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Clinical Significance of Serum Uric Acid Combined with Cystatin C Detection in Patients with Different Levels of Hypertension with High Risk Degree and Above

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ABSTRACT

Objective: To explore the clinical significance of serum uric acid combined with cystatin C detection in high risk degree of hypertension of different grades. Methods: The patients who were treated in the Department of Cardiovascular Medicine of our hospital from January to December 2022 were selected as the study subjects, and the high risk and extremely high risk groups of grade I, II and III hypertension were selected for comparative analysis to explore their clinical significance. Results: There was a statistically significant difference in the number of patients with extremely high risk of grade II hypertension between men and women ($P < 0.05$), which showed that the prevalence rate of women with extremely high risk of grade II hypertension was higher than that of men; compared with the number of patients with high risk of grade III hypertension, the difference was statistically significant ($P < 0.05$), which showed that the prevalence rate of men with high risk of grade III hypertension was higher than that of women. The concentrations of serum uric acid and cystatin C were compared in groups with high risk of hypertension grade I, II and III; and the difference was not statistically significant ($P > 0.05$), which showed that there was no specificity in the concentration detection of serum uric acid and cystatin C in different grades of hypertension; there was no significant difference in serum uric acid concentration between grade II and grade III of hypertension with high risk grade and cystatin C concentration between grade I and grade III of hypertension with high risk grade ($P > 0.05$), but there was significant difference in the concentration detection of serum uric acid and

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cystatin C between the other groups (P < 0.05), which indicates that the detection of serum uric acid and cystatin C has important clinical significance in the high risk degree of hypertension. Conclusion: In the comparison of the detection of blood uric acid and cystatin C in different levels of hypertension with extremely high risk, the difference of cystatin C in grade I and grade III was not statistically significant, and the rest were statistically significant; therefore, the detection of serum uric acid and cystatin C can provide reliable laboratory data for clinical diagnosis and treatment of the extremely high risk degree of different levels of hypertension.

1. INTRODUCTION

Hypertension is a disease with continuous high blood pressure, which can cause stroke, heart disease, hemangioma, renal failure and other diseases. Hypertension is a systemic disease characterized by elevated arterial pressure and can be accompanied by functional or organic changes in heart, blood vessels, brain, kidney and other organs. It can be divided into primary hypertension and secondary hypertension [1-3]. There are many causes of hypertension, which can be divided into genetic and environmental aspects. In the absence of antihypertensive drugs, systolic blood pressure ≥ 139 mmHg and/or diastolic blood pressure ≥ 89 mmHg; and hypertension is divided into 1, 2 and 3 grades according to blood pressure level. Systolic blood pressure ≥ 140 mmHg and diastolic blood pressure < 90 mmHg are classified as simple systolic hypertension. The patient has a history of hypertension and is currently taking antihypertensive drugs; although the blood pressure is lower than 140/90 mmHg, it should also be diagnosed as hypertension [4, 5]. In order to explore the clinical significance of serum uric acid and cystatin C in different levels of hypertension, in this study, we selected hypertensive patients who were admitted to the Department of Cardiovascular Medicine of our hospital from January to December 2022 and were confirmed to be at high risk and very high risk after diagnosis and classification for analysis, to understand the changes of blood uric acid and cystatin C concentrations at high risk and very high risk in patients with different levels of hypertension; the research results are reported as follows.

2. METHOD

2.1. Research Object

1051 patients with different levels of hypertension were from high-risk and extremely high-risk patients hospitalized in our hospital from January to December 2022; Among them, there were 532 men and 519 women who were compared, $\chi^2 = 0.3216$, P = 0.5706, the difference was not statistically significant. There were 21 cases with high risk degree of grade I hypertension (12 males, 9 females), and after comparison between 12 males and 9 females, the difference was not statistically significant ($\chi^2 = 0.8571$, P = 0.3545); There were 32 cases with high risk degree (19 males, 13 females), and after comparison between 19 males and 13 females, the difference was not statistically significant ($\chi^2 = 2.2500$, P = 0.1336). There were 495 cases with high risk of grade II hypertension (248 males, 247 females), and after comparison between 248 males and 247 females, the difference was not statistically significant ($\chi^2 = 0.0040$, P = 0.9493); Among them, there were 95 cases with extremely high risk (37 males, 58 females), and after comparison between the males and females, the difference was statistically significant ($\chi^2 = 9.2842$, P = 0.0023). There were 144 cases with high risk degree of grade III hypertension (81 males and 63 females), and after comparison between the males and females, the difference was statistically significant ($\chi^2 = 4.5000$, P = 0.0339); There were 264 cases of extreme high risk, including 135 males and 129 females, and the difference was not statistically significant after the comparison between the males and females ($\chi^2 = 0.2727$, P = 0.6015). See Table 1 below for specific results. All enrolled cases in this study were approved by the Medical Ethics Committee of our Hospital (approval date: January 1, 2022, No.: 2022010102), and the patients themselves or their family members agreed and signed before entering the study.

Table 1. Gender comparison of high risk and very high risk in patients with different levels of hypertension.

Groups	High risk degree			Very high risk degree			Total cases
	I	II	III	I	II	III	
Male	12	248	81	19	37	135	532
Female	9	247	63	13	58	129	519
χ^2	0.8571	0.0040	4.5000	2.2500	9.2842	0.2727	0.3216
P	0.3545	0.9493	0.0339	0.1336	0.0023	0.6015	0.5706

2.2. Inclusion Criteria and Exclusion Criteria

The risk of hypertension is divided into four levels: low risk, medium risk, high risk and extremely high risk. Among them, 1) Grade I hypertension is called a low risk group when there are no risk factors or history of complications, a medium risk group when there are 1 - 2 risk factors, a high risk group when there are 3 or more risk factors or target organ damage, and a very high risk group when there are complications and combined diabetes. 2) The patients with secondary hypertension are called medium risk group when there are no risk factors and medical history. The patients with 1 - 2 other risk factors can also be called medium risk group. When there are more than 3 risk factors or target organ damage, it is called high risk group. When diabetes or other clinical complications are combined, it is called extremely high risk group. 3) When the patient is a tertiary hypertension, even if there are no risk factors and medical history, it is also called a high-risk group. Whether there are 1 - 2 other risk factors, >3 other risk factors or target organ damage, as well as clinical complications and diabetes, it is called an extremely high-risk group. The inclusion criteria of this study are to select patients with high and high risk of hypertension at all levels, and the exclusion criteria are patients with low and medium risk of hypertension.

2.3. Research Methods

All patients were taken 3 ml of centrifuged serum from venous blood on an empty stomach and stored in the refrigerator for standby; After collecting all patients' serum, the concentrations of serum uric acid and cystatin C of all patients were detected by Beckman Coulter AU5800 automatic biochemical analyzer, and the serum uric acid was detected by uricase - peroxidase method; Cystatin C was detected by latex enhanced immunoturbidimetry; All the data were recorded and tables were made to statistically analyze the differences of cystatin C and uric acid between the high risk and very high risk groups of patients with different levels of hypertension.

2.4. Reference Interval

The expected value of blood uric acid may vary by the difference of age, sex, sample type, diet, and geographical location. Each laboratory should verify the transferability of expected values to its population, and if necessary, determine its own reference range according to Good Laboratory Practice (GLP). When used for diagnosis, the results should be evaluated by combining the patient's medical history, clinical examination and other findings. According to relevant guidelines, the reference interval was confirmed as follows: uric acid: male: 208 - 428 μmol/L; female: 155 - 367 μmol/L.

The reference interval of cystatin C was derived from the experimental data of 120 healthy individuals, which is only for reference only; Due to the differences in region, sex, age, etc., the reference interval confirmed in this laboratory is: cystatin C: 0.55 - 1.05 mg/L.

2.5. Statistical Analysis

SPSS24.0 statistical software was used for statistical analysis, and x^2 test was used to compare the male

and female cases in each group; t test was used to compare the concentrations of serum uric acid and cystatin C in all groups, and $P < 0.05$ was considered statistically significant.

3. RESULTS

The blood uric acid concentrations of the groups with high risk of hypertension grade I, II and III were compared with each other, the t values were 0.4190, 0.0804 and 0.9455, respectively, and the P values were 0.3396, 0.4683 and 0.1726, respectively; The blood cystatin C concentrations in the groups with high risk of hypertension grade I, II and III were compared with each other, the t values were 0.7879, 0.4528 and 1.1951, and the P values were 0.2200, 0.3276 and 0.1165, respectively. The blood uric acid and cystatin C concentrations in each group were compared with each other, and the difference was not statistically significant ($P > 0.05$), which showed that the concentration detection of blood uric acid and cystatin C was not specific in different levels of high risk of hypertension; The blood uric acid concentrations of the groups with extremely high risk of hypertension I, II and III were compared with each other; The t values were 3.1793, 2.5216 and 1.5682, respectively, and the P values were 0.0014, 0.0082 and 0.0593, respectively. The blood cystatin C concentrations in the groups with high risk of hypertension I, II and III were compared with each other; the t values were 1.9602, 1.1298 and 2.1315, respectively, and the P values were 0.0287, 0.1331 and 0.0171, respectively. There was no statistically significant difference in the comparison of blood uric acid concentration between grade II and grade III and in the comparison of cystatin C concentration between grade I and grade III in hypertension of extremely high risk group ($P > 0.05$), but there was statistically significant difference in the comparison of test results in blood uric acid and cystatin C among other groups ($P < 0.05$), which indicates that the detection of blood uric acid and cystatin C has important clinical significance in the extremely high risk degree of hypertension. See Table 2 below for specific results.

Table 2. Thecomparison of blood uric acid and cystatin C test results in patients with different levels of hypertension athigh risk and extremely high risk.

Groups	Cases	UA		CYS-C	
A Grade I high risk group	21	399.62 ± 109.71		1.26 ± 0.69	
B Grade II high risk group	495	388.23 ± 122.49		1.14 ± 0.51	
C Grade III high risk group	144	397.71 ± 100.56		1.19 ± 0.42	
Comparison of each group	—	t	P	t	P
A-B Comparison	—	0.4190	0.3396	0.7879	0.2200
A-C Comparison	—	0.0804	0.4683	0.4528	0.3276
B-C Comparison	—	0.9455	0.1726	1.1951	0.1165
E Grade I extremely high risk group	32	456.84 ± 141.82		1.38 ± 0.63	
F Grade II extremely high risk group	95	371.06 ± 97.19		1.15 ± 0.36	
G Grade III extremely high risk group	264	391.30 ± 111.45		1.25 ± 0.47	
Comparison of each group	—	t	P	t	P
E-F Comparison	—	3.1793	0.0014	1.9602	0.0287
E-G Comparison	—	2.5216	0.0082	1.1298	0.1331
F-G Comparison	—	1.5682	0.0593	2.1315	0.0171

Note: For the convenience of comparison, we mark the groups with high risk of hypertension I, II and III as groups A, B and C, and the groups with extremely high risk of hypertension I, II and III as groups E, F and G.

4. DISCUSSION

Hypertension can be divided into slow progression type and rapid progression type according to the onset and progression of disease, and the slow progression type is more common [6-9]. Clinical manifestations of slow progressive hypertension: 1) Early manifestations: most of them are asymptomatic in the early stage; Occasionally, blood pressure is increased during physical examination, or symptoms such as dizziness, headache, giddiness, tinnitus, insomnia, fatigue, and inattention may be caused by advanced mental disorders; In the early stage, the blood pressure only temporarily increased, and then the blood pressure continued to rise with the progress of the disease, and the organs were involved. 2) Brain manifestations: headache and dizziness are common. It is often induced by emotional excitement, excessive fatigue, climate change or withdrawal of antihypertensive drugs. Blood pressure rises sharply. Severe headache, visual impairment, nausea, vomiting, convulsions, coma, transient hemiplegia, aphasia, etc. 3) Cardiac manifestations: in the early stage, cardiac function compensates, but the symptoms are not obvious; In the later stage, cardiac function decompensates, and heart failure occurs. 4) Renal manifestations: Renal arteriolar sclerosis caused by long-term hypertension; when renal function is reduced, it can cause nocturia, polyuria, and urine containing protein, tubular type and red blood cells; Urine concentrating function is low, and phenol red excretion and urea clearance are impaired; azotemia and uremia appeared. 5) Artery changes. 6) Eyeground changes; the rapidly progressive type of hypertension which is also known as malignant hypertension, accounting for 1% of hypertension disease; It can be suddenly changed from the slowly progressive type and can also cause disease. Malignant hypertension can occur at any age, but the most common is 30 - 40 years old. The blood pressure is significantly increased, the diastolic pressure is more than 17.3 Kpa (130 mmHg), and there are fatigue, thirst, polyuria and other symptoms. Visual acuity decreased rapidly, retinal hemorrhage and exudation were found in the fundus, and bilateral optic nerve papilla edema was often found. Rapid occurrence of proteinuria, hematuria and renal insufficiency. Heart failure, hypertensive encephalopathy and hypertensive crisis can also occur, and most of the patients die of uremia due to rapid progression of the disease.

Hypertension can be divided into three stages [10-13]: the first stage: blood pressure reaches the confirmed level of hypertension, without clinical signs of heart, brain and kidney damage. Phase II: The blood pressure reaches the confirmed level of hypertension, and there is one of the following: 1) physical examination, X-ray, electrocardiogram or echocardiogram which showed left ventricular enlargement. 2) The fundus examination showed that the fundus artery was generally or locally narrow. 3) The concentration of proteinuria or plasma creatinine slightly increased. Phase III: Blood pressure reaches the level of confirmed hypertension and has one of the following: 1) Cerebral hemorrhage or hypertensive encephalopathy. 2) Heart failure. 3) Renal failure. 4) Eyeground hemorrhage or exudation, with or without optic nerve papilla edema. 5) Angina pectoris, myocardial infarction, cerebral thrombosis. Hypertension can be divided into primary and secondary hypertension. In the vast majority of patients, the etiology of hypertension is unknown, which is called primary hypertension, accounting for more than 95% of the total hypertension patients. Secondary hypertension is secondary to other diseases, the most common of which are caused by kidney and adrenal diseases, and by endocrine hypertension.

Kidney damage is a serious complication in hypertensive patients, which is not easy to be detected and diagnosed early [14, 15]. The detection indicators of clinical evaluation of renal damage, such as blood uric acid (UA), cystatin C (CysC) and other indicators which have certain differences in the sensitivity and specificity in the assessment of the early renal damage [16-19]. Hypertension is a clinical frequently-occurring disease, which often occurs in the elderly; it is an important cause and risk factor of a variety of cardiovascular and cerebrovascular diseases and seriously endangers the quality of life of patients. At present, antihypertensive drugs are mostly used in clinical treatment, which can improve the clinical symptoms of patients, but some patients with good blood pressure control still have target organ damage. Studies have shown that dynamic monitoring of changes in serum uric acid (UA) and cystatin C (CysC) levels is beneficial to assess the damage of patients' important target organs, provide reliable basis for early diagnosis and treatment of elderly patients with hypertension, and facilitate the prediction of cardiovascu-

lar and cerebrovascular events [20-22].

The results of this study showed that there was a statistically significant difference in the number of patients with extremely high risk of grade II hypertension between men and women ($P < 0.05$), which showed that the prevalence rate of women with extremely high risk of grade II hypertension was higher than that of men; There was a statistically significant difference in the number of male and female patients with high risk degree of grade III hypertension ($P < 0.05$), which showed that the prevalence rate of men with high risk of grade III hypertension was higher than that of women.

The results of this study also showed that there was no statistically significant difference in serum uric acid and cystatin C concentrations between the groups with high risk of hypertension grade I, II and III ($P > 0.05$), which showed that there was no specificity in the detection of serum uric acid and cystatin C concentrations in different levels of hypertension; There was no statistically significant difference in the comparison of blood uric acid concentration between grade II and grade III and in the comparison of cystatin C concentration between grade I and grade III in hypertension of extremely high risk group ($P > 0.05$), but there was statistically significant difference in the comparison of test results in blood uric acid and cystatin C among other groups ($P < 0.05$),which indicates that the detection of blood uric acid and cystatin C has important clinical significance in the extremely high risk degree of hypertension.

5. CONCLUSION

There was no statistically significant difference in the comparison of blood uric acid concentration between grade II and grade III and in the comparison of cystatin C concentration between grade I and grade III in hypertension of extremely high risk group ($P > 0.05$), but there was statistically significant difference in the comparison of test results in blood uric acid and cystatin C concentration among other groups ($P < 0.05$); therefore, the detection of serum uric acid and cystatin C can provide reliable laboratory data for clinical diagnosis and treatment of extremely high risk of different levels of hypertension.

6. LIMITATIONS OF THE STUDY

The number of cases in each group selected in this study is quite different, and the statistical analysis results also have certain differences. Therefore, the results obtained in this study cannot represent all patients, so it has certain limitations. The next step will be further research under the same conditions.

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CONFLICTS OF INTEREST

For the publication of this paper, all members of the research group hereby declare that there is no conflict of interest in the ranking order of the authors.

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