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CLINICAL STUDY

Correlation between tongue manifestations and glucose, total cholesterol, and high-density lipoprotein cholesterol in patients with acute cerebral infarction

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Abstract

OBJECTIVE: To analyze the association between tongue manifestations and the levels of glucose (GLU), total cholesterol (TCH), and high-density lipoprotein cholesterol (HDL-C) in subjects with acute cerebral infarction.

METHODS: Hospitalized patients with first unilateral cerebral infarction in the Neurological Department of Xuanwu Hospital were included and the correlation between tongue fur color, fur nature, and the levels of GLU, TCH, HDL-C were analyzed.

RESULTS: HDL level in the thin fur group was higher than that in the thick fur group (P=0.02). The difference in the levels of GLU, TCH, and HDL-C among the groups was significant (P<0.05), classified in terms of slippery, moist, and dry fur. Further comparison between the groups by Student-Newman-Keuls test showed that GLU level in the dry fur group was the highest. Moreover, the TCH level in the slippery fur group was higher than the other two groups.

CONCLUSION: A correlation between tongue manifestations and GLU, TCH, HDL-C was identified in the patients with acute cerebral infarction.

Key words: Cerebral infarction; Abnormal tongue manifestation; Glucose; Cholesterol, HDL

INTRODUCTION

Tongue inspection is a primary diagnostic technique of Traditional Chinese Medicine (TCM) practice. According to TCM theory, the tongue is connected to an internal organ that relates to outer meridians and collater-

als. Moreover, tongue inspection is one of the four pillars of syndrome differentiation for treatment.[1] Research suggests that changes in tongue manifestation are closely associated with diseases.[2-10] These changes in tongue manifestation in patients with heart disease, infections, and cancers facilitate syndrome differentiation for treatment, and the prognosis.[5-7] Recent studies on tongue manifestations concerning cerebral infarction mostly focused on the relationship between tongue manifestation and different stages of cerebral infarction.[11-15] Few have studied the correlation between tongue manifestations and laboratory testing outcomes[16] such as glucose (GLU), total cholesterol (TCH), and high-density lipoprotein cholesterol (HDL-C). High blood GLU and TCH are the important risk factors for cerebral infarction and HDL-C has protective effects on cerebral infarction. In this study, we investigated the correlation between tongue manifestations and GLU, TCH, HDL-C in patients with acute cerebral infarction.

METHODS

Diagnostic criteria

Cerebral infarction was diagnosed according to Diagnostic Criteria of Various Types of Cerebrovascular Disease[17] and China Guideline for Cerebrovascular Disease Prevention and Treatment.[18] The locations of cerebral infarction were determined by magnetic resonance imaging (MRI) and diffusion weighted imaging (DWI) (Magnetom Sonata Siemens).

Stroke according to TCM was diagnosed from the Standard for Diagnosis and Therapeutic Effect Evaluation of Stroke drafted by a Collaborative Group of Acute Encephalopathy.[19]

Tongue manifestations classification

Tongue manifestations were classified according to: the features of tongue manifestations described in the Diagnostics of Chinese Medicine[20] by Prof. Wenfeng Zhu and by pictures from the tongue manifestation database in image-analysis system of tongue manifestation[21] developed by Shanghai University of TCM. Manifestation colors were: pale, pink, red, dark-red, and bluish purple. The three forms were: swollen or teeth-marked, normal, and fissured tongues. The six fur textures were: thin, thick, slippery, moist, dry, and greasy. Finally, the three fur colors were: white, white-yellow and yellow. In our study, we mainly observed the correlation between GLU, TCH, and HDL-C and fur textures and colors in patients with acute cerebral infarction.

Subjects

Two hundred subjects with first unilateral cerebral infarction in Department of Neurology, Xuanwu Hospital (Beijing, China), from March 2008 to February 2009 were recruited. All patients were examined by MRI and DWI. Patients were divided into two groups by thin or thick tongue fur; three groups by slippery, moist, or dry fur; two groups by greasy and non-greasy fur; and three groups by fur color.

GLU, TCH, and HDL-C measurement

The blood GLU, TCH, and HDL-C levels were tested routinely by the clinical laboratory in Xuanwu Hospital, using an automatic biochemistry analyzer 7170A (Hitachi, Tokyo, Japan).

Statistical methods

All data were analyzed with SPSS 11.5 (SPSS Inc., Chicago, IL, USA). Data are expressed as mean ± standard deviation ($\bar{x} \pm s$). ANOVA and Student-Newman-Keuls tests were performed. $P<0.05$ was considered statistically significant.

RESULTS

Two hundred patients were enrolled, aged 40-83 years with a mean age of 60±11, with 156 males and 44 females. Among them, 117 patients were in the thick fur group (58.5%) and 83 in the thin fur group (41.5%). Nineteen were in the slippery fur group (9.5%), 137 in the moist fur group (68.5%), and 44 in the dry fur group (22.0%). There were 149 in the greasy fur group (74.5%), and 51 in the non-greasy fur group (25.5%). Finally, there were 75 in the white fur group (37.5%), 80 in the white-yellow fur group (40.0%), and 45 in the yellow fur group (22.5%).

Levels of GLU, TCH, and HDL-C in thin and thick fur groups

The levels of HDL-C in the thin fur group were higher than that in thick fur group (P=0.02). No statistical significance was observed in the levels of GLU and TCH among the thin fur group and thick fur group (Table 1).

Table 1 Levels of GLU, TCH, and HDL-C in thin and thick fur groups (mmol/L, $\bar{x} \pm s$)

Group	GLU	TCH	HDL-C
Thin fur	6.32±2.52	4.94±1.11	1.13±0.27
Thick fur	6.23±2.57	4.72±0.91	1.04±0.26
t	0.25	1.55	2.37
P value	0.80	0.12	0.02

Notes: GLU: glucose; TCH: total cholesterol; HDL-C: high-density lipoprotein cholesterol.

Levels of GLU, TCH, and HDL-C in the slippery, moist, and dry fur groups

The levels of GLU among the three groups were significantly different (P=0.017), and the comparison by Student-Newman-Keuls test demonstrated that the level of GLU in the dry fur group was significantly higher

than the other two groups (P<0.05). The levels of TCH in the three groups were significantly different (P=0.018), and further analysis by Student-Newman-Keuls test showed that TCH in the slippery fur group was the highest among the three groups (P< 0.05). The levels of HDL-C in the three groups were significantly different (P=0.024), and further comparison with the Student-Newman-Keuls test demonstrated that the level of HDL-C in the slippery fur group was higher than those in the other two groups (P< 0.05) (Table 2).

Table 2 Levels of GLU, TCH, and HDL-C in slippery, moist, and dry fur groups (mmol/L, $\bar{x} \pm s$)

Group	GLU	TCH	HDL-C
Slippery fur	5.69±1.40	5.41±1.01	1.22±0.29
Moist fur	6.04±1.95	4.72±0.99[c]	1.08±0.27[c]
Dry fur	7.21±3.99[ab]	4.84±0.99[a]	1.02±0.23[a]
F	4.19	4.10	3.80
P value	0.017	0.018	0.024

Notes: GLU: glucose; TCH: total cholesterol; HDL-C: high-density lipoprotein cholesterol. [a]P<0.05 slippery fur *vs* dry fur; [b]P<0.05, moist fur *vs* dry fur; [c]P<0.05, slippery fur *vs* moist fur.

Levels of GLU, TCH, and HDL-C in greasy and non-greasy fur groups

The levels of GLU, TCH, and HDL-C in the greasy fur group showed no significant difference. All P values were greater than 0.05 (Table 3).

Table 3 Levels of GLU, TCH, and HDL-C in greasy and non-greasy fur groups (mmol/L, $\bar{x} \pm s$)

Group	GLU	TCH	HDL-C
Greasy fur	6.27±2.60	4.77±0.96	1.08±0.28
Non-greasy fur	6.24±2.41	4.94±1.14	1.07±0.21
t	-0.08	1.06	-0.11
P value	0.94	0.29	0.91

Notes: GLU: glucose; TCH: total cholesterol; HDL-C: high-density lipoprotein cholesterol.

Comparison of the levels of GLU, TCH, and HDL-C among different fur color groups

ANOVA for GLU, TCH, and HDL-C among groups with white, white-yellow, and yellow fur suggested no significant differences. All P values were greater than 0.05 (Table 4).

Table 4 Levels of GLU, TCH, and HDL-C in groups with white, white-yellow, and yellow fur (mmol/L, $\bar{x} \pm s$)

Group	GLU	TCH	HDL-C
White fur	6.29±2.37	4.90±1.00	1.05±0.22
White-yellow fur	6.30±2.84	4.73±1.09	1.08±0.30
Yellow fur	6.16±2.30	4.82±0.85	1.12±0.28
F	0.049	0.52	0.92
P value	0.95	0.60	0.40

Notes: GLU: glucose; TCH: total cholesterol; HDL-C: high-density lipoprotein cholesterol.

DISCUSSION

High glucose levels in patients with acute cerebral infarction are probably caused by: (a) diabetes, potential diabetes, or impaired glucose tolerance; (b) stress hyperglycemia; (c) activation of the pituitary-adrenocortical system (ACTH or cortisol); (d) activation of the sympathetic nervous system; or (e) insular cortical ischemia participating in the occurrence of stress hyperglycemia.[22]

Lipid metabolism disorders are a risk factor for cerebral infarction. Previous studies demonstrated that TCH levels are positively correlated with ischemic stroke.[23,24] Moreover, a high TCH level in patients upon admission is an independent factor affecting their prognosis one month after onset.[25] Traditional Chinese Medicine research shows that hyperlipidemia occurs when turbid phlegm remains in the blood. We found that TCH levels in the slippery fur group were always higher than normal. In terms of TCM theory, slippery furs are mainly seen in water-dampness and/or phlegm-fluid retention syndromes. HDL-C is one of the major lipoproteins with an anti-atherosclerotic effect, which also protects the vascular endothelium, and is anti-inflammatory, anti-coagulatory, and anti-oxidative. HDL-C can decrease post-ischemic brain injury caused by inflammatory reaction or oxidative stress. We found that the HDL-C levels of the thin fur group were higher than those of the thick fur group.

In conclusion, the analysis of the correlation between tongue manifestations and GLU, TCH, and HDL-C is helpful to evaluate the conditions of patients with acute cerebral infarction. However because of the small sample size, the statistical power was reduced in this study. Credibility would be enhanced if sample size increased.

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