The Correlation between Morning Blood Pressure Surge, Homocysteine and Left Ventricular Hypertrophy in Elderly Patients with Primary Hypertension

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Abstract

Objective: To investigate the correlation between morning blood pressure surge, homocysteine (Hcy) and left ventricular hypertrophy (LVH) in elderly patients with primary hypertension. **Method:** 215 cases of patients with hypertension from January 2015 to June 2016 were randomly selected from TianYou Hospital attached to WUST. Blood pressure was monitored 24 hours; according to the results, patients were divided into 81 cases of morning blood pressure surge group (study group) and 134 cases of non-morning blood pressure surge group (control group). Biochemical indicators of the two groups were measured, such as Hcy, Glu, blood lipid (TC, TG, LDL-C, HDL-C). The ventricular structure index (IVST, LVDD, LVPWT, LVMI) were measured by color doppler ultrasound. **Result:** 1) The IVST, LVDD, LVPWT and LVMI were significantly higher in study group than in control group ($P < 0.05$), and the incidence of left ventricular hypertrophy (LVH) (74.1%) was significantly higher in study group than in control group (22.4%) ($P < 0.05$). 2) There was no statistical difference in TC, TG, LDL-C and HDL-C between the two groups ($P > 0.05$). The serum levels of Hcy [(16.89 ± 5.84) mmol/L] in study group were significantly higher than those in control group [(10.88 ± 4.07) mmol/L] ($P < 0.05$). 3) Multivariate logistic regression analysis showed that morning blood pressure surge and Hcy were the risk factors of left ventricular hypertrophy. **Conclusion:** In elderly patients with hypertension, the higher the morning blood pressure surge and Hcy level, the more probability of left ventricular hypertrophy and the more obvious degree.

1. Introduction

Dynamic blood pressure monitoring shows that blood pressure rises rapidly in
the early morning awakening. It is the largest period of blood pressure fluctua-
tion throughout the day. The rapid changes in blood pressure during the morn-
ing stage are the relatively big blood pressure variability of the day. Morning
blood pressure surge is a phenomenon of a sudden increase in blood pressure
after waking up. At 6 o'clock to 10 o'clock in the morning, the systolic blood
pressure is increased by an average of 14 - 80 mmHg [1]. Related studies have
shown that: the morning blood pressure surge is closely related to acute coro-
nary syndrome, cerebral apoplexy and sudden cardiac death. It can aggravate the
damage to target organs such as the heart, brain and kidney, and the heart is the
main target organ of the damage [2] [3]. Recent studies have found that [4] [5]:
The serum Hcy plays an important role in the occurrence and development of
hypertension and coronary heart disease. Our study was to investigate the rela-
tionship between morning blood pressure surge, and homocysteine with left
ventricular hypertrophy in patients with essential hypertension.

2. Materials and Methods

2.1. General Material

The 215 cases of patients with hypertension from January 2015 to June 2016
were randomly selected from TianYou Hospital attached to WUST. The stan-
dard of diagnosis is adopted the guidelines for the prevention and treatment of
hypertension in China in 2010 [6]. And the patient did not take antihypertensive
drugs in the preliminary diagnosis or self-withdrawal at least 2 weeks or more.
due to various factors.

Exclusion criteria: taking antihypertensive drugs within 2 weeks of admission,
secondary hypertension, white coat hypertension, severe cardiovascular and ce-
rebrovascular diseases (heart failure, acute myocardial infarction, large area of
cerebral infarction, etc.), hypertension combined with diabetes, severe Liver and
kidney function damage, combined with autoimmune diseases, using glucocor-
ticoid 1 month before admission

2.2. Research Methods

2.2.1. Dynamic Blood Pressure Monitoring

All patients were monitored for 24 hours of dynamic blood pressure by using a
full-information portable dynamic blood pressure analyzer. Bind the cuff to the
patient's upper arm and use the cuff to inflate the pressure. The patient's blood

pressure was measured during daytime (6:00 - 22:00) and night (22:00 - 6:00), every 30 min to measure the patient's blood pressure 1 times. We recorded systolic blood pressure, diastolic blood pressure and heart rate respectively. Valid data is defined as the number of valid measurements in one day exceeding 80% of the total number of measurements. Morning blood pressure surge definition: According to the 2010 "Guidelines for the Prevention and Treatment of Hypertension in China", the mean value of the systolic blood pressure within 2 hours after getting up subtract the mean value of the systolic pressure in the time of night rest, ≥35 mmHg is defined as morning blood pressure surge Increase. The patients were divided into 81 cases of morning blood pressure surge group (study group) and 134 cases of non morning blood pressure surge (control group) by the above method.

2.2.2. Heart Color Ultrasound Detection

Using Siemens doppler ultrasound machine, the ventricular structure index of the two groups were measured: IVST, LVDD, LVPWT and so on. According to the Devereux formula, LVMI is calculated as follows: male LVMI > 125 g/m^2 or female LVMI > 120 g/m^2.

2.2.3. Biochemical Index Detection

All patients were selected to be on an empty stomach more than 12 hours, collecting the venous blood 3 - 5 ml of the elbow in the morning of the next day early morning, adopting Siemens automatic biochemical detector determination of homocysteine (Hcy), glucose (Glu), blood lipid (TC, TG, LDL, HDL-C-C).

2.2.4. Statistical Processing

Using SPSS17.0 statistical software to process relevant data. The measurement data of our study are in normal distribution, expression with $\overline{x} \pm s$, comparison between groups using t test. The incidence of left ventricular hypertrophy in both groups was compared with χ^2 test, risk factors using multivariate logistic regression analysis. P value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of the Basic Data between the Two Groups

There was no statistical difference in age, sex, hypertension duration, smoking, mean systolic blood pressure, mean diastolic blood pressure and heart rate between study group and control group ($P > 0.05$), it was comparable. The study group was significantly higher than the control group in the two groups about morning blood pressure surge ($P < 0.05$). As is shown Table 1.

3.2. Comparison of Left Ventricular Structure Index between the Two Groups

The levels of LVDD, IVST, LVPWT and LVMI in the morning blood pressure surge group were significantly higher than those in the non morning blood

pressure surge group (*P* < 0.05). The incidence of left ventricular hypertrophy (LVH) in the morning blood pressure surge group was significantly higher than that in the non morning blood pressure surge group (74.1%: 22.4%) (*P* < 0.05). As is shown Table 2.

3.3. Comparison of Biochemical Indicators and Hcy between the Two Groups

There was no statistical difference in TC, TG, LDL-C and HDL-C between the two groups (*P* > 0.05). The level of Hcy in study group was significantly higher than that in control group (*P* < 0.05). As is shown Table 3.

Table 1. Comparison of general data between the two groups ($\overline{x} \pm s$).

Group	Case	Age (year)	Gender (man/female)	Hypertension duration (year)	Smoking (case)
Study group	81	61.53 ± 11.43	46/35	9.46 ± 3.26	38
Control group	134	60.04 ± 10.76	68/66	8.56 ± 4.26	52

Group Pressure (mmHg)	Mean systolic blood pressure (mmHg)	Mean diastolic blood pressure surge (mmHg)	Morning blood (times/min)	Heart rate
Study group	125.33 ± 15.08	72.73 ± 9.68	38.21 ± 8.83[1]	73.12 ± 8.24
Control group	122.20 ± 11.45	71.20 ± 11.03	13.27 ± 7.55	72.56 ± 7.86

Note: compare with control group: [1]*P* < 0.05; SBP: mean systolic blood pressure; DBP: mean diastolic blood pressure; HR: heart rate.

Table 2. Comparison of left ventricular structure index between the two groups ($\overline{x} \pm s$).

Group	Case	LVDD (cm)	IVST (cm)	LVPWT (cm)	LVNI (g/m^2)	LVH n (%)
Study group	81	5.09 ± 0.15	1.03 ± 0.12	1.21 ± 0.13	140.89 ± 25.14	60 (74.1%)
Control group	134	4.38 ± 0.08	0.87 ± 0.11	0.98 ± 0.09	106.58 ± 16.43	30 (22.4%)
P	-	0.029	0.034	<0.001	<0.001	<0.001

Note: LVDD: left ventricular diastolic internal diameter; IVST: Interventricular septum; LVPWT: Left ventricular diastolic wall thickness; LVMI: left ventricular mass index; LVH: left ventricular hypertrophy.

Table 3. Comparison of biochemical markers and Hcy between the two groups ($\overline{x} \pm s$).

Group	Case	FBG (mmol/L)	TC (mmol/L)	TG (mmol/L)	LDL-C (mmol/L)	HDL-C (mmol/L)	Hcy (umol/L)
Study group	81	5.16 ± 0.71	4.89 ± 1.17	1.76 ± 1.03	3.01 ± 1.05	1.28 ± 0.81	16.89 ± 5.84
Control group	134	4.89 ± 0.55	4.78 ± 0.88	1.75 ± 1.12	2.93 ± 0.84	1.22 ± 0.30	10.88 ± 4.07
P	-	0.283	0.258	0.564	0.617	0.746	0.002

Note: Glu: fasting plasma glucose; TC: total cholesterol; TG: triglycerides; LDL-C: low density lipoprotein cholesterin; HDL-C: high density lipoprotein cholesterol.

3.4. Risk Factors Logistic Regression Analysis

The left ventricular hypertrophy was measured as the dependent variable, and

sex, age, hypertension, morning blood pressure and Hcy were measured as independent variables in Logistic regression analysis. The results showed that morning blood pressure surge and Hcy were correlated with left ventricular hypertrophy ($P < 0.05$). They are the independent risk factors of the left ventricular hypertrophy in hypertensive patients. As is shown Table 4.

4. Discussion

Primary hypertension is a cardiovascular syndrome whose main manifestation is systemic arterial pressure increase. It is one of the important risk factors of cardiovascular and cerebrovascular disease. It can cause target organ damages, and

Table 4. Multiple factors logistic regression analysis.

Variate	OR value	*P* value
Gender	1.249	0.702
Age	1.654	0.258
Smoking	1.321	0.521
Hypertension grades		
First	1 (Ref.)	0.623
Second	1.542	
Third	2.823	
Hypertension duration		
≤five years	1 (Ref.)	0.425
Five-ten years	1.783	
>ten years	3.245	
Morning blood pressure surge	1.09	0.02
Diabetes	2.125	0.124
Hyperlipemia	2.246	0.524
Hcy	0.346	<0.0

the common target organs such as heart, brain, kidney, etc, ultimately leading to organ failure. In the common target organ damages, cardiac damage is the most common. The main clinical manifestations are left ventricular hypertrophy. The heart is in a state of overload as the arterial blood pressure increases continually, resulting in compensatory cardiomyocyte hypertrophy, causing left ventricular hypertrophy, showing left ventricular weight increase. As the blood pressure is uncontrolled at long-term, it can develop to severe left ventricular hypertrophy, leading to left heart dysfunction, eventually causing congestive heart failure [7].

Gosse P, *et al.* [8] found that the elevated level of blood pressure was closely related to the quality of left ventricle and acute myocardial infarction, cerebral infarction, etc. It was not related to the average blood pressure level of 24 hours. Increase morning blood pressure surge cause left ventricular hypertrophy, which

may increase cardiac preload and after load. Hypertension is one of the risk factors for ventricular hypertrophy in the morning, and it may be the starting factor. The study indicated that the levels of LVDD, IVST, LVPWT and LVMI in the study group were significantly higher than those in the control group ($P < 0.05$). The incidence of left ventricular hypertrophy (LVH) in the study group was significantly higher than that in the control group ($P < 0.05$). It is consistent with the above findings.

Hcy is a sulfur product in methionine metabolism, and a large number of studies have shown that Hcy and hypertension are closely related, Hcy is not only a risk factor for the progressing of hypertension, but also a predictor to assess the happening of hypertension and the risk of cardiovascular events [9]. Alter P [10] [11] and other scientists found that the plasma Hcy level was positively correlated with the index of left ventricular hypertrophy. This study showed that Hcy was significantly higher in the morning blood pressure surge group than in the control group ($P < 0.05$). Left ventricular hypertrophy was measured as the dependent variable, and sex, age, hypertension, blood pressure, peak, Hcy, etc. were measured as independent variables for logistic regression analysis. The results showed that morning blood pressure surge and Hcy were correlated with left ventricular hypertrophy ($P < 0.05$), and that is, morning blood pressure surge and Hcy are an important risk factor for the development of left ventricular hypertrophy in patients with hypertension. The more severe the morning blood pressure surge, the higher the level of Hcy and the more possibly left ventricular hypertrophy happens. The study has found that the neurohumoral factors are involved in the formation of the morning blood pressure surge. Sympathetic nervous system activation may be the main reason for the rapid increase in morning blood pressure in the primary hypertension patiens, and rennin-angiotensin-aldosterone system, plasma cortisol, and other endocrine fluid factors are also involved in this process [12]. From this we can speculate Hcy as a humoral factor, and the level of its expression may be related to the level of morning blood pressure surge. They interact with each other, thus leading to the left ventricular hypertrophy. But which of the two is the motive factor remains to be further studied.

5. Conclusion

In summary, morning blood pressure morning surge and Hcy are independent influencing factors of the left ventricular hypertrophy in hypertensive patients, and both play an important role in the development of left ventricular hypertrophy. Monitoring serum Hcy level can indirectly reflect the occurrence of morning blood pressure surge phenomenon. It can also be the indirect basis of left ventricular diastolic dysfunction in patients with left ventricular hypertrophy. That timely detects and effectively controls the occurrence of the morning blood pressure surge phenomenon and monitoring the level of Hcy can reduce the incidence of cardiovascular and cerebrovascular accident in patients, thus improving the quality of patients life and long-term survival.

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