

Analysis of Clinical Characteristics of Patients with Different Types of Primary Hyperuricemia

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Abstract: *Objective:* This paper aims to study the clinical characteristics of patients with different types of primary hyperuricemia (HUA). *Methods:* Using a retrospective research method, 200 patients with primary HUA in the hospital from June 2020 to January 2023 were selected as the research objects. Patients were grouped according to the detection results of 24-hour urinary uric acid excretion (UUE) and fractional excretion of uric acid (FEUA) (renal insufficiency type, renal overload type, mixed type, and other types). The general information of patients in the four groups (gender, age, body mass index, living habits, etc.), underlying diseases (hypertension, diabetes), blood test results [uric acid (UA), creatinine (Cre)], urine test results (24-hour urine UA, 24-hour urine Cre) were summarized and the differences between the groups were analyzed. *Results:* The 200 cases of HUA patients were divided into 54.00% with renal insufficiency type, 38.50% with mixed type, 6.00% with renal overload type, and 1.50% with other types. The age of patients with mixed HUA was younger than that of patients with other types, renal overload type, and renal insufficiency type, and the difference was statistically significant ($P < 0.05$). The UA level of patients with other types of HUA was lower than that of patients with mixed type HUA, and there was statistical significance ($P < 0.05$). The Cre level of patients with mixed type HUA was lower than that of patients with renal insufficiency type and renal overload type, and the difference was statistically significant ($P < 0.05$). The 24-hour urinary UA level in patients with renal insufficiency type HUA was lower than that in patients with renal overload type and mixed type HUA, and the difference was statistically significant ($P < 0.05$). The 24-hour urinary Cre level of patients with other types of HUA was lower than that of patients with renal overload type and mixed HUA, the difference was statistically significant ($P < 0.05$). The estimated glomerular filtration rate (eGFR) level of patients with other types of HUA was lower than that of patients with mixed type HUA, and the difference was statistically significant ($P < 0.05$). There was no significant difference in the proportions of hypertension, diabetes, coronary heart disease, and urinary calculi among patients with renal insufficiency type, renal overload type, mixed type, and other types of HUA ($P > 0.05$). *Conclusion:* The primary HUA patients are mainly of renal insufficiency type, followed by mixed type. There are significant differences in the clinical characteristics of patients with different types of HUA. Among them, patients with other types of HUA are the oldest and have the lowest uric acid levels. Patients with mixed HUA had the best renal function but the highest 24-hour urine creatinine level. This study can be used as a basis for rational selection of urate-lowering drugs for different HUA patients.

Keywords: Primary hyperuricemia; Impaired renal excretion; Excessive renal load; Blood test; Urine test; Clinical features

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1. Introduction

Hyperuricemia (HUA) is a metabolic disease characterized by abnormally elevated blood uric acid levels. Purine metabolism disorders, excessive uric acid secretion, or renal excretion dysfunction will cause uric acid to accumulate in the patients' blood. It will form an accumulation state, and if blood uric acid exceeds the saturation in blood or interstitial fluid, forms sodium urate crystals and deposits in local joints, thus inducing local inflammatory response and tissue destruction, which is gout^[1]. As an important basis for the onset of gout, HUA is not only a risk factor for atherosclerotic cardiovascular disease and a promoting factor for arteriosclerosis, but also a risk factor for metabolic diseases such as chronic kidney disease, hypertension, and diabetes^[2]. The statistical results suggest that the number of HUA patients in China has reached 120 million, the incidence of HUA can reach 21.96%, and the incidence of HUA in males can reach 29.39%. HUA has become one of the main public health problems in China at this stage^[3]. Therefore, the analysis of the clinical characteristics of HUA patients has a positive effect on improving the cognition level of clinical HUA diseases and ensuring the treatment effect of clinical HUA diseases. In this study, the clinical characteristics of patients with different types of primary HUA were grouped and analyzed.

2. Materials and methods

2.1. Clinical information

Using a retrospective research method, 200 patients with primary HUA in the hospital from June 2020 to January 2023 were selected as the research objects. They were grouped according to the detection results of 24-hour urinary uric acid excretion (UUE) and fractional excretion of uric acid (FEUA), including renal insufficiency type, renal overload type, mixed type, and other types. This study was approved by the Hospital Medical Ethics Committee.

Diagnostic criteria for HUA included the results of two fasting blood uric acid tests $> 420\mu\text{mol/L}$ (adults, male or female) on different days^[4].

HUA typing standard is based on 24-hour urinary uric acid excretion (UUE) and fractional excretion of uric acid (FEUA) typing:

- (1) Renal insufficiency type: $\text{UUE} \leq 600\text{mg/d}/1.73\text{m}^2$ and $\text{FEUA} < 5.5\%$
- (2) Renal overload type: $\text{UUE} > 600\text{mg/d}/1.73\text{m}^2$ and $\text{FEUA} \geq 5.5\%$
- (3) Mixed type: $\text{UUE} > 600\text{mg/d}/1.73\text{m}^2$ and $\text{FEUA} < 5.5\%$
- (4) Other types: $\text{UUE} \leq 600\text{mg/d}/1.73\text{m}^2$ and $\text{FEUA} \geq 5.5\%$ ^[4]

Inclusion criteria:

- (1) Patients aged ≥ 18 years
- (2) Patients who meet the diagnostic criteria for HUA in the "Chinese Guidelines for the Diagnosis and Treatment of Hyperuricemia and Gout (2019)"^[4]
- (3) All patients with primary HUA, with normal renal function test results, and the glomerular filtration rate (estimated glomerular filtration rate, eGFR) $\geq 60\text{ml}/\text{min}/1.73\text{m}^2$
- (4) The patients whose examinations were performed before treatment

Exclusion criteria:

- (1) Patients with HUA caused by malignant tumor diseases, radiotherapy, and chemotherapy
- (2) Patients with a history of taking urate-lowering drugs, diuretics, and other drugs that affect uric acid excretion 30 days before the examination
- (3) Patients with hyperthyroidism or abnormalities, rhabdomyolysis, primary kidney disease, etc.

2.2. Methods

Firstly, the general information and results of the four groups of patients were summarized, including three indicators of gender, age, and body mass index, and the proportion of patients drinking and smoking was counted.

Secondly, blood and urine tests were performed for all patients in the four groups. The blood test items included blood uric acid (UA), serum creatinine (Cre), while the urine test items included 24-hour urine UA, 24-hour urine Cre, and eGFR.

Lastly, four groups of patients underwent blood sugar and blood pressure testing to evaluate whether the patients had diabetes^[5], hypertension, and coronary heart disease.

2.3. Statistical methods

SPSS22.0 software was used to complete the statistical analysis of the data, and the measurement data was represented by mean \pm standard deviation (SD), the difference between two groups was analyzed by *t* test, and the difference between multiple groups was analyzed by *F* test. The count data was represented by percentage (%) and the difference between groups was represented by χ^2 test analysis. $P < 0.05$ means the difference is statistically significant.

3. Results

3.1. Classification of the types of HUA patients

Among the 200 HUA patients, 172 were male (86.00%) and 28 were female (14.00%). According to the HUA classification standard, there were 108 cases (54.00%) with renal insufficiency type, 77 cases (38.50%) with mixed type, 12 cases (6.00%) of renal overload type, and 3 cases (1.50%) of other types. There were 30 cases (15.00%) of patients who had urinary stones.

3.2. Comparison of the general data of the four groups of patients

There was no significant difference in gender, body mass index (BMI), alcohol drinking ratio, and smoking ratio among patients with renal insufficiency type, renal overload type, mixed type, and other types of HUA ($P > 0.05$). The age of patients with mixed HUA was lower than that of patients with other types, renal overload type, and renal insufficiency type, and the difference was statistically significant ($t = 2.911, 2.348, 4.987, P < 0.05$). The details are shown in **Table 1**.

Table 1. Comparison of general data of patients in four groups

Group	Number of cases (200)	Gender (%)		Age	BMI (kg/m ²)	Living habit (%)	
		Male	Female			Alcohol drinking	Smoking
Group of renal insufficiency type HUA	108	87 (80.56)	21 (19.44)	52.37 \pm 15.46	26.05 \pm 3.27	37 (34.26)	43 (39.81)
Group of renal overload type HUA	12	11 (91.67)	1 (8.33)	50.49 \pm 15.22	25.83 \pm 3.26	3 (25.00)	6 (50.00)
Group of mixed type HUA	77	70 (90.91)	7 (9.09)	42.18 \pm 10.74	25.59 \pm 3.94	29 (37.66)	25 (32.47)
Group of other types of HUA	3	2 (66.67)	1 (33.33)	60.85 \pm 15.83	25.82 \pm 3.51	1 (33.33)	1 (33.33)
Statistics	-	4.991		9.082	0.252	0.797	2.931
<i>P</i>	-	0.172		< 0.001	0.860	0.850	0.402

3.3. Comparison of blood and urine test results of four groups of patients

The UA level of patients with other types of HUA was lower than that of patients with mixed type HUA, and the difference was statistically significant ($t = 2.052, P < 0.05$). The Cre level of patients with mixed type HUA was lower than that of patients with renal insufficiency type and renal overload type, and the difference was statistically significant ($t = 3.807, 2.094, P < 0.05$). The 24-hour urinary UA level in patients with renal insufficiency type HUA was lower than that in patients with renal overload type and mixed type HUA, and the difference was statistically significant ($t = 11.507, 16.988, P < 0.05$). The 24-hour urinary Cre level of patients with other types of HUA was lower than that of patients with renal overload type and mixed type HUA, and the difference was statistically significant ($t = 2.431, 3.441, P < 0.05$). The eGFR level of the patients with other types of HUA was lower than that of patients with mixed HUA, and the difference was statistically significant ($t = 2.052, P < 0.05$). The results are shown in **Table 2**.

Table 2. Comparison of blood and urine test results of four groups of patients

Group	Number of cases	UA (μmol/L)	Cre (μmol/L)	24-hour urine UA (mg/d/1.73m ²)	24-hour urine Cre (mmol/L)	eGFR (ml/min/1.73m ²)
Group of renal insufficiency type HUA	108	511.83 ± 92.76	93.95 ± 15.24	425.83 ± 106.95	12.08 ± 3.63	84.85 ± 19.26
Group of renal overload type HUA	12	472.95 ± 105.31	94.67 ± 15.66	855.81 ± 224.75	14.54 ± 3.52	82.58 ± 18.45
Group of mixed type HUA	77	556.86 ± 105.62	85.28 ± 15.31	757.23 ± 158.39	16.81 ± 3.75	94.63 ± 18.26
Group of other types of HUA	3	428.96 ± 115.68	101.62 ± 20.37	462.37 ± 95.94	9.28 ± 2.21	72.73 ± 12.54
<i>f</i>	-	5.350	5.585	104.756	26.794	5.192
<i>P</i>	-	0.001	0.001	< 0.001	< 0.001	0.002

3.4. Comparison of the proportion of basic diseases and stones in the four groups of patients

There was no significant difference in the proportions of hypertension, diabetes, coronary heart disease, and urinary calculi among patients with renal insufficiency type, renal overload type, mixed type, and other types of HUA ($P > 0.05$), as presented in **Table 3**.

Table 3. Comparison of the proportion of basic diseases and stones in the four groups of patients [n (%)]

Group	Number of cases	Hypertension	Diabetes	Coronary heart disease	Urinary stones
Group of renal insufficiency type HUA	108	79 (73.15)	43 (39.81)	17 (15.74)	17 (15.74)
Group of renal overload type HUA	12	10 (83.33)	4 (33.33)	3 (25.00)	2 (16.67)
Group of mixed type HUA	77	56 (72.73)	38 (49.35)	11 (14.29)	10 (12.99)
Group of other types of HUA	3	2 (66.67)	1 (33.33)	1 (33.33)	1 (33.33)
χ^2	-	0.698	2.286	1.568	1.108
<i>P</i>	-	0.874	0.515	0.667	0.775

4. Discussion

HUA is a metabolic disease characterized by purine metabolism disorder and/or abnormal secretion of uric acid. In recent years, while the incidence of HUA disease has gradually increased in China, the age of onset in patients is younger than before^[6]. Elevated body mass index, abnormally increased body mass index, renal function damage, and abnormal blood lipid levels are all risk factors for the onset of HUA^[7]. However, in

the treatment of HUA patients, although the use of urate-lowering drugs can effectively inhibit the increase of uric acid levels in HUA patients, the selection of urate-lowering drugs must comprehensively consider the indications, contraindications, and types of HUA [4]. The reason is that although the related uric acid-lowering drugs all have uric acid-lowering effects, there are differences in the onset mechanism, therapeutic effect, and safety effect of different uric acid-lowering drugs. For example, allopurine and febuxostat belong to the drug mechanism of inhibiting uric acid production. Probenecid, benzbromarone, etc. belong to the drug mechanism of promoting uric acid excretion [8]. Therefore, the results of HUA typing will directly determine the patient's treatment plan and follow-up results. Understanding and clarifying the clinical characteristics of different types of HUA patients will play a positive role in improving the accuracy of HUA typing and ensuring the effectiveness of HUA treatment [9].

In this study, 200 HUA patients were classified based on the HUA classification criteria in the "Chinese Guidelines for the Diagnosis and Treatment of Hyperuricemia and Gout (2019)" [4]. Compared with the method of using kidney FEUA or UUE for typing, it further considers the changes of the above two indicators when the patient is on a low-purine diet, making the patient typing results more accurate. In the research results, among the 200 HUA patients, there were 172 males (86.00%) and 28 females (14.00%). The proportions of different HUA types were 54.00% of renal insufficiency type, 38.50% of mixed type, 6.00% of renal overload type, 1.50% of other types. It shows that HUA patients are generally dominated by renal insufficiency type, followed by mixed type, thus these two types are the main types of HUA patients. In the comparison of the general data of the patients, it was found that the mixed type HUA patients were younger than the other types, the renal overload type, and the renal insufficiency type HUA patients ($P < 0.05$). It shows that the age of patients with mixed HUA is relatively young, which is similar to the research results of Zhou *et al.* [10]. The study by Zhou *et al.* [10] also confirmed that in the case of age stratification, HUA patients in all age groups are mainly of renal insufficiency type, but the proportion of mixed type patients will gradually decrease as the age of patients increases. This is also the main reason the proportion of patients with mixed HUA ranked second in this study. Compared with other studies, this study also compared the proportion of underlying diseases and calculus diseases in patients with different types of HUA. The results found that there was no statistically significant difference ($P > 0.05$) in the proportions of hypertension, diabetes, coronary heart disease, and urinary calculi in patients with renal insufficiency type, renal overload type, mixed type, and other types of HUA. It shows that the risk of developing hypertension, diabetes, and other basic diseases and urinary calculi in patients with different types of primary HUA is the same.

At the same time, the UA level of other types of HUA patients in this study was lower than that of mixed type HUA patients ($P < 0.05$). The 24-hour urinary Cre level of other types of HUA patients was lower than that of renal overload type and mixed type HUA patients ($P < 0.05$). The eGFR level of patients with other types of HUA was lower than that of patients with mixed type of HUA ($P < 0.05$). It can be seen that the blood uric acid level is the lowest in patients with other types of HUA, and the 24-hour urinary uric acid and urine creatinine levels are also the lowest. Therefore, it is speculated that other types of HUA are likely to be the early stage of HUA disease. Patients begin to have symptoms of abnormal blood uric acid level, and may change to other HUA types when blood uric acid levels continue to increase. At the same time, the Cre level in patients with mixed HUA was lower than that in patients with renal insufficiency and renal overload ($P < 0.05$). It shows that the serum creatinine level is the lowest in mixed HUA patients, but the 24-hour urinary Cre and eGFR levels in mixed HUA patients are the highest among the four groups of patients. It shows that patients with mixed HUA have better renal function and stronger kidney load resistance, thus the level of creatinine in urine is also the highest. Clinicians can use this as a basis to help HUA patients to choose more suitable uric acid-lowering

drugs, such as drugs that promote uric acid excretion for patients with other types of HUA, and drugs that inhibit uric acid production for patients with mixed HUA.

To sum up, primary HUA patients are mainly consisted of renal insufficiency type, and the clinical characteristics of different types of HUA patients are significantly different. Among them, other types of HUA patients are the oldest and have the lowest uric acid level, and mixed type HUA patients have the best renal function. However, the 24-hour urine creatinine level was the highest. This study can be used as a basis for rational selection of uric acid-lowering drugs for different HUA patients.

Disclosure statement

The author declares no conflict of interest.

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