucose between different diabetic durations. So the duration of diabetes is the independent risk factor for reaching the standard of blood

glucose.

5. Conclusions

It is easy to ignore the management of blood glucose or the treatment of diabetes when treating hypertension for patients with hypertension complicated with diabetes. So it is necessary to raise the attention of doctors and nurses to give guidance of the management of blood pressure and blood glucose to hypertensive diabetic patients and to guide them to see the cardiovascular and diabetes specialists regularly in order to avoid the increase of nonstandard blood glucose as the disease progresses. But because the sample of this study is relatively small, further study should be conducted.

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