

SHORT COMMUNICATION

The Comparison of Urinary Stones Between *She* Minority and *Han* Nationality in East Fujian, China

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SUMMARY

Background: The purpose of the study was to compare the incidence of urinary stones of *She* minority and *Han* nationality and analyze the composition of urinary stones.

Methods: The study was performed in 381 cases with 181 *She* minority and 200 *Han* nationality. The composition of stones was mainly analyzed by infrared absorption spectrum. The incidence of urinary stones at different ages, different gender and different parts was compared between *She* minority and *Han* nationality.

Results: The urinary stone incidence of males was about twice as high as in women in *She* minority and *Han* nationality, and the incidence reached its maximum between the ages of 41 and 60, but the incidence decreased after 60 years of age. The distribution characteristics of urethra stones between *She* minority and *Han* nationality showed a significant difference ($p < 0.05$). The differences of carbonate apatite and struvite in male and female were statistically significant between *She* minority and *Han* nationality ($p < 0.05$). The level of Ca^{2+} and HPO_4^{2-} in serum showed significant difference between *She* minority and *Han* nationality ($p < 0.05$).

Conclusions: According to these results, we put forward corresponding preventive measures of urinary stones in *She* minority.

(Clin. Lab. 2017;63:xx-xx. DOI: 10.7754/Clin.Lab.2017.161209)

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KEY WORDS

composition analysis, urinary stones, east Fujian, *She* minority, *Han* nationality

INTRODUCTION

Urinary stones, one of the common urinary system diseases, are primary or secondary in the spectrum of urological diseases and topped the list in urology hospitalized patients [1]. The epidemic data of European and American countries showed that 5% - 10% of the people in life suffer from urinary tract stones once, and the incidence of urinary stones in Europe are about 100 - 400/100000 [2]. With the development of science and technology and the improvement of living standards, the structure of residents' diet has undergone great changes, which results in that the overall incidence of urinary stones increasing to 3% - 8% in China [3,4]. With the increasing incidence of urinary stones in China, the medical workers pay more and more atten-

tion to the metabolic risk factors of urinary stones. To understand the reason for formation of urinary stones, composition analysis of urinary stones has become an important research direction. The composition analysis of urinary stones is not only the method of determining the physical and chemical properties of urinary stones, but also the important basis of the preventive measures and treatment methods of urinary stones.

Southern China has a more highly developed economy than northern China, including Fujian province. The incidence of urinary stones in southern China is 5% -10% [5]. Fujian province is located in the subtropical zone, and the incidence of urinary stones is significantly high [6,7]. Persons of the *She* nationality in the area of east Fujian have a relatively high incidence of urinary stones. *She* nationality, being an ethnic minority in China, mainly live in Fujian province and Zhejiang province, about 0.54 million of which inhabit in Ningde city, east Fujian [8].

At present, there has been significant research regarding urinary stones in different populations [9-11]. However, there is no report about the composition analysis of urinary stones in *She* minority and the comparative analysis of the association with biochemical indicators between *She* minority and *Han* nationality. Because *She* minority in east Fujian are still have a lower economic status and their health conditions are poor, we focused our research on the comparison of urinary stones between *She* minority and *Han* nationality so as to pinpoint the reason for the higher incidence of urinary stones in *She* minority with the aim to reduce the incidence of urinary stones in *She* minority. We compared and investigated the composition of the stones and serum biochemistry of patients with urinary stones of both *She* minority and *Han* nationality in east Fujian. The study has important significance for formulating the prevention and cure measures of urinary stones in the area and providing a reference of prevention and therapy of urinary stones in the regions, especially for patients with urinary stones in *She* minority.

MATERIALS AND METHODS

Research population

Three hundred and eighty-one cases (*She* minority: 181 cases, *Han* nationality: 200 case) of patients with urinary stones were included in the prospective study. These patients with urinary stones from the Affiliated Mindong Hospital of Fujian Medical University were diagnosed by B ultrasound, X-rays, and computed tomography (CT) during the period of January 2011 to February 2016. The patients of *She* minority were 181 cases, including 118 male and 63 female cases. The 200 patients of *Han* nationality included 132 male and 68 female cases. Patients suffering from chronic non obstructed kidney disease, digestive system disease and blood system disease, autoimmune disease, having a history of drug abuse and long-term application of hor-

none and immune inhibitors, or had left the place of residence for 2 years or more were excluded from the study.

Methods and apparatus

The stones were collected by open surgery, endoscopic surgery, extracorporeal shock wave lithotripsy (ESWL), and patients spontaneously removing urinary calculus. The chemical compositions of the stones were determined by using an integrative analysis approach. The integrated analysis procedure encompasses several, or all of the following techniques: infrared spectrophotometry, chromatography, polarization crystallography, and photomicroscopy.

Calcium oxalate monohydrate (COM) [$\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$], calcium oxalate dihydrate (COD) [$\text{CaC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$], hydroxyapatite (HAD) [$\text{Ca}_5\text{HO}_{13}\text{P}_3$], carbonate apatite (CA) [$\text{Ca}_{10}(\text{PO}_4)_6\text{CO}_3 \cdot \text{H}_2\text{O}$], uric acid (UA) [$\text{C}_5\text{H}_4\text{N}_4\text{O}_3$], and struvite (STR) [$\text{NH}_4\text{MgPO}_4 \cdot 6\text{H}_2\text{O}$] were measured as the main composition of the urinary stones. The serological examination and the urine analysis of *She* minority and *Han* nationality measured the comparison, including Ca^{2+} , HPO_4^{2-} , Mg^{2+} , UA, SG, pH and 24 hours urine volume. The infrared-spectrometer is a Nicolet Avatar 360 spectrometer from Thermo Fisher Scientific (USA). The urine automatic analyzer is automated urine analysis system (URISYS-2400) from Roche Diagnostics GmbH (Germany).

Statistical analysis

The statistical analyses in this work were carried out by SPSS version 17.0. The comparison of enumeration data between groups was by Chi-square test, and the comparison of quantitative data between groups was by *t*-test. Values for $p < 0.05$ were considered statistically significant.

RESULTS

The urinary stones incidence of *She* minority and *Han* nationality in terms of gender and age

As shown in Table 1, the urinary stones incidence of males was about twice as many females in *She* minority and *Han* nationality, and with the increasing of age, the incidence of urinary stones gradually increased in *She* minority and *Han* nationality. The incidence reached its maximum between the ages of 41 and 60, but the incidence decreased after 60 years of age. According to the Table 1, the incidence of urinary stones showed no significant differences in terms of gender and age between *She* minority and *Han* nationality.

The distribution characteristics of urinary stones of *She* minority and *Han* nationality

As shown in Table 2, urinary stones were given priority to kidney stones, followed by ureteral stones. The kidney stones accounted for 70.34%, and ureteral stones had an incidence of 16.80%. According to the Table 2,

Table 1. The urinary stones incidence of *She* minority and *Han* nationality in terms of gender and age.

	Male		Female		Total
	<i>She</i> minority	<i>Han</i> nationality	<i>She</i> minority	<i>Han</i> nationality	
≤ 20 years	1 (0.85)	2 (1.52)	0	1 (1.47)	4 (1.05)
21 - 30 years	6 (5.08)	7 (5.30)	3 (4.76)	3 (5.88)	20 (5.25)
31 - 40 years	22 (18.64)	22 (16.67)	9 (14.29)	11 (16.18)	64 (16.80)
41 - 50 years	28 (23.73)	33 (25.00)	17 (26.98)	16 (23.53)	94 (24.67)
51 - 60 years	33 (27.97)	38 (28.79)	21 (33.33)	21 (30.88)	119 (31.23)
61 - 70 years	16 (13.56)	18 (13.64)	7 (11.11)	8 (11.76)	43 (11.29)
≥ 70 years	12 (10.17)	12 (9.09)	6 (9.52)	7 (10.29)	37 (9.71)
Total	118	132	63	68	381

Table 2. The distribution of urinary stones of *She* minority and *Han* nationality.

	Kidney		Ureter		Bladder		Urethra	
	Male	Female	Male	Female	Male	Female	Male	Female
<i>She</i> minority	81	42	18	8	9	6	10	7
<i>Han</i> nationality	92	50	24	9	13	8	3	1
χ^2	0.006	0.167	0.214	0.828	0.003	0.004	4.670	5.241
p-value	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	< 0.05	< 0.05

Table 3. The composition analysis of urinary stones of *She* minority and *Han* nationality.

	<i>She</i> minority		<i>Han</i> nationality		Total
	Male	Female	Male	Female	
Calcium oxalate monohydrate	50 (42.37)	21 (33.33)	66 (50.00)	30 (44.12)	167 (43.83)
Calcium oxalate dihydrate	11 (9.32)	8 (12.70)	14 (10.61)	10 (14.71)	43 (11.29)
Hydroxyapatite	20 (16.95)	9 (14.29)	26 (19.70)	14 (20.59)	69 (18.11)
Carbonate apatite	16 (13.56) ^a	11 (17.46) ^b	7 (5.30)	4 (5.88)	38 (9.97)
Struvite	13 (11.02) ^c	10 (15.87) ^d	5 (3.79)	3 (4.41)	31 (8.14)
Uric acid	8 (6.68)	4 (6.35)	14 (10.61)	7 (10.29)	33 (8.66)
Total	118	63	132	68	381

^a - comparing with the male in *Han* nationality, $\chi^2 = 4.77$, $p < 0.05$. ^b - comparing with the female in *Han* nationality, $\chi^2 = 4.18$, $p < 0.05$. ^c - comparing with the male in *Han* nationality, $\chi^2 = 4.63$, $p < 0.05$. ^d - comparing with the female in *Han* nationality, $\chi^2 = 4.67$, $p < 0.05$.

the distribution characteristics of kidney stones, ureteral stones, and bladder stones in *She* minority and *Han* nationality did not show significant differences ($p > 0.05$). However, there was a significant difference in urethra stones between *She* minority and *Han* nationality ($p < 0.05$).

The composition analysis of urinary stones of *She* minority and *Han* nationality

As shown in Table 3, the overall results were that calcium oxalate monohydrate was the most common and

accounted for 43.83%, hydroxyapatite was the second most common and accounted for 18.11%, calcium oxalate dihydrate was in third place and accounted for 11.29%, and carbonate apatite was in the fourth. However, according to the Table 3, carbonate apatite and struvite in *She* minority were slightly higher than in *Han* nationality, and the differences of carbonate apatite and struvite in males and females were statistically significant between *She* minority and *Han* nationality ($p < 0.05$).

Table 4. The comparison of serological examination and urine analysis of *She* minority and *Han* nationality.

	Serological examination (mmol/L)				Morning urine examination		24 hours urine volume (mL)
	Ca ²⁺	HPO ₄ ²⁻	Mg ²⁺	UA	SG	pH	
<i>She</i> minority	2.43 ± 0.23	1.42 ± 0.37	1.12 ± 0.23	279.51 ± 75.43	1.021 ± 0.00.05	6.12 ± 0.76	1889 ± 761
<i>Han</i> nationality	2.21 ± 0.38	1.11 ± 0.21	1.01 ± 0.16	289.63 ± 88.45	1.026 ± 0.02	5.89 ± 0.64	2091 ± 915
p-value	< 0.05	< 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05

The comparison of serological examination and urine analysis of *She* minority and *Han* nationality

As shown in Table 4, there was no significant statistical difference regarding the level of Mg²⁺, UA, pH, and specific gravity (SG) between *She* minority and *Han* nationality ($p > 0.05$), and the 24 hours urine volume showed no significant differences between *She* minority and *Han* nationality ($p > 0.05$). However, the level of Ca²⁺ and HPO₄²⁻ in serum showed significant difference between *She* minority and *Han* nationality ($p < 0.05$).

DISCUSSION

The research showed a significant difference between the distribution characteristics of urethra stones in *She* minority and *Han* nationality ($p < 0.05$). In addition, the differences of carbonate apatite and struvite in males and females were statistically significant between *She* minority and *Han* nationality ($p < 0.05$), and the level of Ca²⁺ and HPO₄²⁻ in serum showed significant differences between *She* minority and *Han* nationality ($p < 0.05$).

The analysis of urinary stones can reflect the physical and chemical changes of urine and metabolic disorders in the process of the urinary stone formation and provides important evidence of the preventive treatment of urinary stones and causes of the urinary stone formation. Fujian is a typical southern climate, and east Fujian is a coastal region. Local people like eating seafood and drinking, and the incidence of urinary stones in the area is on the high side. Thus, it is necessary to analyze the composition of massive urinary stones in order to carry out research on the prevention measures of urinary stones. Table 1 showed that the incidence of urinary stones shows significant differences in gender, and the incidence in males was higher than females in *She* minority and *Han* nationality. The male to female ratio of urinary stones in this study was 1.91:1 in the area of east Fujian, as shown in Table 1. Considering men engaged in heavy manual labor, sweated more at the time of labor, and failed to add timely moisture to the body, the metabolites in male urine were more than in female, androgen increased the level of calcium oxalate, and estrogen increased the level of citric acid which was deemed to be a crystallization inhibitor in urine. The

above factors result in the higher incidence of stones in males compared to females.

Urinary stones can occur at any age. The age of patients with urinary stones increases gradually and increasingly concentrates. In this study, the incidence of urinary stones of the group between 31 and 60 years accounted for 73.48% and 72.00% in *She* minority and *Han* nationality, respectively, which made the people between 31 and 60 years become the high-risk groups of urinary stone incidence. The reason may be that the people between 31 and 60 years have heavy working intensity, sweat more, and drink less. The incidence of females between 51 and 60 was higher than males, which may be due to rarefaction of bone, decreasing of estrogen, increasing of bone calcium re-absorption, and reducing of citric acid excretion. However, the incidence of males over 60 years was obviously higher than females. The reason may be that the old men were susceptible to hyperplasia of the prostate, which results in a high incidence of urinary stones.

Kidney and ureter belongs to the upper urinary tract, and bladder and urethra belongs to the lower urinary tract. According to the Table 2, the stones of the upper urinary tract in *She* minority and *Han* nationality were significantly more than the lower urinary tract, of which kidney stones were the most frequent of urinary stones and accounted for 70.34%. The results may be connected with the economic status and the dietary structure. The research indicated that the increased intake of animal protein and the decreased intake of fiber can promote stone formation of the upper urinary tract. Meanwhile, there was a statistically statistical difference regarding the distribution of urethra stones in males and females between *She* minority and *Han* nationality ($p < 0.05$). The reason may be that the climate is hot in the area where the *She* minority live, and the health condition of *She* minority is poor, resulting in the high incidence of urethra stones in *She* minority.

Calcium oxalate monohydrate in stones was the most common in *She* minority and *Han* nationality. Calcium oxalate dihydrate was mainly in the surface of stones, and its detection rates was significantly less than calcium oxalate monohydrate and accounted for 11.29%. After calcium oxalate monohydrate, hydroxyapatite, a common ingredient of stones, coexists with calcium oxalate monohydrate in stones and accounts for 18.11%.

Carbonate apatite was relatively lower. By contrast, the difference in carbonate apatite between *She* minority and *Han* nationality was statistically significant ($p < 0.05$), and carbonate apatite of males and females in *She* minority was apparently higher than *Han* nationality, as shown in Table 3. The reason may be that the *She* minority in the region prefer sweetmeat and rice wine. In order to reduce the carbonate apatite stone, *She* minority who are susceptible to carbonate apatite stones should change the diet and properly reduce sweetmeat and rice wine, especially for patients with carbonate apatite stones.

Struvite stones are associated with urinary tract infections, which form from urea decomposition by infected bacteria. Women are susceptible to urinary tract infections, so females with struvite stones were close to the males in *She* minority and *Han* nationality. However, there was a statistically significant difference in men and women between *She* minority and *Han* nationality ($p < 0.05$). The results may be connected with the poor health condition in *She* minority. Thus, in order to reduce the incidence of struvite stones in *She* minority, it is necessary to enhance the health education in *She* minority and improve the health conditions of *She* minority. Early detection of urinary tract infections is beneficial to reducing the incidence of struvite stones. The formation of uric acid stones is closely related to purine metabolic disorder and urine pH. When urine was detained in the bladder for a long time, urine has little acid, which readily causes the formation of uric acid stones. Males with uric acid stones were slightly more than females, the reason of which was that men are susceptible to urinary tract obstructive diseases and prefer to eat food containing high purine, such as pluck, beer, and seafood.

According to Table 4, the serum levels of Ca^{2+} and HPO_4^{2-} in *She* minority were higher than in *Han* nationality. The reason may be that *She* minority enjoy eating "black rice" which is one traditional food of *She* minority. The level of calcium and phosphate in "black rice" is high, which resulted in the level of Ca^{2+} and HPO_4^{2-} in *She* minority, and then that the carbonate apatite of males and females in *She* minority was apparently higher than *Han* nationality, as shown in Table 3.

CONCLUSION

In conclusion, for urinary stones, precautionary measures, including drinking water, reducing the intake of high sugar and high oxalate foods, limiting sodium intake, and improving the health conditions, are very critical, especially for reducing the incidence of urinary stones. In terms of *She* minority in the east Fujian, reducing "black rice", sweetmeat, and rice wine can prevent against carbonate apatite stones. With regard to struvite stones, it is necessary to enhance the health education in *She* minority and improve the health condi-

tions and early detection of urinary tract infections of *She* minority.

Acknowledgement:

We gratefully acknowledge the financial support of the Science and Technology Program of Ningde, Fujian Province, China (No. 20100036) and Natural Science Foundation of Fujian Province, China (No. 2016J01661).

Declaration of Interest:

All authors declared that there were no potential conflicts of interest.

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