

Staghorn Calculi in Southern Thailand

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Objective: To study the characteristics and components of staghorn calculi in southern Thailand.

Material and Method: 5,445 urolithiasis patients who underwent treatment in Songklanagarind Hospital between 1997 and 2000 were reviewed and 86 of them were included by the criteria of "complete staghorn" calculi. General data, laboratory data at presentation, and the component analysis was performed with infrared spectroscopy were analyzed.

Results: Forty-three men and 43 women were included in the present study, with a mean age of 55.5 years for men and 50.7 years for women. Uric acid was the most common component of staghorn calculi and 61.8% of the patients had hyperuricemia. Magnesium ammonium phosphate (MAP) was found in 11.6% of the calculi. A positive urine culture was found in 59.3% of the patients and the micro-organisms most frequently found were *Corynebacterium sp* and *E. coli*.

Conclusion: There was a significant higher incidence of staghorn calculi in women in comparison with urolithiasis patients in southern Thailand, and the most common component was uric acid.

Keywords: Staghorn calculi, Composition, Urinary tract infection

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Urolithiasis is a common disease, typically occurring between 30-60 years of age⁽¹⁾. In the majority of patients, the symptoms and consequences are not life threatening, but they are a major cause of morbidity, hospitalization and day lost from work⁽²⁾, thus have a substantial economic impact. Stones that fill the greater part of the collecting system are called staghorn because of the resemblance to the antlers of a male deer. Urologists assume that most of staghorn calculi is composed of struvite (magnesium ammonium phosphate), which formed in the presence of bacteria that produces the enzyme urease. Nevertheless, other stones can assume a staghorn configuration, such as cystine, calcium oxalate monohydrate, and uric acid⁽³⁾.

In Thailand, most studies of urolithiasis were performed in the northern and northeastern part, where a high incidence of the disease is found. However, there are very few reports of staghorn calculi, therefore, the author decided to study the epidemiology of staghorn calculi to use the results as epidemiological data for urolithiasis in southern Thailand.

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Material and Method

From the stone registry, 5,445 patients underwent treatment in the out patients unit between 1997 and 2000. The data were retrieved from 86 patients who met the criteria of complete staghorn calculi, defined as a large pelvic concrement sending branches into at least two calyces⁽⁴⁾. General data (age, sex, occupation, domicile, presenting symptoms, and medical diseases) was noted, and laboratory data was collected at the time of presentation (urine for urinalysis and culture, serum for creatinine, electrolyte, calcium, phosphate, and uric acid). The anatomy of the urinary tract was investigated by intravenous urography before treatment was decided. After treatment had been completed, the composition of the calculi was analyzed by infrared spectroscopy through the following steps:

1. Physical characteristics of the calculi, such as number, size, weight, surface, and color, were noted.
2. The calculi were cut into two parts, and 2-3 specimens were randomly taken from the surface and nucleus for analysis.
3. About 2.0 milligrams of the calculi were mixed with 100-200 milligrams of potassium bromide (KBr) in an agate mortar and ground until 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-mm pellet.

4. The spectrum was analyzed by infrared spectroscopy (ATI Mattson, FTIR™, Genesis Series).

Statistic analysis

Descriptive analysis (number, percentage, mean \pm SD) was performed for general data. Chi-square test was used to assess significant differentiation in sex ratio between urolithiasis and staghorn calculi group and in laboratory data of different stone composition. A p-value of less than 0.05 was considered significant difference.

Results

The prevalence of staghorn calculi in the study hospital was 1.6% of urolithiasis patients, which was significantly higher in women ($p < 0.01$, Table 1). The common age group of staghorn calculi was 41-50 years old, and the mean age for men was 55.5 years and for women 50.7 years (Fig. 1). Sixty-three cases (73.3%) presented with unilateral calculus and 23 cases (26.7%) bilateral calculi. The common presenting symptoms was flank pain, however 4.6% were asymptomatic patients (Table 2). For metabolic evaluation, the author found significant association of hyperuricemia in uric acid calculi patients ($p < 0.01$, Table 3).

In stone analysis performed by infrared spectroscopy, the author found 62.8% of the staghorn calculi were composed of a single component, and uric acid was the most common component found in 46.3%. In the mixed-component calculi, calcium oxalate-phosphate was the most common component (56.3%). In the present study, the authors found overall MAP (magnesium ammonium phosphate) in 11.6% (9.3% of single component and 15.6% of mixed component calculi).

In a study of calculi composition and urinary pH, the author found uric acid and magnesium ammonium phosphate (MAP) calculi patients had urinary pH 5.3 ± 0.58 and 6.4 ± 0.48 , respectively (Table 4).

A positive urine culture was found in 51 cases (59.3%) and the micro-organisms most frequently found were *Corynebacterium sp* and *E. coli* in 23.5% and 21.5%, respectively. Although the urease producing bacteria infection tended to be more often in MAP than other components, there was no statistical significance ($p = 0.430$; Table 5).

Discussion

Urologists assume that most of staghorn

Table 1. Demographic data of urolithiasis and staghorn calculi group

	Urolithiasis group	Staghorn calculi group
No. patients	5,445	86
Gender; Male/Female	1.6/1	1/1
Male	3,330	34
Female	2,115	34
Occupation (%);		
Farmer	33.8	39.5
Government service	23.3	15.1
Laborer	15.9	19.8
Housekeeper	14.2	5.8
Business	9.2	10.5
Others	3.6	9.3
Domicile (%);		
Songkhla	37.1	29.1
Nakorn Si Thammarat	18.7	24.4
Phattalung	12.3	12.8
Trang	6.1	8.1
Pattani	4.5	2.4
Suratthani	4.2	1.2
Yala	3.8	5.8
Narathiwat	3.8	4.6
Satun	3.7	4.6
Krabi	2.4	4.6
Pang Nga	1.0	1.2
Phuket	0.7	0.0
Chumporn	0.6	0.0
Ranong	0.3	0.0
Other provinces	0.8	1.2

Table 2. Presenting symptoms of staghorn calculi patients

Symptoms	Number	Percent
Flank pain	42	48.8
Pyelonephritis; fever, flank pain, pyuria	16	18.6
Chronic renal failure; alopecia, malaise, edema decrease urine volume, etc.	6	7.0
Hematuria	6	7.0
Passed stone	4	4.6
Asymptomatic	4	4.6
Frequent urination	2	2.4
Unknown	6	7.0
Total	86	100.0

Table 3. Serum uric acid in association with composition of staghorn calculi

Composition of calculi	Serum uric acid	
	Uric acid ≤ 7.5 mg %	Uric acid > 7.5 mg %
Uric acid (n = 34)	13 (38.2 %)	21 (61.8%)
Others (n = 52)	35 (67.3 %)	17 (32.7%)

Table 4. Urinary pH in association with composition of staghorn calculi

Composition of calculi	Number	Urinary pH (mean \pm SD)
Pure component	54 (62.8 %)	
Uric acid	25	5.3 \pm 0.58
Calcium phosphate	12	6.1 \pm 0.74
Calcium oxalate	11	5.8 \pm 0.58
Magnesium ammonium phosphate (MAP)	5	6.4 \pm 0.48
Cystine	1	7
Mixed component	32 (37.2 %)	
Oxalate - Phosphate	18	5.7 \pm 0.54
Oxalate - Urate	9	5.3 \pm 0.61
MAP - Phosphate	5	5.7 \pm 0.67

Table 5. Composition of calculi in association with micro-organisms

Organisms	Composition of calculi	
	MAP (n = 8)	Others (n = 43)
Non-urease producing organisms	6 (75 %)	37 (86 %)
<i>Acinitobacter sp</i>	0	1
<i>Citrobactor sp</i>	0	2
<i>Corynebacterium sp</i>	2	10
<i>E. coli</i>	0	11
<i>Gardernella vaginalis</i>	2	2
<i>Staph sp</i>	0	1
Mixed organisms	2	10
Urease producing organisms	2 (25 %)	6 (14 %)
<i>Klebsiella sp</i>	0	3
<i>Pseudomonas sp</i>	2	3

Note MAP; Magnesium ammonium phosphate

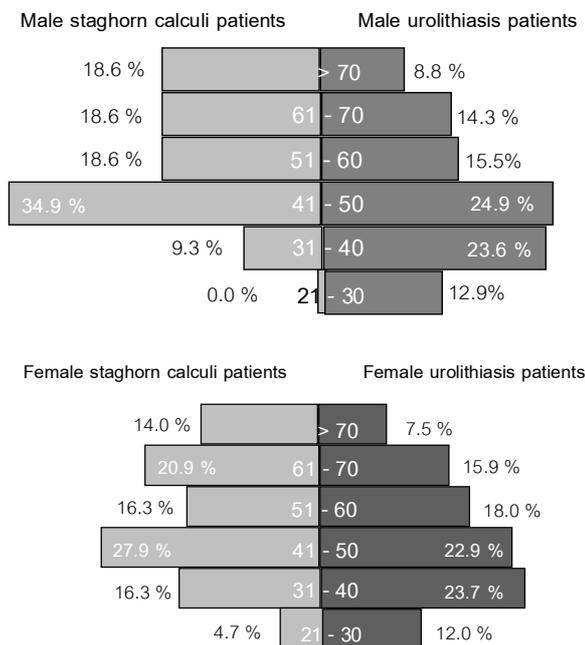


Fig. 1 Age and sex distributions of the staghorn calculi patients compare with urolithiasis patients

calculi are composed of struvite (magnesium ammonium phosphate) that formed in the presence of urease bacterial infection. Therefore, this is known as infection stone. Because women are more susceptible to urinary tract infection than men are, the author expected that women would have a higher incidence of staghorn calculi. However, no sex difference was observed in the present study, which was similar to studies of Miyake et al and Yasumoto et al^(5,6). This is contrary to studies that have revealed sex differences, such as Yamamoto et al and Koga et al, who found a higher incidence in women^(7,8), or Akagashi et al who found a higher incidence in men⁽⁹⁾. This study is also different from the epidemiological data of urolithiasis in southern Thailand⁽¹⁰⁾ where there was a significantly higher incidence of staghorn calculi in women ($p < 0.01$).

Urease-producing bacteria are known to cause an increase in the formation of magnesium ammonium phosphate or carbonate apatite in highly alkaline urine⁽⁹⁾. In previous studies, Akagashi⁽⁹⁾, Saad F⁽¹¹⁾ and Comarr AE⁽¹²⁾ reported 24.4%, 49%, and 77% of positive urine culture, while the calculi component of MAP found in 32.1%, 52%, and 64%, respectively. In the present study, the author found a positive urine culture in 51 cases (59.3%), however, it was surprising

that even with this high rate of positive urine culture, the author found magnesium ammonium phosphate (MAP) in only 11.6% of cases. This may be related to the fact that the micro-organisms most frequently found in the present study were *Corynebacterium sp* and *E. coli*, whereas urease-producing bacteria were positive in only 9.3% of cases. However, the MAP calculi had a higher infection rate of urease-producing bacteria than other type of calculi, but insignificantly ($p = 0.430$).

A stone analysis revealed that most common component (46.3%) was uric acid in the single-component stones 62.8%. In association with urinary pH, the author found that uric acid calculi was associated with a relatively low urinary pH, while MAP were associated with a higher urinary pH. In the mixed components calculi, calcium oxalate - phosphate was most common (56.3%), however, the author could not identify and difference related to urinary pH in this group.

In Thailand, there are no reports of staghorn calculi composition. Previous studies on overall stone components revealed 3% MAP-composition in the northeastern, and northern parts of Thailand^(10,13-15), while the South found 9.7%⁽¹⁶⁾, and the central part had the higher incidence (12.5-22.5%)⁽¹⁷⁾. With our specific focus on the southern area, the author found a higher incidence of MAP in staghorn calculi (11.6%), but the most common composition of staghorn calculi was uric acid (39.5%). This is in contrast with Akagashi et al who found that mixed components of MAP - calcium oxalate and mixed components of calcium oxalate - calcium phosphate - were more common, as they reported only 17.3% uric acid composition⁽⁹⁾.

A previous metabolic evaluation study in different stone components revealed higher serum uric acid in uric acid calculi patients⁽¹⁸⁾. This resembled the result of the present study, attending to the calculi components, hyperuricemia was found more often in the uric acid component group than in the other group (61.8% and 32.7%, respectively).

Conclusion

There was a significantly higher incidence of staghorn calculi in women in comparison with urolithiasis patients in southern Thailand. The most common component of staghorn calculi was uric acid.

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นิ่วเขากวางในภาคใต้

มณฑิรา ตันทนุช

วัตถุประสงค์: เพื่อศึกษาลักษณะของผู้ป่วยนิ่วเขากวางและศึกษาองค์ประกอบของนิ่วเขากวางในภาคใต้

วัสดุและวิธีการ: ทำการศึกษาข้อมูลพื้นฐาน อาการนำ และข้อมูลทางห้องปฏิบัติการของผู้ป่วยนิ่วเขากวางจำนวน 86 รายที่เข้ารับการรักษาในโรงพยาบาลสงขลานครินทร์ ระหว่างปี พ.ศ. 2540 - พ.ศ. 2543 และวิเคราะห์องค์ประกอบของนิ่ว โดยอินฟราเรดสเปกโตรสโคปี

ผลการศึกษา: มีผู้ป่วยชาย 43 ราย และผู้ป่วยหญิง 43 ราย อายุเฉลี่ย 55.5 ปี และ 50.7 ปีตามลำดับ การศึกษาองค์ประกอบของนิ่วพบว่า ส่วนใหญ่มีกรดยูริกเป็นองค์ประกอบ และร้อยละ 61.8 ของผู้ป่วยกลุ่มนี้ มีภาวะกรดยูริกในเลือดสูง การศึกษานี้พบนิ่วแมกนีเซียมแอมโมเนียมฟอสเฟต ร้อยละ 5.8 การศึกษาเชื้อแบคทีเรียในปัสสาวะ พบว่าเชื้อที่พบบ่อย คือ *Corynebacterium sp* และ *E. coli*

สรุป: อุบัติการณ์ของนิ่วเขากวางพบในเพศหญิงมากกว่าเพศชาย โดยองค์ประกอบของนิ่วเขากวางส่วนใหญ่เป็นนิ่วกรดยูริก