# Urinary Tract Calculi in Southern Thailand

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***Objective:*** *To study the epidemiology of urolithiasis in Southern Thailand.*
***Design:*** *Descriptive study.*
***Material and Method:*** *An overview of urolithiasis in the South of Thailand was derived from 10,344 urolithiasis patients seeking treatment in 14 hospitals in southern Thailand, from January to December 2000. An epidemiological study focused on 1,452 urolithiasis patients treated at Songklanagarind Hospital during the same period. Composition of calculi was analysed with infrared spectroscopy.*
***Results:*** *The ratio of male to female was 1.6: 1 and the most common age group was 41-50 years. Ureteric calculi were more frequently found than renal calculi. ESWL was the most common treatment for upper urinary tract (UUT) calculi, while surgery was the most common treatment for lower urinary tract (LUT) calculi. The body mass index (BMI) of 48.1% was between 18.5-24.9. The study of the calculi composition showed that oxalate was found in most UUT, and uric acid was found in most LUT.*
***Conclusion:*** *Ureteric calculi were most common in the South of Thailand. The BMI of urolithiasis patients was higher than the population average.*

***Keywords:*** *Urolithiasis, Calculi, Composition*

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Urolithiasis is an important health problem all over the world, although the incidence rates vary[1]. Most studies on urolithiasis in Thailand have been carried out in the northeastern part of the country because of the high incidence there[2,3]. Although the incidence is low in the South, urolithiasis still results in serious morbidity, pain, hematuria, infection and renal failure, and has a substantial economic impact. Urolithiasis needs to be studied further in order to find more effective ways of treatment and prevention of recurrence. The objective of the present study was to study the incidence rate and to investigate the epidemiology of urolithiasis in southern Thailand.

## Material and Method

The overview of urolithiasis in the South of Thailand was obtained from 10,344 urolithiasis patients getting treatment in 14 hospitals in 11 provinces in southern Thailand; Chumporn, Krabi, Narathivat, Pang-Nga, Pattani, Phuket, Ranong, Satun, Songkhla, Suratthani and Trang, from January to December 2000. Patient's, age, gender, occupation, residence, diagnosis and treatment were recorded and described.

A study on the epidemiology of urolithiasis was based on the medical records of 1,452 out-patients diagnosed with urolithiasis in Songklanagarind Hospital, the university hospital in southern Thailand, during the same period. Patient profiles, presenting symptoms, past history and family history of urolithiasis, diagnosis and treatment were recorded.

Because upper urinary tract (UUT) calculi tend to cause obstructive uropathy more often than lower urinary tract (LUT) calculi, the study focused on 1,402 patients of the UUT calculi group. The assessment of renal function was set as follows:

| **Serum creatinine** | **Renal function status** |
|---|---|
| < 1.4 mg% | Normal |
| 1.4-2.0 mg% | Mild renal insufficiency |
| 2.1-4.0 mg% | Moderate renal insufficiency |
| > 4.0 mg% | Severe renal insufficiency |

Randomisation of 104 patients from the UUT group was performed for body mass index (BMI) studies.

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Because urolithiasis occurs mainly in adults, the formula used in the calculation was as follows:

BMI = weight in kilograms/(height in meters)$^2$

The results of BMI were determined as follows:

| BMI | Weight status |
|---|---|
| Below 18.5 | Underweight |
| 18.5-24.9 | Normal |
| 25.0-29.9 | Overweight |
| 30.0 and above | Obese |

Note: The BMI formula and data from the United States Department of Health and Human Services, Center for Disease Control and Prevention.

A study of the calculi composition was carried out using 229 calculi collected from the operation theater and ESWL Unit of Songklanagarind Hospital during the study period, of which 215 were UUT calculi and 14 were LUT calculi. The composition of the calculi was analyzed through the following steps:

1. Physical characteristics of the calculi, such as their number, size, weight, surface, and color, were noted.
2. If the size of the calculi was larger than 3 millimeters, it was cut into two parts. Then 2-3 specimens were randomly taken from their surface and nucleus for analysis. If the calculi was smaller than 3 millimeters, the whole calculi was crushed for analysis.
3. About 2.0 milligrams of the calculi was mixed with 100-200 milligrams of potassium bromide (KBr) in an agate mortar and ground until they were well blended. Then the mixture was placed into a KBr die; about 5 tons of pressure was applied for about 3-4 minutes to produce a 13-millimeter pellet.
4. The spectrum was analyzed by infrared spectroscopy.

### *Definitions*

- Upper urinary tract (UUT) calculi included renal calculi (RC) and ureteral calculi (UC)
- Lower urinary tract (LUT) calculi included vesical calculi (VC) and urethral calculi
- Recurrence of urolithiasis refers to patients who had a history of urolithiasis that had been diagnosed and treated in a hospital or clinic, or patients who had urinated with stones.

### *Data Analysis*

The data were analyzed by frequency and percentage. Descriptive statistics was applied to present the finding.

## Results

The incidence of urolithiasis in southern Thailand from January to December 2000 was found to be 183.8 per 100,000 population, of which 5,054 patients (48.8%) were with UC; 3,493 patients (33.8%) were diagnosed with RC; and 1,797 (17.4%) were diagnosed with VC and urethral calculi. The ratio of men to women was 1.6 to 1 with most patients in the age range of 31-50 years old (Fig. 1). 35.2% were farmers, 24.4% were laborers, 11.8% were government workers, and 11.2% were housekeepers (Table 1). The provinces with the highest incidences were Krabi, Trang, Suratthani, Songkhla and Phang-Nga with 430.9, 289.8, 238.2, 236.6 and 164.5 per 100,000 population respectively. The lowest incidence was Pattani with 28.3 per

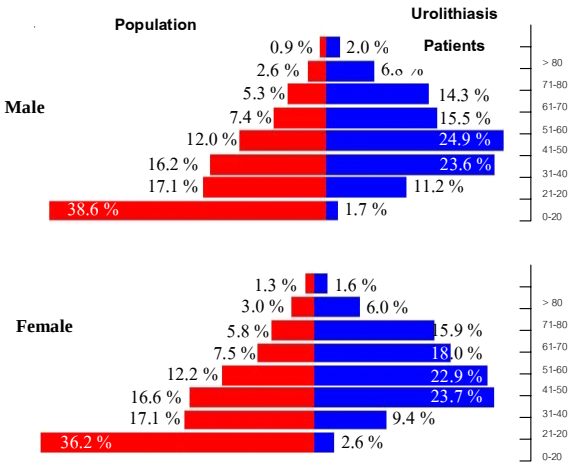


**Fig. 1** Percent of urolithiasis patients in southern Thailand, divided by gender and age

**Note :** population data from Ministry of Interior, 2000
Male population was 4,013,143 and female population was 4,074,328

**Table 1.** Occupations of urolithiasis patients in southern Thailand

| Occupation | Number | Percent (%) |
|---|---|---|
| Manual workers group | | |
| Farmer | 3,644 | 35.2 |
| Laborer | 2,519 | 24.4 |
| Housekeeper | 1,156 | 11.2 |
| Sedentary group | | |
| Government worker | 1,218 | 11.8 |
| Merchant | 664 | 6.4 |
| Student | 160 | 1.5 |
| Monk | 51 | 0.5 |
| Other | 49 | 0.5 |
| Unknown | 883 | 8.5 |
| Total | 10,344 | 100.0 |

100,000 population (Table 2). It was found that ESWL was the most frequently used method (73.3%) to treat RC. For the treatment of UC, ureterorenoscopy (URS) was used most often (33.3%) while cystolitholapaxy was used most frequently (43.3%) to treat VC (Table 3).

The epidemiologic study performed in Songklanagarind Hospital revealed that 53.7% of urolithiasis patients were recurrent cases and most of them recurred within two years (Table 4). Only 3 cases (0.2%) had a family history of urolithiasis. The common presenting symptoms in the UUT group were pain, hematuria, and difficult urination; and in the LUT group difficult urination and hematuria (Table 5). 9.6% of urolithiasis patients were underweight, 48.1% were normal, 30.8% were overweight, and 11.5 were obese (Fig. 2). Most of them had normal renal function (Table 6).

Most of the calculi were single composition, with the UUT group mostly oxalate and the LUT group uric acid. In multiple composition of calculi, both the UUT and LUT groups were found to have a combination of oxalate and phosphate (Table 7).

**Table 2.** Urolithiasis patients in southern Thailand, by province

| Province* | Number | per 100,000 population** |
|---|---|---|
| Krabi | 1,441 | 430.9 |
| Trang | 1,709 | 289.8 |
| Surat Thani | 2,066 | 238.2 |
| Songkhla | 2,960 | 236.6 |
| Phangnga | 385 | 164.5 |
| Narathiwat | 751 | 113.6 |
| Ranong | 179 | 111.2 |
| Phuket | 257 | 107.5 |
| Chumphon | 289 | 64.9 |
| Satun | 139 | 56.2 |
| Pattani | 168 | 28.3 |
| Total | 10,344 | 183.8 |

Note * Data of Nakhon Si Thammarat, Phatthalung and Yala provinces were not returned back to the research team
** Data from Ministry of Interior, 2000

**Table 3.** Treatment of urolithiasis patients in southern Thailand

| Treatment | Number | Percent (%) |
|---|---|---|
| Renal calculi | 617 | 100.0 |
| Endoscopic surgery; PCNL | 2 | 0.3 |
| ESWL | 452 | 73.3 |
| Surgery | 163 | 26.4 |
| Pyelolithotomy | 60 | - |
| Nephrolithotomy | 66 | - |
| Nephrectomy | 37 | - |
| Ureteral calculi | 469 | 100.0 |
| Endoscopic surgery; URS | 156 | 33.3 |
| ESWL | 151 | 32.2 |
| Surgery | 131 | 27.9 |
| Ureterolithotomy | 122 | - |
| Nephrectomy | 9 | - |
| Other | 31 | 6.6 |
| Vesical and urethral calculi | 210 | 100.0 |
| Endoscopic surgery; Cystolitholapaxy | 89 | 42.4 |
| Surgery; Cystolithotomy | 91 | 43.3 |
| Other | 30 | 14.3 |

**Table 4.** Period of recurrent calculi in patients

| History of urolithiasis | Upper urinary tract calculi (%) | Lower urinary tract calculi (%) | Total (%) |
|---|---|---|---|
| First episode | 642 (45.8) | 31 (62.0) | 673 (46.3) |
| Recurrent episode | 760 (54.2) | 19 (38.0) | 779 (53.7) |
| within 2 years | 302 | 9 | 311 |
| 2-5 years | 270 | 7 | 277 |
| more than 5 years | 188 | 3 | 191 |
| Total | 1,402(100) | 50 (100) | 1,452(100) |

**Table 5.** Presenting symptoms of urolithiasis patients

| Presenting symptom * | Upper urinary tract calculi | Lower urinary tract calculi |
|---|---|---|
| Pain | 733 | 5 |
| Hematuria | 70 | 10 |
| Turbid urine | 21 | 2 |
| Fever | 12 | 0 |
| Frequent urination | 15 | 0 |
| Pass small calculi | 29 | 5 |
| Dysuria or retention of urine | 70 | 36 |
| Other | 2 | 0 |
| Asymptomatic | 15 | 0 |
| No data | 511 | 5 |

Note: Each patient may have had more than one presenting symptom

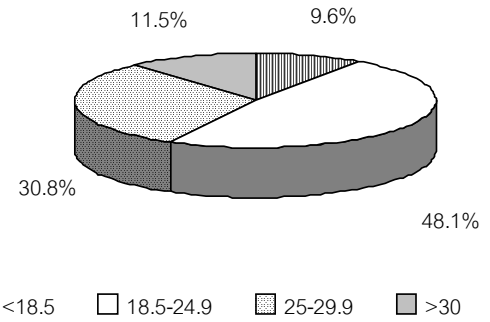


**Fig. 2** Nutritional status of urolithiasis patients

**Table 6.** Serum creatinine of urolithiasis patients

| Serum creatinine | Upper urinary tract calculi | Lower urinary tract calculi | Total (%) |
|---|---|---|---|
| 0-1.4 mg% | 732 | 30 | 762(52.5) |
| 1.4-2.0 mg% | 134 | 3 | 137(9.4) |
| 2.1-4.0 mg% | 62 | 0 | 62(4.3) |
| > 4.0 mg% | 31 | 0 | 31(2.1) |
| unknown | 443 | 17 | 460(31.7) |
| Total | 1,402 | 50 | 1,452(100) |

**Table 7.** Composition of calculi from upper and lower urinary tracts

| Composition of calculi tract calculi | Upper urinary tract calculi | Lower urinary |
|---|---|---|
| Pure calculi | 145 (67.4%) | 11 (78.6%) |
| Oxalate group; Whewellite, Weddellite | 75 | 1 |
| Phosphate group; Dahllite, Brushite, Struvite | 28 | 1 |
| Uric group; Uricite/Urate | 39 | 9 |
| Others; Calcite, Cystine, Xanthine | 3 | 0 |
| Mixed calculi | 70 (32.6%) | 3 (21.4%) |
| Oxalate and phosphate group | 59 | 2 |
| Oxalate and uric group | 7 | 0 |
| Phosphate and uric group | 3 | 0 |
| Oxalate, phosphate and uric group | 1 | 1 |
| Total | 215 (100%) | 14 (100%) |

## Discussion

Urolithiasis is an important health problem in Thailand. Although the incidence is low in the South, the research team found that in the out-patients department, urolithiasis was the complaint of the highest number of patients. A previous urolithiasis survey[2] showed a much lower incidence in the South than the present study, probably reflecting better knowledge and opportunity to seek treatment now than in the past. A study of the data collected from hospitals in other regions showed similarities of the results of university hospitals such as Maharaj Nakhon Chiang Mai Hospital, in the North, and Songklanagarind Hospital, in the South, with fewer cases of LUT calculi than public hospitals, probably because university hospitals are the referral centers for extracorporeal shock wave lithotripsy (ESWL), which has a better result for UUT calculi.

The ratio of male to female in urolithiasis patients was 1.7:1 in the central part of Thailand[7], 1.8:1 in the North[5], 1.3:1 in the Northeast[4] and 1.6:1 in the South. Considering age, the reports from the North and the Northeast found most patients were in the 41-50[4,5] year age group, whereas, the present study found the age range of 31-50 years most common. When divided by occupation into 2 groups, namely manual workers (farmers, laborers, housekeepers), and sedentary (government workers, merchants, students), it was found that manual workers, especially farmers, had a higher incidence of urolithiasis. This is in accordance with a study from the Northeast which found the highest frequency of cases in laborers[9]. However, this is different from Western countries in which urolithiasis occurred more in sedentary workers[10]. The highest incidences of urolithiasis were found in Krabi, Trang, Suratthani, Songkhla and Pang-Nga provinces, whereas Satun and Pattani provinces, where most people are Muslim, had the lowest incidences. Cultural factors such as living and diet should be further investigated.

| Hospital (Time of study) | RC (%) | UC (%) | RC & UC (%) | VC & urethral calculi (%) | Not Specified (%) |
|---|---|---|---|---|---|
| Buriram (1997-2002)[4] | 62.1 | 22.5 | 1.7 | 13.1 | 0.6 |
| Maharaj Nakhon Chiang Mai (2000)[5] | 54.4 | 43.1 | - | 2.5 | - |
| Sawan Pracharak (2000)[6] | 33.0 | 53.0 | - | 14.0 | - |
| Siriraj (1998-2002)[7] | 57.3 | 31.3 | - | 11.5 | - |
| Songklanagarind (2000)[8] | 58.7 | 35.8 | - | 5.5 | - |
| 14 hospitals in the south (2000) | 33.8 | 48.8 | - | 17.4 | - |

Most patients had had urolithiasis previously, with recurrences found more often in the UUT group than the LUT group and usually within 2 years of the first occurrence. Family histories of urolithiasis were only 0.2% in the South, very different from the study in the Northeast which found a family history connection as high as 48%[9], possibly due to renal tubular acidosis which is influential in the occurrence of urolithiasis[11]. The BMI of urolithiasis patients was higher than in the general population compared to a study of the nutritional condition of people aged 40-59[12], this may be from the possible role of carbohydrate induced calciuria[13]

This comparison of the calculi composition in different regions has limitations. The methodology was different so comparison of the results are inconclusive. However, looking at information from various

sources, an overview of the calculi compositions according to the regions can be preliminarily summarized as follows. The report of UUT from Maharaj Nakhon Chiang Mai Hospital revealed mostly urate, followed by oxalate and then phosphate[14]. In the Northeast of Thailand, most calculi were found to have multiple composition. However, calculi found in the UUT were mostly calcium oxalate and one third of the calculi in the LUT were calcium[15]. In the central part (not specified location of the calculi) most were found to be oxalate, followed by phosphate, uric acid, and struvite[16]. Most calculi in the present study contained a single component. Pure calculi of the UUT were mostly oxalate while LUT calculi were uric acid. Mixed composition of oxalate and phosphate were found most in the calculi in both UUT and LUT. However, the present study did not find any Djenkolic acid crystals, an element found in *Archidendron jiringa* Nielsen, which was previously believed to be one of the causes of urinary tract calculi in the South.

## Conclusion

The incidence of urolithiasis in the South was 183.8 per 100,000 population. The ratio of male to female patients was 1.6:1 and the main age range was 31-50 years. Farmers were the highest number of patients. Urolithiasis patients weighed more than average. Most recurrence happened within two years. The calculi in the south were mostly pure calculi, whereas UUT calculi were mostly composed of oxalate and LUT was mostly uric acid. Mixed calculi in both UUT and LUT were mostly a combination of oxalate and phosphate.

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## *นิ่วทางเดินปัสสาวะในภาคใต้*

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***วัตถุประสงค์:*** *เพื่อศึกษาระบาดวิทยาของนิ่วทางเดินปัสสาวะในภาคใต้*
***แบบวิจัย:*** *เชิงพรรณนา*
***วัสดุและวิธีการ:*** *ทำการศึกษาข้อมูลโดยรวมของผู้ป่วยโรคนิ่วทางเดินปัสสาวะ จำนวน 10,344 ราย ที่เข้ารับการรักษาในโรงพยาบาลชุมชน 13 แห่ง และโรงพยาบาลมหาวิทยาลัย 1 แห่ง ครอบคลุม 11จังหวัดในภาคใต้ ตั้งแต่เดือนมกราคม ถึงเดือนธันวาคม พ.ศ.2543 และทำการศึกษาข้อมูลด้านระบาดวิทยาในผู้ป่วยที่เข้ารับการรักษาที่หน่วยศัลยศาสตร์ระบบทางเดินปัสสาวะ ภาควิชาศัลยศาสตร์ โรงพยาบาลสงขลานครินทร์ ในช่วงเวลาเดียวกัน จำนวน 1,452 ราย และศึกษาองค์ประกอบของนิ่วโดยวิธีอินฟราเรดสเปกโตรสโคปี*
***ผลการศึกษา:*** *อัตราส่วนชายต่อหญิงในผู้ป่วยนิ่วทางเดินปัสสาวะในภาคใต้ คือ 1.6 ต่อ1 กลุ่มอายุที่พบนิ่วมากที่สุด คือ 41-50 ปี และพบนิ่วในท่อไตมากกว่านิ่วในไต การรักษานิ่วในไตและท่อไตใช้วิธีสลายนิ่วมากที่สุด ส่วนการรักษานิ่วในกระเพาะปัสสาวะและท่อปัสสาวะใช้วิธีผ่าตัดมากที่สุด การศึกษา body mass index พบว่านิ่วทางเดินปัสสาวะเกิดในกลุ่มผู้ป่วยมีน้ำหนักสูงกว่ามาตรฐาน การศึกษาองค์ประกอบของนิ่วพบว่านิ่วในไตและท่อไตเป็นนิ่วกลุ่มออกซาเลต และนิ่วในกระเพาะปัสสาวะและท่อปัสสาวะเป็นนิ่วยูริกมากที่สุด*
***สรุป:*** *ผู้ป่วยนิ่วทางเดินปัสสาวะส่วนใหญ่ในภาคใต้เป็นนิ่วในท่อไตมากกว่านิ่วในไต และนิ่วทางเดินปัสสาวะเกิดในกลุ่มผู้ป่วยมีน้ำหนักสูงกว่ามาตรฐาน*