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Influence of blood glucose level on incidence of pulmonary infection and prognosis in patients with diabetes mellitus complicated with severe cerebral infarction.

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Abstract

Objective: To study the influence of blood glucose level on incidence of pulmonary infection and prognosis in patients with diabetes mellitus complicated with severe cerebral infarction, so as to provide valuable reference for clinical research.

Methods: 120 cases of diabetes mellitus complicated with severe cerebral infarction in our hospital from April 2011 to November 2016 were enrolled as the research objects and were randomized to observation group and control group, with 60 cases in each group. 2 h postprandial blood glucose was detected in all patients, blood glucose remained at 4.4 to 8.0 mmol/L in observation group and at 8.0 to 11.1 mmol/L in control group. Pulmonary infection and mortality were compared between the two groups, and the influence of blood glucose on the National Institutes of Health Stroke Scale (NIHSS), acute physiology and chronic health evaluation II (APACHE II), Glasgow Coma Scale (GCS) scores and mortality rate were analysed.

Results: The incidence of pulmonary infection and mortality of observation group were significantly lower than those of control group (P<0.05). Before treatment, there were no significant difference between the two groups on NIHSS, APACHE II, GCS scores (P>0.05). After 7 d of treatment, NIHSS, APACHE scores of patients in observation group were significantly lower than those of control group, while GCS score was significantly higher than control group (P<0.05). Univariate analysis showed that age, duration of diabetes and blood glucose level were correlated with survival prognosis, and the difference was statistically significant (P<0.05).

Conclusion: Strict control of blood glucose level in patients with diabetes mellitus complicated with severe cerebral infarction can better reduce the incidence and mortality of pulmonary infection, so as to achieve the purpose of improving the prognosis of patients.

Keywords: Diabetes mellitus, Cerebral infarction, Blood glucose, Pulmonary infection, Prognosis, NIHSS, APACHE II, GCSD.

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Introduction

Diabetes is a kind of metabolic disease which is characterized by high blood glucose levels. Hyperglycemia is caused by defects in insulin secretion or in insulin function, and represents the metabolic abnormalities of sugar, protein and fat. Chronic illness can cause damages to multi-systems and can cause chronic progressive diseases on eye, kidney, nerve, heart and blood vessels. It can also cause functional disease and functional defects or failure [1]. Cerebral infarction is a focal neurological sign caused by reducing blood flow or blood supply interruption, cerebral ischemia and hypoxia and necrosis. It can result from vascular thickening luminal stenosis, occlusion and thrombosis which were caused by brain artery or cortical branches atherosclerosis and other factors [2]. The clinical manifestations of cerebral infarction are hemiplegia, aphasia, dysphagia and other manifestations. In recent years, patients with diabetes and cerebral infarction have increased year by year. Cerebral infarction is also a common chronic complication of diabetes mellitus [3]. Relevant data showed that [4] diabetes patients complicated with acute severe cerebral infarction is often critically ill. They often need complexed treatment and have neurological impairments and poor prognosis, which significantly increased the difficulty of clinical treatment. The research group found in clinical practice that for diabetes patients complicated with severe cerebral infarction, it is not only more difficult for them to be treated, they are more easily complicated with pulmonary infection and other complications, and the condition of cerebral infarction were more likely to progress. Therefore, we should actively control the severity of cerebral infarction combined with strict control of the blood glucose in the process of clinical treatment. Patients with severe cerebral infarction prone to present stress hyperglycemia [5], and it lacks clear standard for

blood glucose control. In this study, we explored the influence of blood glucose level on incidence of pulmonary infection and prognosis in patients with diabetes mellitus complicated with severe cerebral infarction, so as to provide valuable reference for clinical research.

Data and Methods

General data

120 cases of diabetes mellitus complicated with severe cerebral infarction in our hospital from April 2011 to November 2016 were enrolled as the research objects, 68 males and 52 females, aged 46 to 72 y old with a mean age at (59.7 ± 1.4 y). Infarction Sites: 50 cases of medulla, 45 cases of pons and 25 cases of other parts (Table 1). Inclusion criteria: patients conformed by CT or MRI examinations; patients meet the diagnostic criteria for diabetes mellitus. Exclusive criteria: infection within 48 h of hospitalization, liver and kidney dysfunction, malignant tumor, blood and immune system diseases. Informed consents were signed by all patients. Patients were randomly divided into observation group and control group, with 60 cases in each group. There was no significant difference between the two groups in gender, age, infarction location and other general information at baseline.

Table 1. *Comparisons on general data between the two groups.*

Group	N	Age	Gender		Infarction Sites		
			Male	Female	Medulla	Pons	Other parts
Control	60	59.3 ± 1.7	33	27	24	23	13
Observation	60	60.0 ± 1.2	35	25	26	22	12
t		0.593	0.478	0.396	0.685	0.456	0.369
P		>0.05	>0.05	>0.05	>0.05	>0.05	>0.05

Methods

After admission, all patients in 2 group were treated with regular medications, including maintaining airway patency and oxygen supplement; respiratory stimulants when necessary; tracheotomy or tracheal intubation for artificial ventilation; maintaining effective blood circulation and correcting shock; drugs reducing intracranial pressure such as 20% mannitol, furosemide and glycerol to patients with high intracranial pressure; side ventricle puncture drainage when necessary; controlling high blood pressure and high temperature; stopping twitch with diazepam or phenobarbital; correcting water and electrolyte imbalance; nutritional supplements; brain metabolism accelerants and awaking medicine, such as Xing Nao Jing or An Gong Niu Huang Wan; paying attention to oral, respiratory tract, urinary tract and skin care.

2 h postprandial blood glucose was detected in all patients, and insulin pump treatment was provided according to the patient's condition. 2 h postprandial blood glucose remained at 4.4 to 8.0 mmol/L in observation group and at 8.0 to 11.1 mmol/L in control group. Pulmonary infection and mortality were compared between the two groups, and the influence of blood glucose on the National Institutes of Health Stroke Scale (NIHSS), Acute Physiology and Chronic Health Evaluation II (APACHE II), Glasgow Coma Scale (GCS) scores and mortality rate was analysed.

Statistical analysis

SPSS 21.0 statistical software was adopted for analysis. Measurement data were expressed as mean ± standard deviation, and comparisons between groups were conducted using t-test. Comparisons on enumeration data were conducted using Chi-Square test and $P<0.05$ was statistically significant.

Results

Comparisons on incidence of pulmonary infection and mortality between the two groups

The incidence of pulmonary infection and mortality of observation group were significantly lower than those of control group ($P<0.05$), as shown in Table 2.

Table 2. *Comparisons on incidence and mortality of pulmonary infection between the two groups.*

Indexes	Control (n=60)		Observation (n=60)		χ^2	P
	N	%	N	%		
Pulmonary infection	25	41.7	13	21.7	6.548	0.025
Death	17	28.3	8	13.3	5.061	0.034

Comparisons on NIHSS, APACHE II and GCS scores between the two groups before and after treatment

Before treatment, there were no significant difference between the two groups on NIHSS, APACHE II, GCS scores ($P>0.05$). After 7 d of treatment, NIHSS, APACHE scores of patients in observation group were significantly lower than those of control group, while GCS score was significantly higher than control group ($P<0.05$), as shown in Table 3.

Table 3. *Comparisons on NIHSS, APACHE II and GCS scores between the two groups before and after treatment.*

Group	N	NIHSS		APACHE II		GCS	
		Before	After	Before	After	Before	After

Control	60	18.63 ± 1.29	12.26 ± 0.82	27.38 ± 1.94	17.46 ± 1.05	4.52 ± 1.24	5.34 ± 1.25
Observation	60	18.17 ± 1.33	10.08 ± 0.75	27.29 ± 1.61	13.57 ± 1.28	4.49 ± 1.17	7.16 ± 1.18
t		0.672	4.128	0.706	6.403	0.304	5.135
P		0.374	0.012	0.425	0.018	0.416	0.021

Correlation analysis

The study included 120 cases of patients, with 25 cases of death, 95 cases of survival. Univariate analysis showed that age, duration of diabetes and blood glucose level were correlated with survival prognosis, and the difference was statistically significant (P<0.05), as shown in Tables 4 and 5.

Table 4. *Single factors influencing survival prognosis and survival rate of patients (%).*

Factors	Study cases	Survival cases	Survival rate (%)	χ^2	P
Age (y)				6.124	0.026
<60	61	52	85.2		
≥ 60	59	43	72.9		
Diabetes duration (y)				5.763	0.029
<5	42	30	71.4		
≥ 5	78	65	83.3		
Hypertension				1.159	0.375
Yes	66	52	78.8		
No	54	43	79.6		
Blood glucose (mmol/L)				7.414	0.017
<8	60	52	86.7		
≥ 8	60	43	71.7		
Smoking				0.923	0.403
Yes	67	52	77.6		
No	53	43	81.1		
Alcohol				0.571	0.619
Yes	70	56	80		
No	50	39	78		

Table 5. *Correlations between relative factors and survival prognosis of patients.*

Factors	Survive (n=95)	Death (n=25)	t	P
Age (y)	53.17 ± 3.25	62.31 ± 2.58	4.278	0.021
Blood glucose (mmol/L)	6.45 ± 0.81	9.76 ± 1.02	5.092	0.013
Diabetes duration (y)	3.53 ± 0.28	7.41 ± 0.62	4.945	0.016

Summary

The incidence of pulmonary infection and mortality of observation group were significantly lower than those of control group (P<0.05). Before treatment, there were no significant difference between the two groups on NIHSS, APACHE II, GCS scores (P>0.05). After 7 d of treatment, NIHSS, APACHE scores of patients in observation group were significantly lower than those of control group, while GCS score was significantly higher than control group (P<0.05). Univariate analysis showed that age, duration of diabetes and blood glucose level were correlated with survival prognosis, and the difference was statistically significant (P<0.05). Strict control of blood glucose level in patients with diabetes mellitus complicated with severe cerebral infarction can better reduce the incidence and mortality of pulmonary infection, so as to achieve the purpose of improving the prognosis of patients.

Discussion

Patients with severe cerebral infarction have obvious stress reaction in the early stage, which results in obviously increased blood glucose level, decreased resistance, increased bacterial colonization, and increased probability of pulmonary infection. Pulmonary infection is the most common complication in patients with cerebral infarction and is also the most common cause of death [6]. Previous studies have shown that [7], consciousness disorders, dysphagia, hypertension, diabetes history are independent risk factors for pulmonary infection in patients with cerebral infarction. There were few studies on the control of blood sugar level which may affect the pulmonary infection and mortality in diabetic patients with severe cerebral infarction. Strict control of blood glucose can effectively reduce the mortality rate of stroke. Blood glucose increased significantly in the acute phase of severe cerebral infarction, which will bring bad prognosis [8]. If the blood glucose of stroke patients increases continuously, the pulmonary infection rate and fatality rate will increase obviously. Another study showed that [9] aging red blood cells will continue to increase with increased aggregation and brittle when blood glucose elevated. Blood flow velocity in the infarcted area of the collateral circulation will continue to slow down if there was infarction existing in larger vessels, causing the red cell sedimentation or broken and the infarction area increasing continuously, and increased the severity of brain edema at the same time. Based on the points of view above, in the treatment of diabetic patients with severe cerebral infarction in the process, we must strictly control the patient's blood glucose levels to reduce the lung infection rate and mortality rate [10]. However, it is very difficult to reduce the mortality of patients with stroke, even with relatively strict control of blood glucose within 90 d [11]. Therefore, it is necessary to study the level of blood glucose in patients with diabetes mellitus complicated with severe cerebral infarction.

In this study, patients with blood glucose at 4.4-8.0 mmol/L were set as observation group, while patients with blood glucose at 8.0-11.1 mmol/L were set as control group, pulmonary infection and mortality of patients at different levels of glucose were analysed in diabetes patients complicated with severe with cerebral infarction. The study found that pulmonary infection incidence and mortality rates were significantly lower in observation group than that of control group ($P<0.05$). Severity of stroke at admission is assessed by NIHSS score, APACHE II score is calculated to determine systemic severity of illness and GCS is used to assess the conscious state [12]. NIHSS, APACHE II and GCS scores in observation group after 7 days of treatment were significantly better than control group ($P<0.05$). Control of the blood glucose at 4.4-8.0 mmol/L can better reduce the pulmonary infection and mortality. Possible reasons are as follows: there is insulin resistance at stress state in patients with severe cerebral infarction, patients prone to have acute inflammatory response syndromes, which can stimulate hyperglycemia. There is insulin resistance in diabetes itself, so blood glucose increased more significantly, and is more difficult to control [13]. For diabetes patients complicated with severe cerebral infarction, when the body is in high glucose condition, it can stimulate the protein kinase C pathway activation, and promote the secretion of inflammatory cytokines, so as to increase systemic inflammatory responses [14]. At the same time, as diabetes patients with severe cerebral infarction need long-term bedridden and respiratory secretions cannot be ruled out in time, which provide a hotbed for pathogenic bacteria infection and increase the risk of pulmonary infection. In addition, when the body blood glucose rises, the aging red blood cells increase and are more prone to aggregating. Brittle also increase as red cells age [15,16]. Therefore, when severe cerebral infarction occurs to diabetic patients, it will further exacerbate the blood silt resistance and lead to red cell disruption, eventually leading to the expansion of the infarct size and progressive brain edema, endangering the lives of patients. After further analyzing the factors affecting the survival of patients, we also found that age, duration of diabetes and blood glucose levels were correlated with survival prognosis, and the difference was statistically significant ($P<0.05$). In the treatment of diabetic patients with severe cerebral infarction, we should attach great importance of the above factors on the prognosis of patients.

In conclusion, strict control of blood glucose in patients with diabetes mellitus complicated with severe cerebral infarction can better reduce the incidence of pulmonary infection and mortality of patients, so as to achieve the purpose of improving the prognosis of patients.

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