

CORRELATION BETWEEN LEVELS OF SERUM FIBROBLAST GROWTH FACTOR 21, VON WILLEBRAND FACTOR, AND CAROTID ATHEROSCLEROSIS IN ELDERLY PATIENTS WITH HYPERTENSION

WEIWEI QIN¹, RONG LIU², WENFANG CHEN^{1*}

¹Department of Laboratory Medicine, Hanchuan People's Hospital, Hanchuan 431600, PR China - ²Lichuan National Traditional Chinese Medicine Hospital, Lichuan 445400, PR China

ABSTRACT

Objective: To study the correlation between levels of serum fibroblast growth factor 21 (FGF-21), von Willebrand factor (vWF), and carotid atherosclerosis in elderly patients with hypertension.

Methods: 96 patients with essential hypertension who were treated in the Department of Neurology at our hospital between February 2017 and April 2019 were randomly selected as the study group. All patients underwent carotid ultrasonography and their IMT levels were measured. They were divided into a normal endometrial group (IMT <0.8mm, 35 cases), an endometrial thickening group (28 cases), and an endometrial plaque group (33 cases). Another 50 healthy subjects who underwent a physical examination in our hospital during the same period were selected as the control group. The levels of serum FGF-21, vWF, and lipoprotein (a) [Lp (a)] in each group were measured via enzyme-linked immunosorbent assay, fibrinogen (FG) levels were measured by Glauss method, and changes in uric acid levels were assessed using an automatic biochemical analyzer. The correlation between levels of serum FGF-21, vWF, Lp (a), FG, uric acid, and IMT in elderly patients with cranial hypertension was analyzed using a Pearson correlation test.

Results: Compared to the control group, the levels of serum FGF-21, vWF, Lp (a), FG, and uric acid in the study group were significantly higher. IMT measurements also increased notably in the study group ($P<0.05$). With increases in IMT thickness, the levels of serum FGF-21, vWF, Lp (a), FG, and uric acid also increased significantly ($P<0.05$). Our Pearson correlation test analysis showed that the levels of serum FGF-21, vWF, Lp (a), FG, and uric acid were positively correlated with IMT in elderly patients with hypertension ($P<0.05$).

Conclusion: Serum FGF-21, vWF, IMT, Lp (a), FG, and uric acid levels were significantly positively correlated with IMT. The criteria listed above can be used as key indicators for estimating the degree of carotid atherosclerosis in elderly patients with hypertension.

Keywords: Elderly hypertension, fibroblast growth factor 21, von Willebrand factor, carotid atherosclerosis, correlation.

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Introduction

Hypertension is the most common cardiovascular disease in the world. According to recent statistics, more than 50% of elderly people (those aged 60 and older) in China suffer from hypertension. Hypertension has serious impacts on the health and quality of life of these patients, and it is a prevalent cause of death among the elderly⁽¹⁾. Long-term hypertension can cause damage to multiple target organs-including the heart, liver, kidney, and the brain-altering the structure and function of the organs and eventually causing organ failure⁽²⁾. Hypertension has become an

independent risk factor for cardiovascular disease in the elderly. The higher a patient's blood pressure, the higher the risk of cardiovascular disease⁽³⁾.

Therefore, it is important to actively control blood pressure in order to reduce potential damage to target organs. Studies have found that cerebral infarction is the main complication of patients with hypertension, and its incidence rate is about five times that of myocardial infarction⁽⁴⁾. As a critical risk factor for cerebral infarction, carotid atherosclerosis's correlation with the occurrence and development of cerebral infarction has gradually attracted the attention of clinical medical researchers. The

use of high-frequency probes to assess carotid intima-media thickness (IMT) and detect atherosclerotic plaques is now recognized as a reliable method for determining a patient's degree of atherosclerosis. This enables practitioners to provide corresponding treatment to reduce the incidence of cerebral infarction⁽⁵⁾. According to reports, serum fibroblast growth factor 21 (FGF-21), von Willebrand factor (vWF) levels, and many other factors are present during the onset of essential hypertension.

This study analyzes the correlation between serum FGF-21, vWF levels, and carotid atherosclerosis in elderly patients with hypertension.

Materials and methods

Basic information

The study group was comprised of 96 randomly selected patients with essential hypertension who were treated in our hospital's neurology department between February 2017 and April 2019. The group included 57 males and 39 females, aged 59 to 76 years, with an average age of 69.18 ± 8.65 years. All patients underwent carotid ultrasonography to measure their IMT levels. They were divided into three groups: an endometrial normal group (IMT < 0.8 mm, 35 cases), an endometrial thickening group (28 cases), and an endometrial plaque group (33 cases).

Our inclusion criteria were as follows:

- All patients met the diagnostic criteria for essential hypertension outlined at the World Health Organization/International Hypertension Alliance Hypertension Conference: systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg⁽⁶⁾;

- This study was approved by the hospital ethics committee, in compliance with medical ethics;

- All research subjects provided informed consent and signed an informed consent form;

- The patients' pathological data was complete and they were able to comply with the research requirements.

Our exclusion criteria were as follows:

- Those with severe heart dysfunction and/or liver and kidney dysfunction;

- Those with secondary hypertension;

- Breastfeeding or pregnant patients;

- And patients with systemic lupus erythematosus, rheumatoid arthritis, or other autoimmune diseases. Another 50 healthy subjects who underwent a physical examination in our hospital during the same period were selected as the control group, including

27 males and 23 females, aged 58 to 77 years, with an average age of 70.63 ± 6.79 years. There was no statistically significant difference in the basic data of the subjects ($P > 0.05$).

Methods and observation indicators

After 8 hours of fasting and drinking, all patients took 5 mL of fasting elbow median venous blood in the morning. The serum and blood cells were separated with a centrifuge at 1500 r/min. The supernatant was collected and stored in a refrigerator at -20°C for testing.

Determination of serum FGF-21 and vWF levels

Serum FGF-21 and vWF levels were measured by enzyme-linked immunosorbent assay.

Determination of serum Lp (a), FG, and uric acid levels

The serum lipoprotein (a) [Lp (a)] levels of patients in each group were measured by enzyme-linked immunosorbent assay, fibrinogen (FG) levels were tested by Glaus method, and changes in uric acid levels were measured using an automatic biochemical analyzer.

Correlation analysis

The correlation between serum FGF-21, vWF, Lp (a), FG, uric acid, and IMT in elderly patients with cranial hypertension was analyzed using a Pearson correlation test.

Statistical methods

The comparison of measurement data between multiple groups was conducted via a factor multi-sample means comparison. An independent sample t-test was run to compare the two groups, and count data was compared using an χ^2 test.

The correlation between serum FGF-21, vWF, Lp (a), FG, uric acid, and IMT was analyzed using a Pearson correlation test. Results were statistically significant with $P < 0.05$. This study used an SPSS19.0 software package for statistical data analysis.

Results

Comparison of serum FGF-21, vWF, and IMT levels between the control group and the study group

Compared with the control group, levels of serum FGF-21 and vWF were significantly higher in the study group. IMT levels also increased significantly in the study group ($P < 0.05$). See Table 1.

Groups	Cases (n)	FGF-21 (µg/L)	vWF (%)	IMT (mm)
Study group	96	1.99±0.62	186.47±79.96	1.17±0.27
Control group	57	1.49±0.54	111.74±58.47	0.84±0.25
<i>t</i>		5.054	6.144	7.511
<i>P</i>		<0.001	<0.001	<0.001

Table 1: Comparison of serum FGF-21, vWF and IMT levels between the control group and the study group ($\bar{x}\pm s$).

Comparison of serum FGF-21 and vWF levels in different IMT patients

With increases in IMT levels, the levels of serum FGF-21 and vWF of patients increased significantly ($P<0.05$). See Table 2.

Groups	Cases (n)	FGF-21 (µg/L)	vWF (%)
Endometrial normal group	35	1.48±0.45	122.04±64.96
Endometrial thickening group	28	1.84±0.52 ^a	161.16±70.59 ^a
Endometrial plaque group	33	2.27±0.59 ^{ab}	211.99±75.04 ^{ab}
<i>F</i>		19.48	13.99
<i>P</i>		<0.001	<0.001

Table 2: Comparison of serum FGF-21 and vWF levels in different IMT patients ($\bar{x}\pm s$).

Note: ^a $P<0.05$ compared with group 0~5; ^b $P<0.05$ compared with group 6~10.

Comparison of serum Lp (a), FG, and uric acid levels between the control group and the study group

Compared to the control group, the serum Lp (a), FG, and uric acid levels in the study group were significantly higher ($P<0.05$). See Table 3.

Groups	Cases (n)	Lp (a) (mg/L)	FG (g/L)	Uric acid (mmol/L)
Study group	96	362.57±135.59	3.83±2.19	336.25±47.65
Control group	57	203.86±116.24	2.66±1.45	214.79±33.51
<i>t</i>		7.372	3.591	16.911
<i>P</i>		<0.001	<0.001	<0.001

Table 3: Comparison of serum Lp (a), FG, and uric acid levels between the control group and the study group ($\bar{x}\pm s$).

Comparison of serum Lp (a), FG, and uric acid levels in patients with different IMT

With increases in IMT levels, the serum Lp (a), FG, and uric acid levels increased significantly ($P<0.05$). See Table 4.

Groups	Cases (n)	Lp(a) (mg/L)	FG (g/L)	Uric acid (mmol/L)
Endometrial normal group	35	316.28±79.52	3.16±1.01	233.33±32.13
Endometrial thickening group	28	369.76±107.77 ^a	3.79±1.18 ^a	277.97±54.13 ^a
Endometrial plaque group	33	428.40±118.13 ^{ab}	4.39±1.28 ^{ab}	344.79±47.51 ^{ab}
<i>F</i>		10.18	9.59	53.07
<i>P</i>		<0.001	<0.001	<0.001

Table 4: Comparison of serum Lp (a), FG and uric acid levels in patients with different IMT ($\bar{x}\pm s$).

Note: ^a $P<0.05$ compared with group 0~5; ^b $P<0.05$ compared with group 6~10.

Correlation analysis between levels of serum FGF-21, vWF, Lp (a), FG, uric acid, and IMT in elderly patients with hypertension

Our Pearson correlation test analysis showed that levels of serum FGF-21, vWF, Lp (a), FG, and uric acid were significantly positively correlated with IMT in elderly patients with hypertension ($P<0.05$). See Table 5.

Indicators	IMT	
	<i>r</i>	<i>P</i>
FGF-21	0.251	<0.05
vWF	0.302	<0.05
Lp(a)	0.449	<0.05
FG	0.316	<0.05
Uric acid	0.733	<0.05

Table 5: Correlation analysis.

Discussion

With advances in social and economic development, the pressures of daily life are constantly increasing. Cases of hypertension are rising alongside this mounting pressure.

In China, hypertension has become one of the most prevalent chronic diseases; according to statistics, it accounts for more than 50% of common disease diagnoses among the elderly. It poses a serious threat to their health quality of life⁽⁷⁾. Elderly patients with hypertension experience damage to target organs due to the disease's lengthy onset period. Additionally, hypotension cure rates and treatment compliance rates are relatively low amongst elderly patients in China. Appropriate pathogenesis, standardized diagnosis, and treatment procedures for hypertension can reduce damage to other organs of the body. Attention to these areas will decrease the disability and mortality rates of hypertension patients, improving their quality of life.

At present, the pathogenesis of hypertension in China is unclear. It is thought to be the result of multiple intersecting factors, including hereditary quality, platelets, smooth muscle cells, endothelial cells, cholesterol, and lipoproteins⁽⁸⁾. Atherosclerosis is a systemic disease that can affect large and medium-sized arteries throughout the body. Carotid artery lesion is closely related to the development of cerebral infarction. Ultrasounds are often used clinically to detect IMT and atherosclerotic plaque in patients. Visentin et al.⁽⁹⁾ observed that IMT levels are closely related to the severity of cerebral infarction and coronary heart disease. IMT observation can be a non-invasive method for detecting early atherosclerosis, providing important clinical information. This method allows clinicians to deliver earlier diagnoses, evaluate curative effects, and consider surgical treatment options.

Many studies have confirmed that hypertension is closely related to atherosclerosis, and hypertension is an important risk factor for carotid atherosclerosis⁽¹⁰⁾. This study explored the correlation of serum FGF-21, vWF, Lp (a), FG, and uric acid levels with carotid atherosclerosis amongst elderly patients with hypertension. It did so by selecting factors such as FGF-21, vWF, Lp (a), and FG, combined with changes in the patient's IMT level.

FGF-21 belongs to the family of fibroblast growth factors and is an endogenous regulator of glucose and lipid metabolism, which can promote cell mitosis while facilitating the repair and metabolism of tissue damage⁽¹¹⁾. Some scholars have found that FGF-21 can improve blood lipids, insulin resistance, and anti-atherosclerosis, all of which can be used to predict cardiovascular disease⁽¹²⁾. vWF is a polysaccharide protein that is mainly produced by vascular endothelial cells and macrophages. It is an indispensable protein that allows platelets to adhere to the walls of damaged blood vessels. Mandorfer et al.⁽¹³⁾ reported that when patients develop hypertension, levels of vascular endothelial cells and vWF increase significantly due to changes in hemodynamics. These changes promote the adhesion and aggregation of platelets, notably increasing the rate of thrombosis. Boneu was the first to highlight vWF's importance as a marker of vascular endothelial damage⁽¹⁴⁾. Lp (a) is a special high polymorphic lipoprotein mainly composed of low-density lipoprotein-like particles.

Its specific apolipoprotein (a), which promotes the proliferation of median smooth muscle cells and increases their vitality, can be combined with

FG to prevent the formation of plasminogen activator-FG-plasminogen compound. This combination then promotes the formation of thrombus and plaque instability⁽¹⁵⁾. Studies have found that uric acid levels are closely related to the formation of atherosclerosis, and uric acid may be involved in the formation of atherosclerosis⁽¹⁶⁾. This may account for increases in uric acid levels, which promote the proliferation of oxygen free radicals in the body, produce an inflammatory response, and thereby encourage platelet aggregation⁽¹⁷⁾.

This study found that levels of serum FGF-21, vWF, IMT, Lp (a), FG, and uric acid were considerably higher than in patients with hypertension than in healthy subjects. With increases in IMT levels, the levels of serum FGF-21, vWF, Lp (a), FG, and uric acid also gradually increased. The indicators above are closely related to IMT levels. In summary, the levels of serum FGF-21, vWF, IMT, Lp (a), FG, and uric acid are significantly positively correlated with IMT. The indicators discussed in this paper can be used as barometers for judging the degree of carotid atherosclerosis in elderly patients with hypertension, helping to improve their health outcomes.

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Corresponding Author:
WENFANG CHEN
Email: cuipt3@163.com
(China)