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Original Article

The correlation study on homocysteine, blood lipids and blood glucose levels in patients with cerebral infarction

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Abstract: Purpose: To explore the correlation of changes in homocysteine (HCY) l, blood lipids and blood glucose levels in patients with cerebral infarction. Methods: 120 patients with cerebral infarction admitted to our hospital from February 2018 to February 2020 were selected as the experimental group, and 120 healthy volunteers in the same period were selected as the control group. The blood pressure and the homocysteine, blood lipids, blood glucose levels were compared; the experimental group was subdivided into single cerebral infarction group, combined diabetes group and combined hypertension group, and their blood lipid levels were compared with the control group; Spearman method was used to analyze the relationship between HCY, blood lipid, blood sugar levels and cerebral infarction. Results: ① The diastolic and systolic blood pressure levels of the experimental group were higher, whereas the control group were lower (P<0.05). ② The levels of total cholesterol (TC), triglyceride (TG), low density lipoprotein cholesterol (LDL-C) and TC/[high density lipoprotein cholesterol (HDL-C)] of the experimental group were higher, but the level of HDL-C was lower than that of the control group (all P<0.05). ③ The fasting blood glucose (FBG) and glycosylated hemoglobin (GHb) levels of the experimental group were higher than those of the control group (all P<0.05). ④ The HCY level in the experimental group was higher than that in the control group (P<0.05). ⑤ The levels of TC, TG, LDL-C and TC/HDL-C in single cerebral infarction group, combined diabetes group and combined hypertension group were higher, and HDL-C level was lower than that in control group (all P<0.05). ⑥ Spearman analysis revealed that HCY was positively correlated with TC, TG, LDL-C and FBG (all P<0.05). Conclusion: The level of HCY is positively correlated with the levels of TC, TG, LDL-C and FBG in patients with cerebral infarction.

Keywords: Cerebral infarction, homocysteine, blood lipids, blood sugar, level changes, correlation

Introduction

Cerebral infarction, also known as ischemic stroke or cerebral embolism, is one of the commonest cerebrovascular diseases [1]. It is generally attributed to blood circulation dysfunction in the brain, which in turn leads to tissue softening or necrosis of human brain tissue due to hypoxia and ischemia. It is characterized by rapid onset, high recurrence rate, fatality rate and pathogenicity rate, and has become one of the leading diseases threatening human life and health [2]. In China, the number of deaths due to cerebral infarction has reached 1.2 million each year, accounting for more than 40% of the total cardiovascular and cerebrovascular deaths [3]. How to reduce the recurrence and mortality of cerebral infarction has become a public health concern worldwide. Existing findings revealed that hypertension, hyperglycemia, and increased plasma homocysteine are all risk factors for cerebral infarction [4]. This study was designed to detect the homocysteine, blood lipids and blood glucose levels of 120 patients with cerebral infarction and 120 healthy volunteers, to explore the correlation between these changes and cerebral infarction. The aim of this study is to guide for the prevention and diagnosis of cerebral infarction.

Materials and methods

General information

120 patients with cerebral infarction admitted to our hospital from February 2018 to February 2020 were selected as the experimental group, aged 25-88 years old; according to clinical manifestations, they were divided into a single cerebral infarction group (n=24), a combined hypertension group (n=52), and a combined

Table 1. Experimental instruments and regents

instruments	manufacturer
AU5800 automatic biochemical analyzer	America Beckman Coulter
AutolumiS 2000 automatic chemiluminescence immunoassay analyzer	Shandong Weigao Group
Variant II analyzer	America Bio-Rad
regents	manufacturer
TG, TC regents	Shanghai Xinfan Biological Technology Co., Ltd.
LDL-C, HDL-C regents	Japan Sekisui Corporation
Blood glucose reagent	German Desay
Homocysteine reagent	Shandong Weigao Group
Glycated hemoglobin reagent	America Bio-Rad

Table 2. Baseline information

Index	experimental group (n=120)	control group (n=120)	t/X^2	P
Gender			1.634	0.965
male	83	84		
female	37	36		
years	64.63±2.36	63.96±2.45	1.354	0.536

diabetes group (n=44). At the same time, 120 healthy volunteers from the same period were selected as the control group, aged 24-87 years old.

Inclusion/exclusion criteria

Inclusion criteria: ① Patients in the experimental group met the diagnostic criteria formulated by the *National Cerebrovascular Academic Conference* (the 4th) [5]; ② No history of cerebral infarction and family medical history was presented in the control group; ③ All study subjects had no severe visceral and brain syndromes and complications; ④ This study has been approved by the hospital ethics committee, and informed consent forms were obtained from all patients [6].

Exclusion criteria: ① Patients with functional diseases such as heart, liver, kidney, or blood diseases; ② Patients with unclear consciousness, abnormal mental and cognitive level; ③ Incomplete clinical data or be unlikely to participate in this study.

*Instruments and reagents (**Table 1**)*

Sample collection and testing

5 mL venous blood in the early morning of the 2nd day after admission was drawn in both groups using vacuum blood collection tubes, and centrifuged at 3000 r/min for 20 min at 4°C to separate the serum and stored at -20°C for testing [7]. Among them, blood lipids and blood glucose were detected by biochemical analyzer, and homocysteine and glycosylated hemoglobin were detected by immunoassay and Variant II analyzer respectively [8].

Testing indicators

Blood lipid indicators: total cholesterol (TC), triglyceride (TG), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C), TC/HDL-C; blood glucose indicators: fasting blood glucose (FBG), glycosylated hemoglobin (GHb); homocysteine (HCY).

Statistical processing

The statistical analysis was performed with the IBM-SPSS 22.0 Measurement data were expressed as ($\bar{x} \pm s$), and performed by t test, the comparison between multiple groups was performed by repeated ANOVA test, and the Spearman method was used for correlation analysis. Significance was set as a level of $P<0.05$. GraphPad prism 8 software was used to plot graphics.

Results

Baseline information

There was no significant difference in clinical data such as age and gender between the two groups ($P>0.05$). See **Table 2**.

Comparison of blood pressure levels, blood glucose levels and HCY levels

The diastolic and systolic blood pressure of the experimental group were higher ($P<0.05$), see **Figure 1A**. Compared with the control group, the FBG level and GHb level of the experimental group were higher ($P<0.05$), see **Figure 1B**, **1C**.

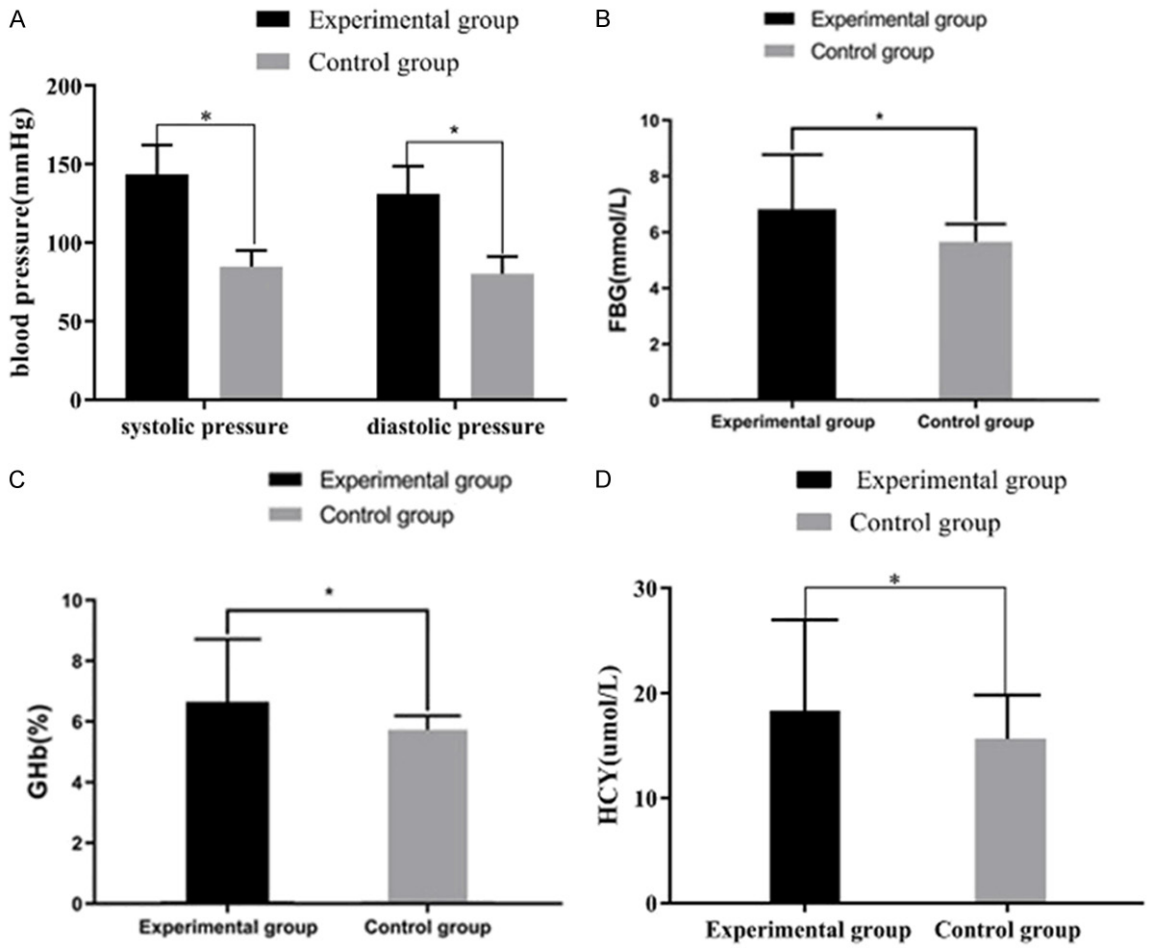

Figure 1. Comparison of blood pressure, blood glucose and HCY levels between experimental group and control group. Note: (A) The systolic blood pressure of the experimental group was 143.63±18.61, while the control group was 130.93±17.82; Comparison between the two groups was significant (*P<0.05); the diastolic blood pressure of the experimental group was 84.71±10.36, while the control group was 80.06±11.25; comparison between the two groups was significant (*P<0.05); (B) FBG level of experimental group was 6.30±2.48, while the control group was 5.38±0.59; comparison between the two groups was significant (*P<0.05); (C) GHb level in experimental group was 6.45±1.94, while the control group was 5.88±0.56; comparison between the two groups was significant (*P<0.05); (D) HCY level of experimental group was 18.25±8.71, while the control group was 15.61±4.17; comparison between the two groups was significant (*P<0.05).

The HCY level of the experimental group was higher in contrast with the control group (P<0.05). See **Figure 1D**.

Comparison of blood lipid levels

The levels of TC, TG, LDL-C and TC/HDL-C in the experimental group were higher, whereas the levels of HDL-C were lower in the experimental group (P<0.05). See **Table 3**.

Comparison of blood lipid levels

Table 4 details that the levels of TC, TG, LDL-C and TC/HDL-C in the single cerebral infarction group, combined diabetes group, and combined hypertension group were higher, and the HDL-C level was lower than that of the control group (P<0.05), but was no noticeable difference was seen in blood lipid indexes between the three groups (P>0.05).

Correlation between HCY and TC, TG, LDL-C, HDL-C and FBG

Spearman analysis found that HCY was positively correlated with TC, TG, LDL-C and FBG (all P<0.05), but not with HDL-C (P>0.05). See **Table 5**.

Discussion

Cerebrovascular disease is a common clinical disease, with high mortality and high morbidity,

Table 3. Comparison of blood lipids between the experimental group and the control group ($\bar{x} \pm s$)

Groups	n	TC (mmol/L)	TG (mmol/L)	LDL-C (mmol/L)	HDL-C (mmol/L)	TC/HDL-C
experimental group	120	4.79±1.04	1.55±0.98	2.89±0.72	1.11±0.36	4.28±1.38
control group	120	4.01±0.99	1.16±0.55	2.35±0.65	1.38±0.28	3.62±0.97
t		5.95	3.80	6.10	6.49	4.29
P		<0.05	<0.05	<0.05	<0.05	<0.05

Table 4. Comparison of blood lipid levels between the experimental group and the control group

Groups	n	TC (mmol/L)	TG (mmol/L)	LDL-C (mmol/L)	HDL-C (mmol/L)	TC/HDL-C
Single cerebral infarction group	24	4.77±0.95	1.31±0.55	2.91±0.66	1.16±0.30	4.24±1.55
combined hypertension group	52	4.78±0.97	1.61±1.23	2.43±0.73	1.12±0.40	4.21±1.41
combined diabetes group	44	4.80±1.18	1.63±0.80	2.96±0.73	1.06±0.32	4.40±1.23
Control group	120	4.01±0.99	1.16±0.55	2.35±0.65	1.38±0.28	3.62±0.97
t		23.38	11.17	23.55	33.45	12.15
P		<0.05	<0.05	<0.05	<0.05	<0.05

Table 5. Correlation between HCY and TC, TG, LDL-C, HDL-C and FBG

HCY	TC (mmol/L)	TG (mmol/L)	LDL-C (mmol/L)	HDL-C (mmol/L)	FBG (mmol/L)
r	0.48	0.37	0.36	0.16	0.42
P	<0.05	<0.05	<0.05	>0.05	<0.05

and has a detrimental effect on human life safety [9]. The prevalence of cerebral infarction is high, accounting for 75%-80%. Over the last decade, China has witnessed a dramatic increase in the incidence of cerebral infarction which is a consequence of lifestyle changing, and begins to affect younger population [10]. Studies have demonostrated that cerebral blood perfusion is closely related to the onset of cerebral infarction. If the blood pressure level is beyond the ability of cerebrovascular auto-regulation, it will lead to insufficient cerebral blood perfusion, which can easily result in cerebral infarction [11]. We found that the diastolic and systolic blood pressure levels of the experimental group were higher than those of the control group, suggesting that hypertension is a risk factor for cerebral infarction.

Abnormal blood lipid metabolism is also a key factor triggering cerebrovascular diseases, and the measurement of blood lipid levels is the main way to clinically monitor human lipid metabolism, which is also a major indicator for the prevention and treatment of cerebrovascular diseases [12]. Elevated blood lipid TG level have been considered important risk factors for ischemic cerebrovascular disease, and changes in TG levels are often accompanied by changes in LDL-C and HDL-C levels [13, 14]. Studies have demonstrated that elevated TC levels can cause arterial stenosis and atherosclerosis [2]. The present study found that the levels of TC, TG, LDL-C and TC/HDL-C of the experimental group were higher, but the HDL-C level was lower. We subsequently subdivided the experimental group into a single cerebral infarction group, a combined diabetes group, and a combined hypertension group, and found that the blood lipid indicators of the three groups were not significantly different, but the blood lipid indicators of the three groups and the control group were significantly different. The above results indicated that the changes in blood lipids TC, TG, LDL-C and HDL-C levels are closely related to the onset of cerebral infarction, but the blood lipid indexes were not correlated with diabetes and hypertension.

At present, studies have demonstrated that cerebral infarction is mainly caused by atherosclerosis. High blood sugar can result in lipid metabolism disorder, promote lipid deposit in the blood vessel wall and invade endothelial cells to advance the formation of atherosclerosis, and increase the incidence of cerebral infarction [15]. The current study found that the FBG and GHb levels of the experimental group were higher in comparison with the control group, which was similar to the results of a pre-

vious study [16], in which the authors found that the blood glucose level of patients with cerebral infarction was significantly higher than that of healthy persons. It is suggested that high blood sugar is a risk factor for cerebral infarction.

Homocysteine is an essential intermediate product in the metabolism of methionine. In 1969, McGully first proposed that hyperhomocysteine is the cause of arteriosclerosis and thrombosis [17]. Since then, more and more studies have confirmed that elevated homocysteine is an important risk factor in cerebrovascular diseases, and studies have found that elevated homocysteine is independently associated with the onset of acute cerebral infarction [18]. This study revealed that the HCY level of the experimental group was higher, and it is consistent with previous study [19], suggesting that elevated HCY levels are risk factors for cerebral infarction.

Moreover, we also analyzed the correlation between HCY and blood sugar and blood lipids using Spearman method, and found that HCY is positively correlated with TC, TG, LDL-C and FBG, but has no correlation with HDL-C. This suggests that if the level of HCY increases, the levels of TC, TG, LDL-C and FBG will also increase, which can provide guidance for clinical diagnosis of cerebral infarction. However, the data obtained in our study was derived from a small samples, it remains unknown whether our results can be replicated.

Conclusion

To conclude, abnormal levels of homocysteine, blood pressure, blood sugar, and blood lipids are risk factors for cerebral infarction, and HCY levels in patients with cerebral infarction are positively correlated with TC, TG, LDL-C and FBG levels.

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Disclosure of conflict of interest

None.

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