

BODY OF REPORT

SEATO Medic Study No. 101 Epidemiological Factors Related to Formation
of Urinary Tract Calculi

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Objective: The objective of this study is to determine epidemiological factors related to formation of urinary tract calculi particularly bladder stone.

Description: Bladder stone is the most common surgical problem in North and Northeast Thailand. The condition is considered by most authorities to be a nutritional disorder. In January, 1963, selected rural and urban areas of Ubol Province were surveyed for prevalence of bladder stone. Sample populations of 44 villages and 3 towns were selected randomly from village rosters. Interviewees were asked to recall whether they or any member of their family remembered history of:

1. Stone operation
2. Passing a stone per urethra
3. Episode of sandy or cloudy urination
4. Episode of dysuria

Table 1

VILLAGES VISITED AND POPULATION STUDIED. BLADDER STONE
SURVEY, THAILAND, JANUARY-FEBRUARY 1965

Changwad	No. villages	Studied families	Studied population
Khonkaen	3	129	859
Korat	16	785	4,977
Saraburi	20	528	2,992
Chiengmai	9	466	2,404
Pratoomthanee	16	536	2,349
Samutprakarn	14	612	4,017
Hill Tribes	7	293	1,727
Total	85	3,329	20,425

5. Episode of painful urination
6. Hematuria

The first 2 occurrences are classified as positive episodes (of bladder stone disease) and the latter 4 episodes are classified as presumptive episodes.

Progress: Between 4 January-4 February and 22 February-5 March, 1965, 85 villages in Provinces of Khonkaen, Korat, Saraburi, Chiengmai, Pratoomthanee and Samutprakarn were visited and randomly selected residents interviewed for prevalence of bladder stone symptoms and nutritional habits. Villages visited and population studied are shown in Table 1. The method of selection of villages and the questionnaire used was the same as employed in the study of January 1963. Additional questions on the source of water, type of rice consumed and infant feeding patterns were included.

Observed prevalence of "positive" (stone passed or operation) history of bladder stone could be divided into 3 groups (Tables 2 and 3). Many villages in the Provinces of Pratoomthanee and Samutprakarn had not heard of bladder stone disease; this was never found in villages in North and Northeast Thailand. As shown in Table 3, a history of bladder stone was obtained in hill tribes. Unfortunately the numbers are small and no conclusions may be drawn of the comparative prevalence of bladder stone in hill tribes and valley residents. Although in this study the predominance of males resembled the earlier study in Ubol Province, the age of onset of symptoms found in Korat and Chiengmai was considerably skewed toward adulthood (Table 4) compared with the Ubol data (see Annual Report

Table 2

PREVALENCE OF POSITIVE BLADDER STONE HISTORY IN SELECTED
AREAS OF THAILAND, JANUARY-FEBRUARY 1965

Bladder stone status	Changwad	No. Positive	Studied Population	Positive per 1,000 pop.
Endemic	Khonkaen	16	859	18.62
	Chiangmai	56	2,404	23.29
Hypoendemic	Korat	34	4,977	6.83
Rare	Saraburi	7	2,992	2.33
	Pratoomthane	4	3,249	1.23
	Samutprakarn	7	4,017	1.74

Table 3

PREVALENCE OF POSITIVE AND PRESUMPTIVE SYMPTOMS OF BLADDER
STONE DISEASE IN SELECTED THAI HILL TRIBE VILLAGERS, CHIENGMAI
THAILAND, 1965

Village	Tribe	No. Positive	Positive per 1000	No. Presumptive	Presumptive per 1000
Ban Huey Mae Nyorn	Yao	-	-	-	-
Ban Yang	Chinese*	-	-	1	4.44
Ban Bor Luang	Lawa	-	-	1	2.35
Ban Mae Lee Doi-Pui	Meow	1	5.98	2	11.97
Ban Khoon	Lawa	-	-	-	-
Ban Vieng Vay	Shan	2	9.61	3	14.42
Doi-Pak-Ka	Black Muser	1	4.95	1	-

* Ex-members of Nationalist Chinese Army and their families.

Table 4

SEX DISTRIBUTION AND AGE OF ONSET OF POSITIVE BLADDER STONE
EPISODES IN RESIDENTS OF SELECTED AREAS OF THAILAND,
STUDY OF JANUARY-FEBRUARY 1965

Age Group	Endemic and hypoendemic						Rare			
	Khonkaen and		Chiengmai		Saraburi		Samutprakarn		Pratoomthanee	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Total Cases	45	5	51	5	6	1	5	2	2	2
0-4	24.0%	4.0%	7.1%	3.6%	-	-	14.3%	-	25.0%	-
5-9	14.0%	-	-	-	-	-	14.3%	-	-	-
10-19	12.0%	2.0%	3.6%	1.8%	14.3%	-	-	28.6%	-	-
20-29	16.0%	2.0%	26.8%	3.6%	28.6%	-	-	-	-	-
30-39	12.0%	2.0%	33.9%	-	28.6%	14.3%	42.9%	-	-	25.0%
40-49	10.0%	-	8.9%	-	-	-	-	-	-	-
50-59	2.0%	-	3.6%	-	14.3%	-	-	-	-	25.0%
60+	-	-	7.1%	-	-	-	-	-	25.0%	-
Total	90.0%	10.0%	91.0%	9.1%	85.8%	14.2%	71.5%	28.6%	50.0%	50.1%

Table 5

TYPE OF RICE CONSUMED IN VILLAGES STUDIED FOR BLADDER STONE
PREVALENCE, THAILAND, JANUARY-FEBRUARY, 1965, SURVEY

Bladder Stone Status	Changwad	Total No. villages	No. villages type of rice consumed		
			Glutinous	Mixed	Ordinary
Endemic	Khonkaen	3	2	1	-
	Chiengmai	9	7	2	-
Hypoendemic	Korat	16	1	8	7
Rare	Saraburi	20	-	2	18
	Pratoomthanee	16	-	-	16
	Samutprakarn	14	-	-	14
<u>Hill tribe villages</u>					
	1. Ban Huay Mae Ngorn (Yao)	1	-	1	-
	2. Ban Yang (Chinese)	1	-	-	1
	3. Ban Bor Luang (Lawa)	1	-	-	1
	4. Ban Mae Lee, Doi Pui (Meow)	1	-	1	-
	5. Ban Khoon (Lawa)	1	-	-	1
	6. Ban Vieng Vay (Shan)	1	1	-	-
	7. Doi Pak-Ka (Bl. Muser)	1	-	1	-

FY 64) In the 1965 study areas it appeared that bladder stone disease might be disappearing as a disease of young children. Only 5 children from 0-5 years old had passed stones.

The dominant food staple varied significantly between areas studied. In Korat Province, glutinous and ordinary rice culture was carried on in the same areas sometimes by different families within the same village. Table 5 summarizes the type of rice grown and eaten in the studied areas.

Sources of drinking and cooking water for each areas are summarized in Table 6. Inclusion of forest plants in the diet have been mentioned as a possible cause of bladder stone. Evidence of consumption of the types of plants found in Nong Kohn (Ubol Province) diets was sought in other areas of Thailand. The scientific name and plant eaten of seven edible species are summarized in Table 7. Not one of these plants was eaten by villagers in all endemic areas.

In most areas of North and Northeast Thailand, breast milk is supplemented during the first few months of life with pre-masticated rice and banana. The time of beginning breast milk supplementation differs within villages and between regions studied. In Table 8, the time of starting rice supplementation is indicated by family in bladder stone endemic and hypoendemic areas.

From data presented, the following conclusions are suggested:

1. While glutinous rice consumption is frequently associated with bladder stone disease, it is not a prerequisite to the disease. Histories of 15 stone episodes were found in families eating ordinary rice. This incidence is somewhat lower than that observed among glutinous rice eaters in the same area but other causal factors may be more frequently associated with consumers of glutinous rice.

2. It appears unlikely that consumption of forest plants plays a role in bladder stone formation. The tree leaves and flowers eaten in Ubol province were not found universally distributed in other bladder stone endemic regions.

3. The use of water from moving sources (klong or river) was more frequent in areas where bladder stones were rare, whereas wells and ponds were commonly the water sources in endemic areas.

4. The prevalence of bladder stone varied directly with the percentage of infants begun on rice supplements during the first week of life. In Khonkaen, Korat, Samutprakarn and Pratoomthane Provinces there was no suggestion that infant feeding patterns had ever changed (few health workers had visited these villages to advise on infant nutrition). It appears that the Thai of the Central Plain and the Lao-Thai of North and Northeast Thailand still preserve infant feeding practises of great antiquity. When the incidence of bladder stones in families beginning infant feeding at 1 week compared with incidence in families starting supplementary feedings after 1 week (Table 9) the higher incidence of stone in families feed-

Table 6

SOURCE OF DRINKING AND COOKING WATER IN VILLAGES STUDIED FOR BLADDER STONES,
THAILAND, JANUARY-FEBRUARY, 1965

Bladder Stone Status	Changwad	Total Village studied	SOURCE OF WATER						
			Well only	Well and pond	Pond	Well and stream	Well and klong	Pond and klong	River, stream or klong
Endemic	Khonkaen	3	-	-	3	-	-	-	-
	Chiengmai	9	9	-	-	-	-	-	-
Hypoendemic	Korat	16	1	-	15	-	-	-	-
Rare	Saraburi	20	4	2	3	-	1	9	1
	Pratoomthanee	16	-	-	-	-	-	9	7
	Samutprakaen	14	-	-	-	-	5	4	5
<u>Hill tribe villages</u>									
	1. Ban Huay Mae Ngorn (Yao)	1	-	-	-	-	-	-	1
	2. Ban Yang (Chinese)	1	-	-	-	1	-	-	-
	3. Ban Bor Luang (Lawa)	1	1	-	-	-	-	-	-
	4. Ban Mae Lee Doi-Pui (Meow)	1	-	-	-	-	-	-	1
	5. Ban Khoon (Lawa)	1	-	1	-	-	-	-	-
	6. Ban Vieng Vay (Shan)	1	1	-	-	-	-	-	-
	7. Doi Pak-Ka (Bl. Muser)	1	-	-	-	-	-	-	1

Table 7

TREE LEAVES EATEN IN NONG KOHN VILLAGE, UBOL CHANGWAD

No.	Thai Name	Scientific Name	What part of Plant is eaten	What season is plant eaten	How is the plant prepared
1	Muerd	Symplocos Impressa	Young leaves	Winter	Fresh
2	Kradone Koke	Barringtonia Spp.	Young leaves	All year round	Fresh
3	Lin Fah	Oroxylum Indicum	Pods, flowers	All year round	Baked, boil
4	Tiew	Cratoxylum Spp.	Young leaves	All year round	Fresh
5	Krajiew	Curcuma Spp.	Pods, flowers	Rainy season	Boiled
6	E-heen	Monochoria vaginalis	Young leaves	Rainy season	Baked with fish, fresh
7	Samek	Syzygium Spp.	Young leaves	All year round	Fresh

Table 8

AGE OF INFANT WHEN RICE FEEDINGS WERE BEGUN. BLADDER STONE SURVEY
JANUARY-FEBRUARY 1965

Bladder Stone Status	Changwad	Total families studied	No. families beginning rice feedings			
			1 week	1 week - 1 Mo.	1 Month	Not known
Endemic	Khonkaen	129	73	37	13	6
	Chiangmai	466	182	131	112	41
Hypoendemic	Korat	785	298	157	290	40
Rare	Saraburi	528	49	191	255	33
	Pratoomthanee	537	22	146	322	47
	Samutprakarn	602	47	245	279	31
<u>Hill tribe villages</u>						
	1. Ban Huay Mae Ngorn (Yao)	19	-	3	15	1
	2. Ban Yang (Chinese)	50	-	6	38	6
	3. Ban Bor Luang (Lawa)	66	55	4	3	4
	4. Ban Mae Lee Doi Pui (Meow)	17	-	-	12	5
	5. Ban Khoon (Lawa)	58	57	-	-	1
	6. Ban Vieng Vay (Shan)	41	6	16	18	1
	7. Ban Pak-Ka (Bl. Muser)	42	6	5	24	7

Table 9

PREVALENCE OF BLADDER STONE AND AGE OF INFANT WHEN RICE SUPPLEMENTATION WAS BEGUN IN SELECTED ENDEMIC AREAS OF THAILAND. KORAT AND KHONKAEN. JANUARY-FEBRUARY 1965.

Age of Infant when rice supplement began	No. families in indicated group	Total persons in indicated group	Prevalence of bladder stone (positive)
1 week	355	2,352	28
1 wk - 1 mo.	247	1,600	10
1 mo.	265	1,738	10
No information	47	146	2

ing infants rice during the first few days of life was statistically significant (Chi square value is 5.94, significant at the 5% level).

The studies of Van Reen et. al. (1-4) in infant rats provide an experimental model which might explain how rice supplements to infants could cause bladder stone. Van Reen has observed that kidney and bladder stones are formed in young rats when their protein intake is reduced below a threshold value (30%) while mineral and sucrose intakes are increased. Rice supplements in humans would have the effect of reducing total protein intake from breast milk and increasing carbohydrates during the period of maximum protein requirement. Once a stone nidus was formed rates of growth may be individualized resulting in the observed age spread in the onset of symptoms.

It is likely that cereal supplements for infants may have been a custom among rural families in many countries for centuries. When the lactating female has many demands on her time and energy, some other source of infant nutrition would be sought. As modern medical knowledge and urbanization have served to change infant feeding practises and to provide more free time for mother as well as provide acceptable protein supplements (cow's milk), the use of very early non-protein feedings may have largely disappeared. This may explain why bladder stone, once common in Europe, spontaneously disappeared during the 19th Century.

The practise of non-protein infant feeding supplementation in warm climates is an attractive unitary theory for the causation of bladder stone disease.

Summary and Conclusions: Bladder stone is an acute and chronic disease occurring among the rural inhabitants of North and Northeast Thailand. In a survey conducted in 1963 in Ubol Province no inhabited area was found to be free of bladder stones, however, prevalence in urban areas was very low. Disease prevalence did not vary significantly with ethnic group, heredity or economic status. Symptoms begin most frequently during the dry, hot weather before and after the rainy season. Burning or painful urination, the passing of urinary sand or obstruction of urinary flow may be the only symptoms of the disease; and 8 persons have these lesser symptoms to every 1 person hospitalized. Spontaneous stone passing is three times as frequent as symptoms requiring operation. Stone passing and obstruction of the GU tract occur primarily in males but the lesser symptoms occur nearly as frequently in females as males. In 1965 similar studies were made in Khonkaen, Korat, Saraburi, Chiangmai, Samutprakarn and Pratoomthane Provinces.

1. Van Reen, R. et. al. Urolithiasis in the Rat. I. J. Nutrit. 69: 392-396, 1959
2. Van Reen, R. et. al. Urolithiasis in the Rat, II. J. Nutrit. 69: 397-402, 1959
3. Van Reen, R. et. al. Urolithiasis in the Rat. III. J. Nutrit. 77: 137-141, 1962
4. Van Reen, R. et. al. Urolithiasis in the Rat. IV. J. Nutrit. 83: 358-364, 1964

Bladder stone disease was very rare in the provinces on the Central Plain. Although glutinous rice consumption is most characteristic of endemic areas, some rural residents in these areas who grew and ate ordinary rice were found to have bladder stone. Very early carbohydrate feeding of infants was correlated with the incidence of bladder stone disease in the areas studied. This lowering of protein consumption in rapidly growing infants resembles the experimental conditions for the production of urolithiasis in rats and may be the cause of bladder stone in Thailand.