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Study on the Risk of Metabolic Syndrome Based on UA/Cr Analysis

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Abstract: To explore the epidemiological trend of the relationship between serum uric acid/creatinine ratio(UA/Cr) and metabolic syndrome (MS) in middle-aged and old people in Wuhan, Hubei Province. The study used the method of cluster sampling, In 2016, 6570 residents over 45 years old in Wuhan City, Hubei Province were investigated with standardized questionnaire, physical examination and biochemical examination. MS is defined according to the standard of the International Diabetes Union. According to the quartile grouping of UA/Cr, the regression analysis of risk metabolism indexes between UA / Cr and MS was carried out. Analyze the correlation between UA / Cr and MS to determine whether UA / Cr can be an independent risk factor of MS.6414 subjects were included in this study including 3313 MS patients (52.7%). Blood CR level is 77(70~87) mmol/L,Blood UA level is 314(267~372) mmol/L,UA/Cr level is 4.01(3.46~4.65). The study population was divided into four groups according to the UA / Cr quartile.Group 1 UA/Cr <1.0, Group 2 1.0≤UA/Cr<1.5,Group 3 1.5≤UA/Cr<2.0,Group 4 UA/Cr≥2.0. From the first group to the fourth group, with the increase of UA / Cr level, the body mass index (BMI), waist circumference, blood pressure, triacylglycerol, low-density lipoprotein cholesterol, total cholesterol, C-reactive protein and insulin resistance increased gradually ($P < 0.01$). The prevalence of MS and its components also increased significantly ($P < 0.01$).Conclusion:There was an independent positive correlation between UA / Cr and MS in the middle-aged and old people in the community, UA / Cr can be used as early biomarker of MS. It provides a new scientific basis for the early detection of MS, the intervention of high-risk population and the reversal of cardiovascular disease.

Keywords: Ratio of Serum Uric Acid/Creatinine; Metabolic Syndrome; Middle Aged and Old People

1. Introduction

Metabolic syndrome (MS) is a clinical syndrome in which multiple metabolic abnormalities accumulate in the same individual, including abnormal glucose regulation, abdominal obesity, hypertension, lipid metabolism disorder, etc. The common influence of heredity and environmental factors on its pathogenesis.

There are many risk factors defining MS, but they can't explain all cardiovascular events. Therefore, it is suggested that other risk factors such as inflammatory biomarkers, microalbumin, hyperuricemia should be included in the definition of MS. Previous studies have found that elevated serum uric acid and creatinine can increase the risk of MS, hypertension and cardiovascular disease. Gersch *et al*found that increased blood uric acid increased the risk of MS by 1.6 times. During Norvik *et al* 7-year follow-up, he found that the increase of serum uric acid was also significantly related to MS. At the same time, the study also found that serum creatinine was significantly related to MS, hypertension, cardiovascular disease and obesity. Renal function affects the correlation between serum uric acid, MS and its components,because uric acid is mainly removed by urine, the impairment of renal function is closely related to

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the decrease of glomerular filtration rate, the increase of serum creatinine level and the increase of serum uric acid level. At the same time, the increase of serum uric acid can reflect the change of renal function and is an independent predictor of MS and cardiovascular events.The standardized blood uric acid of renal function, such as UA / Cr, reflects the net output of uric acid. It may be a better biomarker to predict MS and related diseases.

The purpose of this study is to understand the UA / Cr level and MS prevalence of residents over 45 years old in Wuhan, Hubei Province The relationship between UA / Cr and MS and its components was further explored, which provides new ideas for early detection of MS high-risk groups and prevention of MS and related diseases, it provides clues for the formulation of health strategy as well.

2. Research objects and methods

From May 2017 to August 2018, 6570 permanent residents over 45 years old who participated in the survey of diabetes and other chronic diseases in Wuhan City, Hubei Province in 2016 were investigated with standardized questionnaire, physical examination, biochemical test, etc. After the elimination of 156 patients with loss of serum uric acid, creatinine, MS and other indicators, 6414 subjects were finally included in the statistical analysis. All subjects in this study signed written informed consent.

In this paper, we use five research methods: medical history record, physical examination, blood examination, MS diagnosis and statistical treatment.

Information was collected one by one according to the order of international standardized questionnaire, including demographic data, smoking and drinking history, physical activity level, eating habits, etc. Current smoking or current drinking is defined as regular smoking or drinking behavior within the first 6 months of the survey. The level of physical activity was calculated by international physical activity questionnaire. All investigators are strictly and uniformly trained.

All subjects received routine physical examination, including height, weight, waist circumference and resting blood pressure. When measuring the waist circumference, the subjects stood vertically, and when they exhaled calmly, they were measured around the umbilicus, with an accuracy of 0.1cm.

Height measurement is accurate to 0.1cm, weight measurement is accurate to 0.1kg, body mass index (BMI) = weight / height 2 (kg / m2).After sitting for at least 10 minutes, the subjects took their non dominant arms and measured their blood pressure three times with Omron model hem-752fuzzy (OMRON company). The interval of each time was at least 1 min. The average value of three times was taken for analysis.

In the morning, the fasting venous blood (fasting for at least 10 hours) was collected and the serum triglyceride (TG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (H) were detected by Beckman coulterau5800 DL-C). Serum uric acid was measured by enzymatic method, creatinine was measured by picric acid method, fasting insulin was measured by Electrochemiluminescence Method (rochecobas e 601 electrochemiluminescence analyzer), fasting blood glucose was measured by hexose excitation method, insulin resistance level was assessed by homeostasis model assessment of insulin resistance (HOMA-IR), HOMA-IR = fasting pancreas Island element (mIU / L × fasting blood glucose (mmol / L) / 22.5.

SAS 9.3 statistical software was used for data analysis. All the quantitative data of normal distribution are expressed by X ± s; the quantitative data of non normal distribution are expressed by median, quartile range m (p25-p75), and statistical analysis is conducted after logarithmic transformation; the qualitative data are expressed by number of people (composition ratio). The subjects were divided into the first group, the second group, the third group and the fourth group according to the UA / Cr quartile. One way ANOVA and χ 2 test were used to compare the variables of continuous normal distribution.

3. Result analysis

(1) Basic information of the object

This study included 6414 subjects, including 3313 (52.7%) of MS patients, 1032 (43.9%) of male patients and 2281 (56.1%) of female patients, 77 (70-87) mmol / L of Cr, 314 (267-372) mmol / L of UA and 4.01

(3.46-4.65) of UA / CR. According to the UA / Cr quartile, the study population was divided into four groups: group 1, UA / Cr < 1.0; group 2, 1.0 ≤ UA / Cr < 1.5; group 3, 1.5 ≤ UA / Cr < 2.0; and group 4, UA / Cr ≥ 2.0. The results showed that the BMI, waist circumference, systolic blood pressure, diastolic blood pressure, insulin resistance, TG, LDL-C, TC, and C-reactive protein levels increased gradually with the increase of UA / Cr (P < 0.01); the risk of MS, hypertension, hyperglycemia, low HDL-C, high Tg and central obesity also increased significantly (P < 0.01) . 01); HDL-C level showed a downward trend (P < 0.01) (**Table 1**).

Parameter	Group 1	Group 2	Group 3	Group 4	P
Number	1 603	1 604	1 604	1 603	/
Age (years)	62.6±9.2	62.2±8.7	62.2±8.6	62.1±8.6	0.2300
BMI(kg/m2)	23.9±3.5	24.6±3.3	25.2±3.4	26.0±3.6	<0.0001
Waist(cm)	81.1±10.2	82.6±10.1	84.3±9.6	86.5±10.3	<0.0001
Systolic pressure(mmHg)	133.9±18.1	139.9±17.7	135.0±16.5	136.2±16.8	0.0003
Diastolic pressure(mmHg)	75.6±9.7	75.8±9.7	76.7±9.3	77.1±9.6	<0.0001
Fasting blood glucose(mmol/L)	6.21±1.71	6.10±1.43	6.08±1.37	6.17±1.33	0.0400
Insulin resistance index	1.60(1.10~2.40)	1.74(1.21~2.58)	1.93(1.32~2.81)	2.32(1.57~3.43)	<0.0001
TG(mmol/L)	1.27(0.96~1.76)	1.44(1.08~1.96)	1.55 1.14~2.16)	1.87(1.31~2.69)	<0.0001
LDL-C(mmol/L)	3.51±0.79	3.60±0.76	3.60±0.77	3.69±0.84	<0.0001
HDL-C(mmol/L)	1.39±0.33	1.35±0.30	1.32±0.30	1.29±0.28	<0.0001
TC(mmol/L)	5.17±0.99	5.25±0.95	5.27±0.98	5.41±1.12	<0.0001
C reactive protein(mg/L)	0.19(0.14~0.28)	0.21(0.16~0.30)	0.23(0.17~0.34)	0.26(0.19~0.40)	<0.0001
Dietary factors (Edible frequency×Food consumption)	32.3±17.6	33.3±19.6	32.6±16.8	32.5±16.5	0.4500
MS[n(%)]	624(38.9)	744(46.4)	876(54.1)	1069(66.7)	<0.0001
Hypertension [n(%)]	1058(66.0)	1082(67.5)	1171(73.0)	1228(76.6)	<0.0001
Hypertriglyceridemia [n(%)]	452(28.2)	579(36.1)	688(42.9)	927(57.8)	<0.0001
Low and high density lipoprotein [n(%)]	432(27.0)	457(28.5)	587(36.6)	648(40.4)	<0.0001
Hyperglycemia [n(%)]	938(58.5)	951(59.3)	954(59.5)	1061(66.2)	<0.0001
Central obesity [n(%)]	622(38.8)	725(45.2)	881(54.9)	993(62.0)	<0.0001
Physical activity(MET-h/wk)	16.8(3.0~21.0)	15.0(4.5~21.0)	18.0(4.5~21.0)	15.0(3.0~21.0)	0.2200
Smoking at present [n(%)]	314(19.6)	321(20.0)	300(18.7)	297(18.5)	0.6700
Drinking at present [n(%)]	181(11.3)	212(13.2)	221(13.8)	292(18.2)	<0.0001

Table 1. Basic characteristics of population grouped by the quartile of UA / Cr ratio

(2) Regression analysis of risk factors and metabolic indexes of UA / Cr and MS

After adjusting for age, gender, current smoking, current drinking, physical activity and diet factors, multiple regression analysis showed that UA/Cr was positively correlated with BMI, waist circumference, systolic blood pressure, diastolic blood pressure, TG, TC, LDL-C, C-reactive protein and insulin resistance (P < 0.01); UA/Cr was most significantly correlated with waist circumference and systolic blood pressure (β ± se was 2.15 ± 0.15; 1.17 ± 0.27, respectively) , P < 0.01); UA / Cr and HDL-C levels were significantly negatively correlated (P < 0.01); there was no correlation between UA / Cr and fasting blood glucose (P > 0.05) (**Table 2**).

Parameter	β±SE	P
Waist(cm)	2.15±0.15	<0.0001
BMI(kg/m^2)	0.82±0.05	<0.0001
Systolic Pressure(mmHg)	1.17±0.27	<0.0001
Diastolic Pressure(mmHg)	0.71±0.14	<0.0001
Fasting Blood Glucose(mmol/L)	-0.006±0.02	0.7900
Insulin Resistance Index	0.06±0.004	<0.0001
TG①(mmol/L)	0.06±0.003	<0.0001
HDL-C(mmol/L)	-0.04±0.004	<0.0001
LDL-C(mmol/L)	0.05±0.01	<0.0001
TC(mmol/L)	0.08±0.02	<0.0001
C-reactive protein①(mg/L)	0.05±0.004	<0.0001

Note: ① adjusted for age, gender, current smoking and drinking, diet and physical activity

Table 2. Correlation Analysis of UA / Cr ratio with MS risk factors and metabolic indexes

In addition, UA / Cr was used as a continuous variable and adjusted for age, gender, BMI, current smoking, current drinking, physical activity, eating habits and C-reactive protein. It was found that UA / Cr was significantly related to MS, hypertension, high Tg, low HDL-C, insulin resistance and central obesity ($P \leq 0.01$) (**Figure 1**); and it was most related to high Tg The or and 95% CI were 1.51 (1.41-1.62).

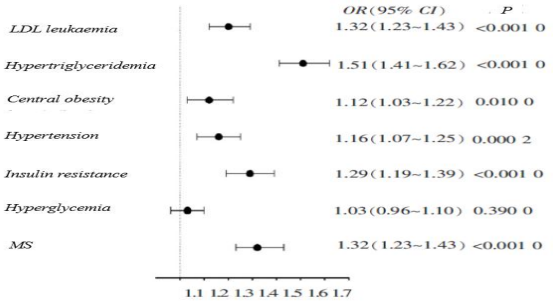

Figure 1. Correlation between UA / Cr ratio and MS.

4. Conclusion

Among the elderly in Wuhan, Hubei Province, with the increase of UA / Cr level, BMI, waist circumference, systolic blood pressure, diastolic blood pressure, insulin resistance, TG, LDL-C, TC, and C-reactive protein levels increased gradually. The risk of MS, hypertension, hyperglycemia, low HDL-C, high Tg and central obesity also increased significantly.

UA/Cr ratio is a good biomarker for predicting chronic kidney disease, and it is better than UA in blood.Al daghri *et al* confirmed that the UA/Cr value of type 2 diabetic patients was related to their MS and components. The results of this study show that UA/Cr is significantly correlated with high Tg and low HDLC, which is consistent with the conclusions of foreign studies.

UA/Cr is significantly correlated with high Tg and low HDLC, which is consistent with the conclusions of existing studies. Possible explanation for the relationship between UA/Cr and hypertriglyceridemia: at the same time, TG synthesis promotes the de novo synthesis of phosphoribosylpyrophosphate-5 through the common metabolic pathway, thus increasing the production of UA.There is a negative correlation between UA/Cr and HDL-C. the possible reason is that low HDL-C level is significantly related to insulin resistance, and insulin increases serum UA concentration by reducing UA excretion and then resistance.

Among the middle-aged and old people in Wuhan City, Hubei Province, Ms shows a high prevalence. UA/Cr value is positively correlated with MS and its components. UA/Cr value has important clinical value for early detection of MS high-risk population,

prevention of chronic kidney disease and cardiovascular disease. At the same time, to understand the correlation between UA/Cr and MS is helpful to provide strategies for early prevention of diseases, and to provide ideas for the formulation of health strategies.

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