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Application of Cystatin C Combined with Homocysteine Detection in AIDS and Tuberculosis Complicated with Hypertension

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Abstract

Objective: To investigate the application of cystatin C combined with homocysteine detection in AIDS and tuberculosis complicated with hypertension. **Methods:** 57 patients with AIDS complicated with hypertension and 52 patients with tuberculosis complicated with hypertension from Guangxi Infectious Diseases Hospital Nanning Fourth People's Hospital/Guangxi AIDS Clinical Treatment Center (Nanning) from October 2022 to March 2023, and 196 patients with simple hypertension from Guangxi Cardiovascular Diseases Hospital Nanning Third People's Hospital were selected as research objects. And then the difference in the detection results of cystatin C and homocysteine among the three groups was compared. **Results:** The detection results of serum cystatin C and homocysteine in AIDS patients with hypertension and tuberculosis patients with hypertension were higher than those in the simple hypertension group, and the difference was statistically significant ($P < 0.05$). However, there was no significant difference in the detection results of cystatin C or homocysteine between the AIDS hypertension group and the tuberculosis hypertension group ($P > 0.05$). **Conclusion:** The detection of cystatin C combined with homocysteine has high clinical application value in AIDS with hypertension and tuberculosis with hypertension. When AIDS is combined with hypertension or tuberculosis is combined with hypertension, cystatin C and homocysteine are at a high level, while the concentration levels of cystatin C and homocysteine are relatively low in simple hypertension. Therefore, cystatin C combined with homocysteine detection can provide better laboratory evidence for clinical diagnosis and differential diagnosis, and is worth promoting and applying.

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Keywords

Cystatin C, Homocysteine, AIDS, Tuberculosis, Hypertension

1. Background

In clinical practice, AIDS has no particularly obvious relationship with hypertension. AIDS is caused by human immunodeficiency virus infection, and after entering the human body, this disease will lead to a significant weakening of human immunity, which will lead to a variety of complications. In the late stage of AIDS, hypertension may also be triggered, but not all hypertension is related to AIDS [1]. Hypertension is generally influenced by dietary factors, environmental factors, and genetic factors. In daily life, if you want to reduce the incidence rate of hypertension, you should first control your own diet, ensure a diet of low sugar, low fat and low salt, and also take physical exercise in daily life. Tuberculosis has no special relationship with hypertension, and not all tuberculosis will cause hypertension [2]. Research has shown that general pulmonary tuberculosis and bone tuberculosis do not cause hypertension, while kidney diseases, including renal tuberculosis, may be related to hypertension because there are two nouns related to kidney diseases, namely, hypertensive nephropathy and renal hypertension. The former first has hypertension, which causes structural damage to the kidney and eventually leads to renal failure. The latter is hypertension caused by kidney disease, which is secondary hypertension, and hypertension caused by renal tuberculosis is one of them [3]. In order to explore the application of cystatin C combined with homocysteine detection in AIDS and tuberculosis complicated with hypertension, 57 patients with AIDS complicated with hypertension, 52 patients with tuberculosis complicated with hypertension and 196 patients with simple hypertension were selected as subjects in this study. Cystatin C and homocysteine were detected respectively in order to compare the differences among the groups. The results are reported as follows.

2. Materials and Methods

2.1. Research Object

57 cases of AIDS patients with hypertension and 52 cases of tuberculosis patients with hypertension were all from Guangxi Infectious Diseases Hospital—Nanning Fourth People's Hospital/Guangxi AIDS Clinical Treatment Center (Nanning), and were named as AIDS patients with hypertension group and tuberculosis patients with hypertension group, respectively. There were 42 males and 15 females in the group of AIDS patients with hypertension, and males and females were compared, $\chi^2 = 25.5789$, $P = 0.0000$; the difference was statistically significant, $P < 0.05$. The age ranged from 35 to 88 years, with an average age of (63.26 ± 11.26) years. In the group of tuberculosis with hypertension, there were 35 males and 17 females, and males and females were compared, $\chi^2 = 12.4615$, $P = 0.0004$,

the difference was statistically significant, P < 0.05. The age ranged from 42 to 92 years, with an average age of (70.37 ± 9.64) years. Gender comparison between the two groups of patients, χ^2 = 0.5331, P = 0.4653, the difference was not statistically significant, P > 0.05. Compared with the age of the two groups, t = 3.5247, P = 0.0003, the difference was statistically significant, P < 0.05. Both groups excluded other opportunistic infectious diseases and complications, and the inclusion criteria were simple AIDS with hypertension or tuberculosis with hypertension. 196 patients with simple hypertension were from the Guangxi Cardiovascular Hospital—Nanning Third People's Hospital. They were named the simple hypertension group, with 87 males and 109 females, male and female comparison, χ^2 = 4.9388, P = 0.0263, the difference was statistically significant, P < 0.05. The age ranged from 26 to 97 years, with an average age of (66.56 ± 12.65) years. The selection of cases in this group excluded the combination of other diseases. After comparing the sex of patients in the simple hypertension group, the AIDS with hypertension group and tuberculosis with hypertension group, the values of χ^2 were 15.1660 and 8.6379, respectively, and the P values were 0.0001 and 0.0033, respectively, with statistically significant differences (P < 0.05). Compared with age, t were 2.3613, 1.7751, and P were 0.0101, 0.0395, respectively, and the differences were statistically significant, P < 0.05. The specific results are shown in Table 1 below. All cases were included in the study group for research only with the consent of the patient or his family and the approval of the Ethics Management Committee of the medical institution.

2.2. Research Methods

3 ml of venous blood was extracted from all patients on an empty stomach and centrifugally separated serum was stored in the refrigerator. After collecting the

Table 1. Comparison of general information of patients in each group.

Group	Number of cases			Age	
	Total number of cases	Male	Female		
1) AIDS with hypertension group	57	42	15	63.26 ± 11.26	
2) Tuberculosis with hypertension group	52	35	17	70.37 ± 9.64	
3) Simple hypertension group	196	87	109	66.56 ± 12.65	
Group Comparison		χ^2	P	t	P
1)-2) Comparison	-	0.5331	0.4653	3.5247	0.0003
2)-3) Comparison	-	8.6379	0.0033	1.7751	0.0395
1)-3) Comparison	-	15.1660	0.0001	2.3613	0.0101

serum from all patients, the concentrations of cystatin C and homocysteine in the blood of all patients were detected using a Beckmann AU5800 automatic biochemical analyzer. Cystatin C was detected by latex-enhanced immune turbidimetry. Homocysteine was detected by enzyme cycle method. All the data were recorded and tables were made to statistically analyze the differences between cystatin C and homocysteine among the groups of AIDS patients with hypertension, tuberculosis patients with hypertension and simple hypertension.

2.3. Reference Interval

The reference interval of cystatin C was derived from the experimental data of 120 healthy individuals, which is for reference only. Due to the differences in region, gender, age, etc., the reference interval confirmed for use by this laboratory is: cystatin C: 0.55 - 1.05 mg/L. Reference values for homocysteine may vary depending on age, gender, sample type, diet, and geographic location. Each laboratory should verify whether this reference range is suitable for the local population, and establish its own reference range if necessary. The results should be evaluated in conjunction with the patient's medical history, clinical diagnosis, and other examination results [4] [5]. The reference range for homocysteine in adult males and females is: 5 - 15 μmol/L. The value of homocysteine in men is higher than that in women, and the value of homocysteine in postmenopausal women is higher than that in premenopausal women. As age increases, the value of homocysteine generally increases. The reference value range for elderly people (>60 years of age) is 5 - 20 μmol/L. A decrease in homocysteine levels was observed in samples taken from patients who received folic acid supplementation, such as intake of folic acid-fortified foods. Based on 120 healthy human samples, the statistical results were analyzed and combined with references to confirm the reference value range (95% confidence interval) as follows: adults (≥19 years old) 5 - 15 μmol/L.

2.4. Statistical Analysis

SPSS24.0 software was used for statistical analysis, and χ^2 test was used to compare the male and female cases in each group. The comparison of cystatin C and homocysteine concentrations among all groups was performed by t-test, and $P < 0.05$ was considered to be statistically significant.

3. Results

The concentrations of cystatin C and homocysteine in AIDS patients with hypertension were 2.03 ± 1.57 mg/L and 22.35 ± 12.02 μmol/L, respectively. The concentrations of cystatin C and homocysteine in tuberculosis patients with hypertension were 1.93 ± 1.56 mg/L and 20.19 ± 12.06 μmol/L, respectively. The concentrations of cystatin C and homocysteine in patients with simple hypertension were 1.30 ± 0.61 mg/L and 13.25 ± 10.47 μmol/L, respectively. Compared with the concentration of cystatin C and homocysteine in the AIDS

hypertension group and the tuberculosis hypertension group, the t-values were 0.3332 and 0.9356, respectively, and the P values were 0.3698 and 0.1758, respectively. The difference was not statistically significant ($P > 0.05$). Compared with the concentration of cystatin C and homocysteine in the group of tuberculosis with hypertension and the group of simple hypertension, the t-values were 2.9908 and 4.1123, respectively, and the P values were 0.0021 and 0.0001, respectively. The differences were statistically significant ($P < 0.05$). The comparison of cystatin C and homocysteine concentrations between the AIDS patients with hypertension and the patients with simple hypertension showed that t-values were 3.4358 and 5.5810, respectively, and P values were 0.0005 and 0.0000, respectively. The differences were statistically significant ($P < 0.05$), and the specific results are shown in Table 2 below.

4. Discussion

AIDS itself has no direct relationship with hypertension [1]. Hypertension is generally highly correlated with genetic factors, environmental factors and dietary factors, so good control of a healthy diet has a great relationship with reducing the risk of hypertension. AIDS patients are prone to hypertension, mainly because HIV destroys the human immune system, which leads to a variety of complications. Complications lead to increased blood pressure, but AIDS itself does not cause hypertension. Complications are easy to lead to vascular diseases, especially cardiovascular diseases, which can lead to vascular inflammation and atherosclerosis, and it is easy to have medium and high cholesterol, which is the basis of cardiovascular stenosis. When there is chronic inflammation in the artery and stenosis of the heart and brain vessels, the elasticity of the blood vessels can be weakened, leading to an increase in blood pressure. At this time, while controlling AIDS, we should also control hyperlipidemia and inhibit atherosclerosis, and also inhibit chronic inflammation of blood vessels. After this comprehensive treatment, it is possible to control blood pressure. Therefore, although

Table 2. Comparison of detection results of cystatin C and homocysteine in three groups.

Group	No. of cases	Cystatin C		Homocysteine	
1) AIDS with hypertension group	57	2.03 ± 1.57		22.35 ± 12.02	
2) Tuberculosis with hypertension group	52	1.93 ± 1.56		20.19 ± 12.06	
3) Simple hypertension group	196	1.30 ± 0.61		13.25 ± 10.47	
Group Comparison		t	P	t	P
1)-2) Comparison	-	0.3332	0.3698	0.9356	0.1758
2)-3) Comparison	-	2.9908	0.0021	4.1123	0.0001
1)-3) Comparison	-	3.4358	0.0005	5.5810	0.0000

there is no direct relationship between AIDS and hypertension, there is an inevitable relationship. Most patients with AIDS are prone to hypertension, hyperlipidemia, heart disease, stroke and so on. Therefore, early diagnosis of AIDS and active control of hypertension are the basis for the treatment of other diseases and the key to prolonging life. After suffering from AIDS, blood pressure indicators should be monitored daily in a timely manner.

Like the mechanism of AIDS, there is no special relationship between tuberculosis and hypertension, and tuberculosis itself does not cause hypertension. We know that tuberculosis, which is most likely to be complicated by hypertension, is mainly pulmonary tuberculosis. In clinical practice, pulmonary tuberculosis generally does not cause hypertension. Pulmonary tuberculosis is a chronic infectious disease of the respiratory system caused by the decline of the body's immunity and infection by external *Mycobacterium tuberculosis* [6]. However, hypertension is a chronic disease caused by many reasons that increase the lateral pressure of blood in the blood vessels against the blood vessel wall beyond the normal range, mainly affecting target organs such as the heart, brain, and kidney. The two diseases are different. Tuberculosis can be cured by early regulation combined with anti-tuberculosis drug treatment, which is mainly caused by lung inflammation. However, hypertension is a disease characterized by temporarily unknown elevated blood pressure, which requires long-term drug treatment [7]. Tuberculosis can cause low fever, night sweating, coughing, and expectoration, and a few patients may experience chest pain. There are many factors that can cause hypertension, such as genetic factors or frequent low sodium, high potassium diets. Clinically, it can cause dizziness, headache, insomnia, and forgetfulness. Tuberculosis refers to lesions confined to the lungs. If the structures in the lungs are severely damaged, it may lead to pulmonary hypertension, which can lead to a functional insufficiency of the right heart. Hypertension is a group of cardiovascular syndromes characterized by elevated systemic arterial pressure [8]. There is no clear correlation between the two, so for hypertension, a factor related to its pathogenesis, including genetic factors and environmental factors and other factors interact. Among them, genetic factors are relatively important, with a significant familial predisposition. If both parents have hypertension, the probability of their children becoming ill is as high as 46%. About 60% of hypertensive patients also have a familial history of hypertension. There are also some mental stress factors, smoking, high salt diets, being overweight, and oral hormone drugs that can lead to an increase in blood pressure.

Hypertensive nephropathy is also known as hypertensive renal arteriolar sclerosis, which is the damage of renal structure and function caused by essential hypertension. The common symptoms of patients are hypertension, hematuria, albuminuria, etc. Clinical studies have shown that there is no sign at the early stage of hypertensive nephropathy, and the results of routine examinations are mostly negative. If the patient's kidney has pathological results, the kidney injury has been very serious, so it is of great significance to conduct the examination of

kidney injury at the early stage of hypertension [9] [10] [11] [12]. Previous studies have shown that [13] [14] [15], glomerular filtration rate is the "gold standard" for evaluating clinical renal function, and CysC can inhibit the activity of cysteine protease. Cysteine protease can cooperate with matrix metalloproteinases to degrade extracellular matrix, and its degradation rate of extracellular matrix depends on the level of CysC [16] [17] [18]. In general, the higher the level of CysC, the slower the rate of degradation of the extracellular matrix, and the higher the chance of vascular wall remodeling in patients. The glomerular filtration rate can be reflected by serum cystatin C, and Hcy is a sulfur-containing amino acid that is a primary intermediate product of methionine produced during circulatory metabolism [19] [20]. Normally, levels of Hcy are low in the human body. However, if the decomposition rate of Hcy in human body is much lower than the rate of its production, it is easy to accumulate in large quantities in blood vessels and generate peroxides, which can damage vascular endothelium, change the function of coagulation factors, promote platelet aggregation, accelerate the formation of atherosclerotic plaques, and then cause thrombosis and other cardiovascular and cerebrovascular events [21] [22]. Serum homocysteine levels increased with the severity of patients during renal impairment. The research results show that H-type hypertension is the main disease in China, and its incidence is about 80%, while the Hcy concentration of H-type hypertension is above 10 μmol/L [23] [24]. The results of this study showed that the average concentration of Hcy in the three groups was more than 10 μmol/L, and the average concentration of Hcy in the simple hypertension group was more than 13 μmol/L, while the average concentration of Hcy in the AIDS group with hypertension and the tuberculosis group with hypertension was even more than 20 μmol/L. The diagnostic results of the three groups were in line with the diagnostic standards of H-type hypertension in China.

The results of this study showed that among the enrolled AIDS patients with hypertension and tuberculosis patients with hypertension, the prevalence rate of male patients was higher than that of female patients, and the difference was statistically significant ($P < 0.05$), indicating that the incidence of HIV and tuberculosis patients with hypertension was higher in males than in females, in other words, males were more susceptible. This may be related to the different dietary habits of men and women, and may also be related to the higher prevalence of AIDS or tuberculosis in men than in women. In patients with simple hypertension, the prevalence rate of women was higher than that of men, which was different from that of AIDS and tuberculosis patients with hypertension, and the difference was statistically significant ($P < 0.05$). This indicates that women with simple hypertension have a higher risk of developing the disease than men, in other words, women are more susceptible. This may be due to the conditions under which cases are selected, or it may be due to genetic factors or dietary habits. The results of this study showed that the comparison of the average age among the subjects in the three groups was statistically significant, $P < 0.05$,

which indicated that the three groups were different in the age of hypertension. The average age of AIDS combined with hypertension was lower than that of tuberculosis combined with hypertension and simple hypertension. Secondly, the mean age of the patients with simple hypertension was lower than that of the patients with tuberculosis combined with hypertension. The highest mean age was found in the patients with tuberculosis combined with hypertension, which may be related to the pathogenesis of various diseases and the selection of enrolled cases.

The results of this study also showed that there was no significant difference in the concentration of cystatin C and homocysteine between the AIDS hypertension group and the tuberculosis hypertension group ($P > 0.05$). This indicates that the concentration of cystatin C and homocysteine in both the AIDS group with hypertension and tuberculosis group with hypertension were consistently increased to varying degrees, but there was not much difference between them. However, the concentrations of cystatin C and homocysteine in the AIDS hypertension group and tuberculosis hypertension group were compared with those in the simple hypertension group, and the differences were statistically significant ($P < 0.05$). These results indicated that the levels of the increased concentration of cystatin C and homocysteine in the simple hypertension group are lower than that in the AIDS hypertension group and tuberculosis hypertension group. In other words, the levels of the increased concentration of cystatin C and homocysteine in patients with simple hypertension were relatively low, or even not necessarily increased or slightly increased. This study can provide more powerful laboratory data for the clinical diagnosis of AIDS with hypertension and tuberculosis with hypertension.

5. Conclusion

To sum up, the detection of cystatin C and homocysteine has high clinical application value in AIDS with hypertension and tuberculosis with hypertension. When AIDS is combined with hypertension or tuberculosis is combined with hypertension, cystatin C and homocysteine are at a high level, while the concentration of cystatin C and homocysteine in simple hypertension is relatively low. Therefore, the detection of cystatin C combined with homocysteine can provide better laboratory evidence for clinical diagnosis and differential diagnosis and is worth promoting and applying.

6. Limitations of the Study

The number of enrolled cases of AIDS with hypertension and tuberculosis with hypertension selected in this study is relatively small and the research conclusions have certain limitations. The next step of the research will increase investment and collect more cases of AIDS with hypertension and tuberculosis with hypertension for research in order to make the research results more representative.

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Conflict of Interest Statement

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

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