



Original Article

Urinary tract stone analysis in Loei Province

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boiled water,
bottled water

Abstract

Objective: To study and analyze stones in urolithiasis patients in Loei province.

Material and Method: A case-control study that included 161 urolithiasis patients who underwent any treatment at Loei Hospital and received stone infrared spectroscopy and 170 patients who did not have urolithiasis or a history of urolithiasis with investigations that did not show urinary tract stones between July 2015 and January 2016. The parameters of the demographic data, urolithiasis data, and stone analysis data were collected and analyzed using the descriptive statistic method.

Result: The percentage of urolithiasis patients in Loei province who had a family history of urolithiasis was 24.8%. The most common occupation was farmer at 80.1%. Boiled water and bottled water were statistically significant for stone prevention. Papaya salad with pickled fish and Laab/Koi eaten by patients more than 3 times per day were statistically significant for stone formation.

The percentage of urolithiasis patients in Loei province who had pure stones was 56%, and with more than mixed stones 44%. Stone types, regarding the major components found: the most common group was oxalate, followed by the phosphate group and the uric group.

Conclusion: Urolithiasis in Loei province comprised pure stones more than mixed stones. Stone type with regard to major components found: the most common group was oxalate. Risk factors for stone formation were papaya salad with pickled fish and Laab/Koi. Boiled water and bottled water were protective urinary tract stone formation factors.

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Introduction

Urolithiasis is a public health problem all over the world. The world prevalence is 4-20%⁽¹⁾. In Thailand urolithiasis is also a serious health problem, especially in the Northeast where the prevalence of urolithiasis is about 16.9%⁽²⁾. Loei is a province in Northeast Thailand where many patients have urolithiasis. There are about 3,083 outpatients with urolithiasis per year (Figure 1).

Urolithiasis patients may present with flank pain, urinary tract infection, renal failure and death. The government must provide a large budget for patient care. A urolithiasis treatment problem is recurrent stones after previous treatment. The recurrence rate was found to be 50% within 5 years⁽³⁾. In Thailand, a study conducted in Khon Kaen found that the recurrence rate was 40% within 2 years⁽⁴⁾; this problem may be due to a lack of understanding of urolithiasis characteristics. The prevention of recurrent stones can save the cost of treatment⁽⁵⁾.

Stone analysis is a method to analyze individual stone composition, which can provide options for investigating the cause of urolithiasis and help prevent recurrent stones⁽⁶⁾. This research was created for stone analysis in order to decrease the incidence of recurrent stones and guide treatment.

Material and Method

This was a case-control study. Patients who underwent treatment for urolithiasis at Loei Hospital and stone analysis between July 2015 and January 2016 were enrolled. One hundred and sixty-one urolithiasis specimens were collected and sent to Songklanagarind Hospital for infrared spectroscopy analysis.

Food and drink were assessed for dietary risk factors for urolithiasis. One hundred and seventy patients who did not have urolithiasis and no history of urolithiasis with investigations (ultrasound whole abdomen, plain KUB, CT scan whole abdomen, cystoscope, ureterorenoscope) that did not show urolithiasis were enrolled. Demographic data, family stone history, previous stone treatment, education, occupation, income, work place, dietary habits, urolithiasis data, and stone analysis data were collected. The data were analyzed using SPSS version 13.

Descriptive statistics used mean, SD, median, mode, minimum and maximum for continuous data and percentage for group data. Univariable analysis used the chi-square test. Multiple logistic regression used the odds ratio (95% confidence interval) and $\alpha = 0.05$ determined the statistical significance applied in multivariable analysis.

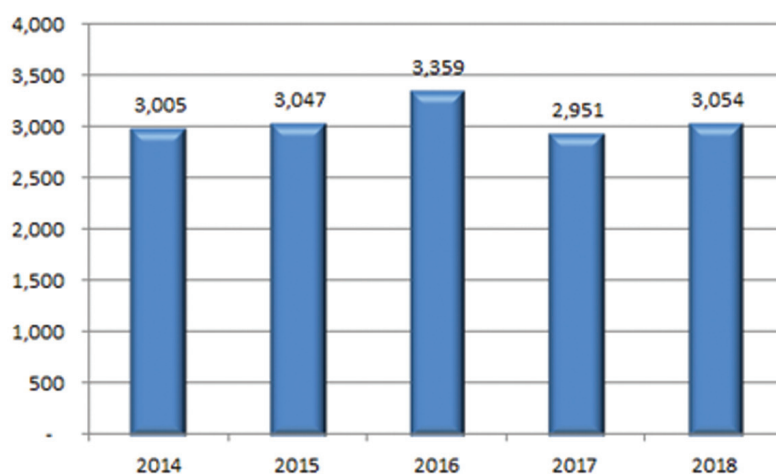


Figure 1. Number of urolithiasis patients who met a doctor at the outpatient department in Loei Hospital between 2014 and 2018.

Result

Demographic data of urolithiasis patients revealed the ratio of male to female was 2.7: 1, and body mass index was 23. In Loei Province, 24.8% of urolithiasis patients had a family history of stones, and the patients who had a history of previous treatment for stones was 37.3%, as shown in Table 1. Occupation of the patients: farmer was the most common (80.1%). For analysis of income of the patients: most urolithiasis patients had $\leq 10,000$ Baht per month (75.2%). Most patients worked outdoors (84.5%) and for less than 8 hours/day (70.8%). For water intake analysis: 58.4 % of urolithiasis patients drank more than 8 glasses of water per day, 32.9 % drank 4-8 glasses per day and only 8.7% drank less than 4 glasses per day, as shown in Table 2.

We found that rain water and bottled water were statistically significant compared to the control group. Papaya salad with pickled fish and Laab/Koi with a frequency of more than 3 times/day had statistical significance for stone formation (Table 3 and Table 4), while paprika was the most popular high oxalate vegetable (58.4%) that was frequently eaten, following by dill (50.9%) and bamboo shoots (46%), as shown in Table 5.

The treatment of calculi in Loei Hospital: open surgery is the most frequent operation for renal calculi treatment while most ureteric calculi were cured by URSL. For lower urinary tract calculi treatment: most of the vesical calculi treatment was cystolitholapaxy and urethral calculi were treated by transurethral lithotripsy (Table 6).

Table 1. Demographic data of urolithiasis patients.

Characteristics	Number (%)
Sex	
Male	117 (72.7%)
Female	44 (27.3%)
Age - Mean \pm SD	54.4 \pm 12.8
BMI - Mean \pm SD	23.2 \pm 3.9
Underlying disease	51 (31.7%)
Diabetes mellitus	18 (31.7%)
Hypertension	31 (19.3%)
Dyslipidemia	10 (6.2%)
Gout	8 (5%)
Spinal cord injury	4 (2.5%)
History of family urolithiasis	40 (24.8%)
Previous stone treatment	60 (37.3%)

Table 2. Character of urolithiasis patients.

Characteristics	Number (%)
Occupation	
Farmer	129 (80.1%)
Government officer	3 (1.9%)
Freelance	8 (5.0%)
Self employed	11 (6.8%)
State enterprise officer	1 (0.6%)
Labor	1 (0.6%)
Housewife	1 (0.6%)
Monk	2 (1.2%)
Merchant	1 (0.6%)
Unemployed	2 (1.2%)
Other	6 (3.7%)
Income	
≤ 10,000 Baht/month	121 (75.2%)
10,001 - 20,000 Baht/month	32 (19.9%)
20,001 - 30,000 Baht/month	4 (2.5%)
≥ 30,001 Baht/month	4 (2.5%)
Work place	
Outdoors	136 (84.5%)
Indoor	6 (3.7%)
Other	19 (11.8%)
Working time	
≤ 8 hours/day	114 (70.8%)
> 8 hours/day	47 (29.2%)
Amount of water intake (glass/day)	
< 4	14 (8.7%)
4-8	53 (32.9%)
> 8	94 (58.4%)

Table 3. Type of food and water related to urolithiasis in the patient group and control group.

Characteristics	Patients				Control				p-value
	Yes		No		Yes		No		
	No	%	No	%	No	%	No	%	
Type of water									
Tap water (น้ำประปา)	12	7.5	149	92.5	11	6.5	159	93.5	0.725
Ground water (น้ำบาดาล)	9	5.6	152	94.4	9	5.3	161	94.7	0.906
Boiled water (น้ำต้ม)	3	1.9	158	98.1	13	7.6	157	92.4	0.014
Rainy water (น้ำฝน)	110	68.3	51	31.7	67	39.4	103	60.6	<0.001
Bottled water (น้ำบรรจุขวด)	44	27.3	117	72.7	107	62.9	63	37.1	<0.001
Filter water (น้ำกรอง)	4	2.5	157	97.5	4	2.4	166	97.6	0.938
Type of food									
Noodle (ก๋วยเตี๋ยว)	35	21.7	126	78.3	28	16.5	142	83.5	0.222
Laab/Koi (ลาบ/ก้อย)	32	19.9	129	80.1	11	6.5	159	93.5	<0.001
Papaya salad with pickled fish (ส้มตำ ปลาจ๋า)	105	62.5	56	34.8	57	33.5	113	66.5	<0.001
Chilli fried rice with holy basil (กระเพรา)	35	21.9	125	78.1	28	16.5	142	83.5	0.212
Spicy shredded bamboo-shoot salad (in northeastern style) (ซูปหน่อไม้/แกงหน่อไม้)	52	32.3	109	67.7	38	22.4	132	77.6	0.042
Rice noodles in fish curry sauce with vegetables (ขนมจีนน้ำยา)	22	13.7	139	86.3	29	17.1	141	82.9	0.393

Table 4. Multivariable analysis by multiple logistic regression about food and water.

Factor	Adjusted odds ratio	95% CI of odds ratio	P value
Type of water			
Boiled water (น้ำต้ม)	0.18	0.05-0.72	0.015
Rain water (น้ำฝน)	1.32	0.66-2.64	0.44
Bottled water (น้ำบรรจุขวด)	0.25	0.13-0.5	<0.001
Type of food			
Laab/Koi (ลาบ/ก้อย)	2.67	1.13-6.3	0.025
Papaya salad with pickled fish (ส้มตำ ปลาจ๋า)	3.82	2.16-6.77	<0.001
Spicy shredded bamboo-shoot salad (in northeastern style) (ซูปหน่อไม้/แกงหน่อไม้)	0.83	0.46-1.53	0.58

Table 5. Type of high oxalate vegetable⁽⁷⁾ that Loei urolithiasis patients ate more than once per week.

Characteristics	Name in Thais	Number (%)
Vietnamese coriander	ผักแพว	14 (8.7%)
Eggplant	มะเขือพวง	71 (44.1%)
Betel	ชะพลู	29 (18.%)
Eggplant	มะเขือเปราะ	44 (27.3%)
Cha-om	ชะอม	60 (37.3%)
Water spinach	ผักบุ้งไทย	58 (36%)
Paprika	พริกขี้หนู	94 (58.4%)
Neem	สะเดา	22 (13.7%)
Bamboo shoot	หน่อไม้	74 (46%)
Basil	โหระพา	49 (30.4%)
Dill	ผักชีลาว	82 (50.9%)

Table 6. Urolithiasis treatment in Loei Hospital.

Characteristics	Number (%)
Renal calculi	91 (56.5%)
Conservative treatment	4 (2.5%)
Extracorporeal shock wave lithotripsy (ESWL)	34 (21.1%)
Endoscopic surgery	12 (7.5%)
Percutaneous nephrolithotomy (PCNL)	11 (6.8%)
Retrograde intrarenal surgery (RIRS)	1 (0.6%)
Open surgery	41 (25.5%)
Pyelolithotomy	12 (7.5%)
Nephrolithotomy	18 (11.2%)
Nephrectomy	14 (8.7%)
Ureteric calculi	37 (23%)
Conservative treatment	6 (3.7%)
Extracorporeal shock wave lithotripsy (ESWL)	6 (3.7%)
Ureterorenoscopy lithotripsy (URSL)	14 (8.7%)
Open surgery	11 (6.8%)
Ureterolithotomy	7 (4.3%)
Nephrectomy	4 (2.5%)
Vesical calculi	34 (21.1%)
Conservative treatment	3 (1.9%)
Cystolitholapaxy	29 (18%)
Open cystolithotomy	2 (1.2%)
Urethral calculi	7 (4.3%)
Conservative treatment	2 (1.2%)
Transurethral lithotripsy	5 (3.1%)

Note: Due to the fact that each patient may have had multiple sites of calculi, patients had multiple treatments.

For component analysis of the upper urinary tract calculi (N=121, Male 81, Female 40): For men, the pure component was more common than the mixed component and in the oxalate group the most common found was in the pure component of males with upper urinary tract calculi. In contrast, in women we found the pure stone was equal to the mixed component and the most common components

found in female upper urinary tract stones were oxalate and phosphate (Table 7).

For lower urinary tract calculi (N=40, Male 36, Female 4): we found mixed components more than pure components in both sexes. The oxalate and phosphate group is the most common component found in lower urinary tract calculi (Table 8).

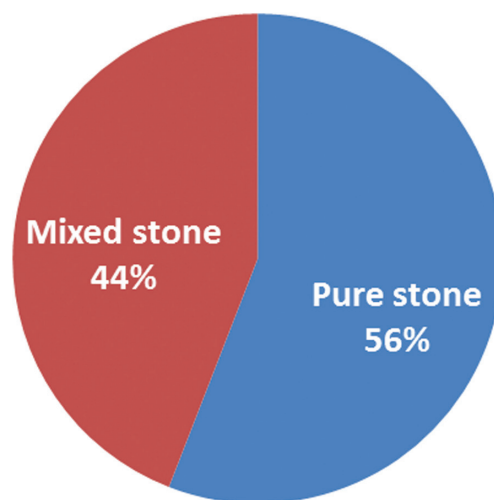


Figure 2. Component stone analysis of Loei urolithiasis patients.

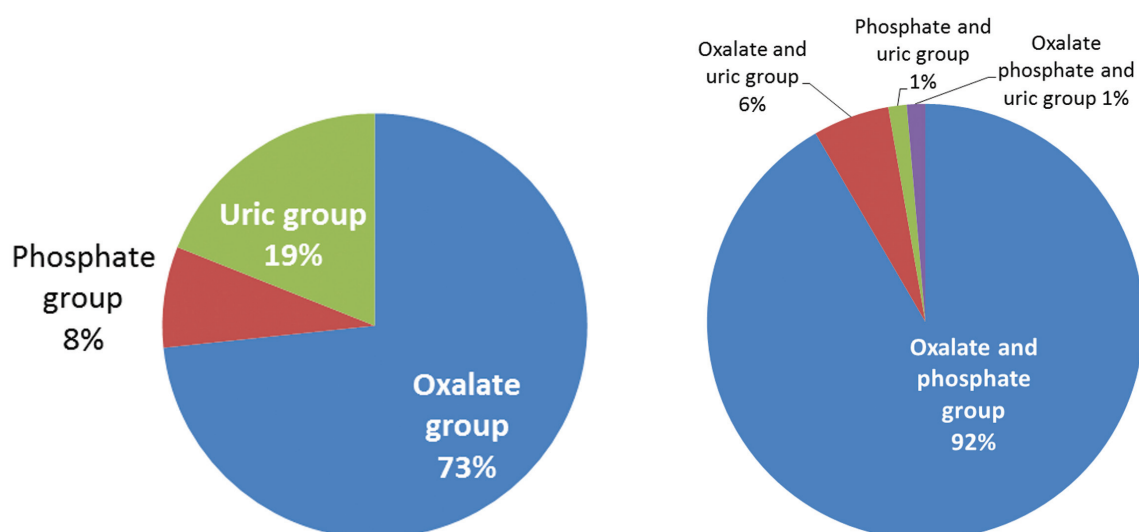


Figure 3. Compositions of calculi, (a) pure composition and (b) mixed composition.

Table 7. Chemical compositions of upper urinary tract calculi.

Characteristics	Male (N=81)	Female (N=40)
Pure component	53 (65.4%)	20 (50%)
Oxalate group; Whewellite, Weddellite	42	16
Phosphate group; Dahllite, Brushite, Struvite	3	2
Uric group; Uricite / Urate	8	2
Other group; Calcite, Cystine, Xanthine	0	0
Mixed component	28 (34.6%)	20 (50%)
Oxalate and phosphate group	25	19
Oxalate and uric group	2	2
Phosphate and uric group	0	1
Oxalate, phosphate and uric group	1	0

Table 8. Chemical compositions of lower urinary tract calculi.

Characteristics	Male (N=36)	Female (N=4)
Pure component	17 (47.2%)	0 (0%)
Oxalate group; Whewellite, Weddellite	8	0
Phosphate group; Dahllite, Brushite, Struvite	2	0
Uric group; Uricite / Urate	7	0
Other group; Calcite, Cystine, Xanthine	0	0
Mixed component	19 (52.8%)	4 (100%)
Oxalate and phosphate group	17	4
Oxalate and uric group	2	2
Phosphate and uric group	0	0
Oxalate, phosphate and uric group	0	0

Discussion

Urinary tract calculi have been a health problem in Thailand for a long time. The cause of urolithiasis has multiple factors, which can be divided into 2 groups: intrinsic and extrinsic. The intrinsic factors include sex, age, ethnicity, family history of urolithiasis, while the extrinsic factors include weather, environment, lifestyle, food consumption, occupation and education.⁽⁸⁾

In our study, the most common age group was 51-60 years, which is different from a prior study in which patient age was between 31 and 40 years⁽⁹⁾. However, the presenting symptoms of our patients was 42-43 years and most of the patients waited 3-4 years to seek treatment, which may explain why the age of Loei patients was older than in the other study. For sex ratio: our study revealed a male to



female ratio of 2.7: 1, according to northeast patients that reported 2.3-4: 1⁽⁹⁾, which may be due to the effects of hormone testosterone in males that increases synthesis oxalate but in females estrogen hormones can increase excreted citrate in the urine, causing higher oxalate levels in men but lower citrate levels in women⁽¹⁰⁾. Genetics may play a role in kidney stones in the northeastern Thai population⁽¹¹⁾. In the same Loei urolithiasis patients, genetics should play some role due to finding that 24.8% had a family history of urinary tract calculi, and oxalate composition was found to be 82.5% in this population. Many studies show that calcium oxalate can be inherited.^(12,13)

Lifestyle and dietary habits were also important factors for stone formation⁽¹⁴⁾. Due to the instructions of stone prevention, such as "Drinking more than 8 glasses of water per day can protect against stone formation"⁽¹⁵⁾, our study found that most of the urolithiasis patients drank more than 8 glasses per day. However, when the urinary tract stone was diagnosed, patients were advised to drink a lot of water and thus patients changed their water intake behavior or amount of drinking water does not the cause of urolithiasis in Loei. We also found that rain water and bottled water were statistically significant compared with the control group. Further investigation should be performed. Papaya salad with pickled fish and Laab/Koi are famous Loei foods that urolithiasis patients eat more than 3 times per day, and were statistically significant for stone formation. Both foods are high in oxalate ingredients, such as pickled fish, paprika, betel, Vietnamese coriander, basil, eggplant, neem^(7, 16), and may be the cause of the oxalate stones that were found to be the most common component in our study. In our study, the urolithiasis patients preferred paprika, which was the most common high oxalate vegetable followed by dill and bamboo shoots. Thus, lifestyle and dietary habit may be causes of calculi in Loei province.

Farmer is the most common occupation of urolithiasis patients in our study. As farmers work

outdoors, the weather in Loei province has high temperature with low humidity, and may be a factor in stone formation.

Our study found pure composition stones much more than mixed compositions. This finding is different from most studies that found mixed composition more than pure composition^(2,17-19). In our study, oxalate was the most common component, which is similar to most studies. The second most common were phosphate and uric, which is different from most studies that found uric and phosphate^(2,8,18,19). In male urolithiasis patients, the most common chemical compositions of male upper urinary tract stones were pure composition. Oxalate was the most common found, whereas the composition in lower urinary tract stones was mixed, and the most common was in the oxalate-phosphate group, which may allow for the conclusion that the lower urinary tract stones did not come from the upper urinary tract stones. In contrast, for female urolithiasis patients, the most common compositions of both upper and lower urinary tract calculi were mixed stones, and oxalate-phosphate was the most common found, which may allow for the conclusion that lower urinary tract stones come from upper urinary tract stones.

Conclusion

For urolithiasis in Loei province a pure composition was found much more frequently than a mixed composition, and the most common chemical composition was oxalate, with a family history of urinary calculi. For the risk factors of urolithiasis patients in Loei, the occupation of farmer and dietary habits, especially eating papaya salad with pickled fish and Laab/Koi more than 3 times per day were commonly found in urolithiasis patients.

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Conflict of interest

The authors declare no conflict of interest.

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