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Urolithiasis in Geriatric Patients

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Objectives: **We intended to find risk factors for urolitiasis and its recurrence in a geriatric population.**
Patients and Methods: **The medical records of 209 elderly stone patients over age 65 were reviewed. They had been regularly seen at our stone clinic for a mean follow-up period of 1385 ± 1324 days after urolithiasis was diagnosed.**
Results: **The elderly population comprised 9.6 % of all the stone patients followed at the stone clinic. Regarding stone compositions, calcium oxalate and calcium phosphate were most common in the elderly patients (80 %). The incidence of uric acid stones was higher in the elderly patient group than in the younger group (10.7 % vs. 5.1 %; p = 0.0046). Recurrent stones were seen in 18 of the 207 geriatric patients (15.4 %) during the follow-up period. The urinary calcium excretion of the recurrent stone patients was significantly higher than in those without recurrence (293 ± 138 mg vs. 177 ± 98 mg/day, p = 0.0035). However, the probability of stone recurrence estimated by Kaplan-Meier curves was as equivalent in the elderly patient group as in the younger group.**
Conclusions: **Hypercalciuria may also play a part in stone recurrence of geriatric patients.**

Key words : urolithiasis, geriatric patients, stone risks, stone recurrence

INTRODUCTION

An increasing incidence of urolithiasis has been observed in industrialized countries for the last four decades [1]. The incidence in Japan increased from 53.8 per 100,000 people in 1965 to 92.5 in 1985. The age of peak incidence shifted from 20-30s in 1965 to 40-50s in 1995 [2]. A current trend in any stone clinic appears to be towards seeing an increasing number of geriatric patients with urinary stones. Appropriate management of those aged patients is essential for their enjoying a better quality of longevity. However, there are still few data available in the literature on urolithiasis of elderly people. We evaluated age factor on the incidence of urolithiasis, stone compositions and stone-forming risk factors, particularly in those who developed recurrent stones after 65 years of age.

PATIENTS AND METHODS

The database of 2174 urolithiasis patients filed at the stone clinics of the two hospitals (Tokai University Tokyo Hospital and Inagi Municipal Hospital) was surveyed with respect to age, stone compositions, blood and 24-hour urine chemistry and stone recurrence rates from January 1982 through December 1998.

A total of 209 geriatric patients ($>$ 65 years old at the first visit) had been followed up regularly after initial diagnosis and managements for their urinary stones. The mean follow-up period was 1385 ± 1324 days.

The chemical analysis of 24-hour collected urine samples, definitions of metabolic abnormalities related to urolithiasis are described in one of our published articles [3]. Stone compositions were analyzed by infrared spectroscopy. The stone recurrence

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rate was calculated by the method published previously [4].

Statistical analysis (unpaired t-test, chi-square test, Mann-Whitney U analysis, and log rank test) was performed with the StatView 5. The rate free of stone recurrence was shown on Kaplan-Meier survival probability curves.

RESULTS

The age distribution of stone patients is shown in Figure 1. The elderly patients comprised 9.6 % of all the stone formers (209/2174). The male proportion in the elderly patient group (71.7 %, 150/209) was lower than in the younger group (77.9 %, 1531/1965, $p = 0.0438$). On the other hand, the incidence of lower urinary tract stones was significantly higher in the elderly patients (16.6 % vs. 1.4 %, $p < 0.001$), probably due to increased susceptibility to bladder calculi.

The analysis of 930 stones of geriatric patients disclosed that calcium stones were most common in both groups (Table 1). However, the incidence of calcium oxalate stones in the elderly group was lower than in the younger group (40 % vs. 54.3 %, $p = 0.0167$). On the other hand, uric acid stones and struvite stones developed more frequently in the el-

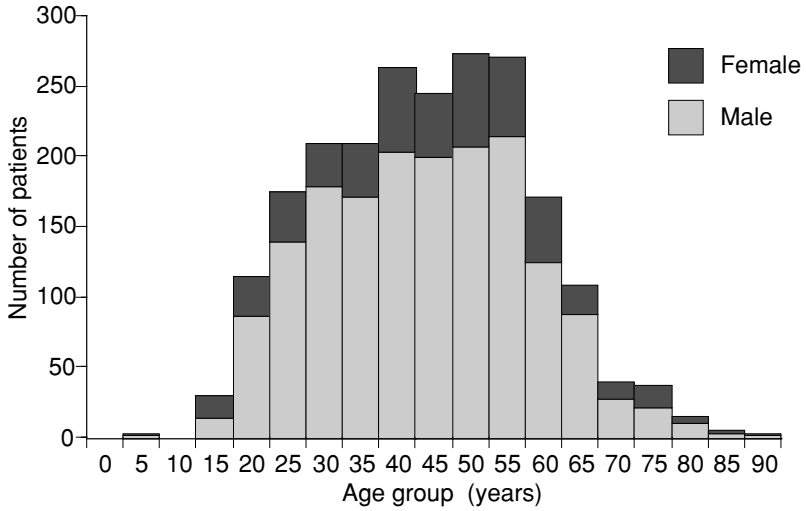

Fig. 1 Age and sex distribution of 2174 urolithiasis patients: (■), female; (■), male.

Table 1 Infrared analysis of stone compositions in elderly and younger patient groups

Composition	Elderly group (%)		Younger group (%)		P
CaOx	30	(40)	465	(54.3)	0.0167
CaOx + CaP	24	(32)	287	(33.6)	0.7827
CaOx + UA	3	(4)	14	(1.6)	0.1431
CaP	3	(4)	25	(2.9)	0.2730
UA	8	(11)	44	(5.1)	0.0460
Struvite	3	(4)	10	(1.2)	0.0453
Cystine	1	(1)	6	(0.7)	0.5440
Others	3	(4)	4	(0.5)	0.0007
Total	75	(100)	855	(100.0)	

CaOx, calcium oxalate; Cap, calcium phosphate; UA, uric acid.

Table 2 Metabolic evaluation in elderly and younger patient groups

	Elderly group (56 patients)	Younger group (407 patients)	P
Blood chemistry			
Total protein (mg/dl)	7.1 ± 0.5	7.2 ± 0.5	0.0136
Albumin (mg/dl)	4.2 ± 0.4	4.4 ± 0.5	< 0.0001
Alkaline phoshatase (IU/L)	175 ± 74	163 ± 51	0.0475
Urea nitrogen (mg/dl)	18.9 ± 4.5	14.6 ± 3.7	< 0.0001
Creatinine (mg/dl)	1.1 ± 0.3	1.0 ± 0.3	0.4074
Uric acid (mg/dl)	5.8 ± 1.4	6.0 ± 1.5	0.2465
Sodium (mEq/L)	143 ± 2	142 ± 2	0.0053
Chloride (mEq/L)	105 ± 3	104 ± 3	0.0681
Calcium (mEq/L)	4.5 ± 0.5	4.6 ± 0.5	0.0188
Phospharus (mg/dl)	3.3 ± 0.6	3.3 ± 0.6	0.3010
Urine chemistry			
Urine volume (ml)	1,802 ± 577	1,854 ± 598	0.5372
Oxalate (mg. daily)	42 ± 18	46 ± 20	0.1821
Citrate (mg. daily)	469 ± 215	449 ± 549	0.5553
Calcium (mg. daily)	190 ± 95	219 ± 88	0.0245
Magnesium (mg. daily)	90 ± 42	89 ± 30	0.0148
Uric acid (mg. daily)	538 ± 166	644 ± 193	0.0001
Creatinine (mg. daily)	1,035 ± 315	1,282 ± 438	< 0.0001
Urea nitrogen (mg. daily)	8,794 ± 2749	9,837 ± 2955	0.0148
Sodium (mEq. daily)	194 ± 71	216 ± 72	0.0402
Phospharus (mg. daily)	699 ± 230	812 ± 264	0.0025
Chloride (mEq. daily)	193 ± 68	215 ± 70	0.0288
Potassium (mEq. daily)	52 ± 18	50 ± 16	0.3906
pH	5.8 ± 1.0	5.7 ± 0.9	0.8083
No. cystinuria	1	6	0.5878

Table 3 Stone-related urinary abnormalities in elderly and younger patient groups

	Elderly group (%)	Younger group (%)	P
Hyperoxaluria	20 (36)	183 (45)	0.1909
Hypocitraturia	3 (5)	21 (5)	0.9502
Hypercalciuria	10 (18)	98 (21)	0.3020
Hypomagnesiuria	18 (32)	109 (27)	0.3992
Hyperuricosuria	2 (4)	77 (19)	0.0042

derly group (11 % vs. 5.1 %, p = 0.0460 and 4 % vs. 1.2 %; p = 0.0453, respectively).

To clarify stone risk factors, pertinent metabolic studies were completed in 463 subjects (56 elderly and 407 younger patients) (Table 2). Urinary tract infection was prevalent in the elderly group (11 of 56 patients, 10.7 % vs. 29 of 407, 5.1 %; p < 0.001). Metabolic stone risk factors were found in 41 (73.2 %) of 56 elderly patients and 306 (75.2 %) of 407 younger patients. Twelve (21 %) of 41 elderly patients and 147 (36 %, p

Table 4 24-hour urine chemistry of recurrent group and non- recurrent group of elderly patients

	Recurrent group	Non-recurrent group	P
Urine volume (ml)	2,035 ± 831	1,793 ± 526	0.2601
Oxalate (mg. daily)	41 ± 17	45 ± 18	0.5711
Citrate (mg. daily)	447 ± 159	508 ± 240	0.4422
Calcium (mg. daily)	293 ± 138	177 ± 98	0.0035
Magnesium (mg. daily)	92 ± 62	84 ± 42	0.7422
Uric acid (mg. daily)	510 ± 227	505 ± 190	0.9455
Creatinine (mg. daily)	938 ± 339	1,001 ± 309	0.5649
Urea nitrogen (mg. daily)	8,688 ± 3,818	8,305 ± 2,633	0.7215
Sodium (mEq. daily)	206 ± 55	190 ± 82	0.5775
Phospharus (mg. daily)	778 ± 354	675 ± 232	0.2708
Chloride (mEq. daily)	210 ± 51	190 ± 83	0.4667
Potassium (mEq. daily)	49 ± 20	54 ± 19	0.4694

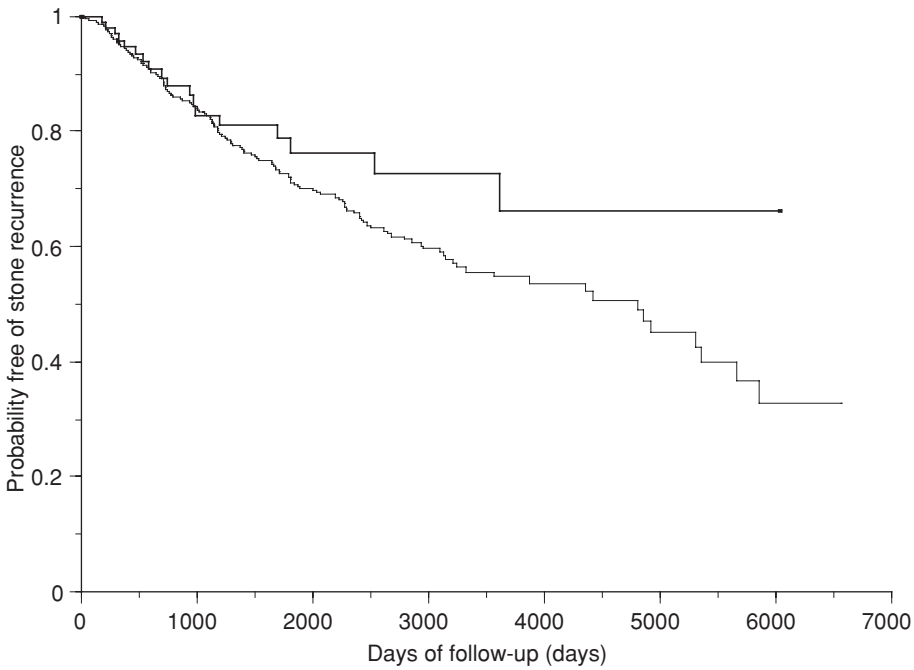

Fig. 2 Kaplan-Meier survival probability curves showing % free of recurrence in the 117 elderly patients (—) and 483 younger patients (—), (p = 0.1173, Logrank test).

= 0.0300) of 306 younger patients had more than one metabolic risk factors. The rate of hyperuricosuria was significantly greater in the younger patient group than in the elderly group (18.9 % vs. 3.6 %, p = 0.0042) (Table 3).

In a subgroup of 117 elderly patients who completed metabolic studies relevant to stone recurrence, 18 developed recurrent stones eventually. These 117 patients were divided into the recurrent and non-recurrent group. The urinary calcium excretion in 18 patients with recurrent stones was significantly higher than in non-recurrent patients (p = 0.0035) (Table 4).

As shown in a stone-free probability curve of Fig. 2, there was no significant difference in the stone recurrence rate between the elderly and younger groups (p = 0.1173, Log rank test).

DISCUSSION

Geriatric population (> 65 years old) comprised 9.6 % of all the stone patients in this study. Asper reported that the incidence of urinary calculi was 2 % in the elderly population [5], but, according to another recent literature, the incidence has increased up to 12 % [6]. Yoshida *et al.* reported that while, in 1965, aged patients over 60 years old constituted 7.1 % of all the studied patients with first stone episodes, by 1995, the proportion of those elderly patients had increased up to 23.1 % [1, 2]. Takeuchi *et al.* observed in the age distribution study of upper urinary tract stones in northern Hyogo, Japan that the peak incidence of urolithiasis was in the age of 60s [7]. The stone incidence of the elderly people observed in our study was lower than in the nation-wide study, probably because the scope of our study was limited to a local, urban community.

In this study, the male preponderance of non-infected urolithiasis, commonly seen in stone epidemiology, was not apparent in the elderly patient group. Vagelli demonstrated the similar findings in his epidemiological study [8].

Of stone compositions, calcium oxalate was most common in both the elderly and younger patient groups. However, there was a significant decrease in the rate of predominance of calcium oxalate stones in the elderly group compared with the younger group (76 % vs. 89.5 %, p = 0.005). Estepa *et al.* reported that the proportion of calcium component in elderly patients' stones was 45.8 %, whereas it was 89.4 % in younger patients [9]. Goldfarb *et al.* described that calcium excretion and urine calcium concentration was lower in older patients [10]. In our current study, there was also a significant decrease in urinary calcium excretion in the elderly group. In contrast, however, there was no difference in urinary oxalate excretion between the elderly and younger groups. Considering that calcium stone formation is largely dependent on urinary calcium concentration rather than oxalate concentration, the reduction in urinary calcium excretion may account for the loss of predominance of calcium stones in the elderly patients.

In this study, struvite stones comprised 4 %. The incidence of struvite stones in the elderly peoples are reported from 1 % to 5 % [6, 8, 9]. A higher incidence of urinary tract infections observed in our geriatric patients may account for a relatively higher incidence of struvite stone formation.

In the literature, the incidence of uric acid stones in the geriatric patients ranged from 11 to 31.5 % [6, 8, 11]. It is known that the formation of uric acid calculi is correlated with urinary pH and a low urine volume. In this study, while the mean urinary pH and the mean urinary volume in the elderly group was nearly equivalent to the younger group data and the urinary uric acid excretion was lower, the incidence of uric acid stones was significantly higher than in the younger group. A similar data was described by Goldfarb *et al.* that the urinary pH was distinctly lower in their older patient group, whereas the uric acid excretion was low as well [10]. Hypothetically, a defect of ammonium excretion of the kidney reduces urinary buffer availability and leads to a low urinary pH. Whether they had such a defect remains to be investigated.

In this study, 18 (15.4 %) of 117 geriatric patients had recurrent stones during the follow-up period. A longitudinal study of unselected population in a Swedish community town revealed 19 % of overall incidence rate of renal stones among aged men for 10-year follow-up. In 47 % of these cases, stones were recurrent, while the rest were new ones [11]. In our patient group, the probabilities of the stone recurrence estimated by Kaplan-Meier method were 23.8 % at 5 years and 33.9 % at 10 years, respectively, almost the same

probability as in the younger group. Thus, recurrent stones may occur in elderly people as frequently as in younger people.

Epidemiologic studies have shown that an expected recurrence rate of urinary stones in general population is around 50 % at 10 years, though it is much lower among first-time stone formers than among those who have formed $>$ 1 stone [12]. Thus, increasing time of follow-up observation may correlate with increasing recurrence rates. Important risk factors for stone recurrence in the general population include disorders of calcium, oxalate, citrate, uric acid and cystine metabolism. As calcium stones are most prevalent, hypercalciuria, though usually in combination with other fators rather than as a single agent, is believed to be a most common culprit for recurrent stone formation. Any aberration in dietary and drinking habits may enhance those risk factors unfavorably. In this study, however, hypercalciuria seemed to be a sole risk factor among the recurrent subgroup of elderly urolithiasis patients.

We examined the urinary excretion of stone-related substances in 8 healthy elderly volunteers. The average age was 73.4 ± 9.4 years. The daily urinary volume was 2015 ± 483 ml and 24-hour urinary excretion of the oxalate, citrate, calcium, magnesium, and uric acid were 30.7 ± 10.3 mg, 570 ± 531 mg, 175 ± 61 mg, 88 ± 37 mg, and 516 ± 125 mg, respectively. There was no difference in these parameters between them and the recurrent stone formers of the same age. Kohri *et al.* [13] also reported that there was no difference in urinary electrolytes, urinary oxalic acid and citrate between elderly stone patients and the healthy controls. In this study, however, the urinary calcium excretion of the recurrent stone group was higher than that of the non-recurrent group (293 ± 138 mg vs. 175 ± 61 mg, $p = 0.0274$). So, it is suggested that hypercalciuria may play a part in stone recurrence of elderly people. The subtype of hypercalciuria remained to be determined. However, we speculate that most of them may have Type 2 absorptive hypercalciuria (dependent upon calcium intake) because we encountered many patients who are advised by their home physicians to take calcium-rich foods and/or calcium supplements to prevent progression of osteoporosis.

In conclusion, we studied 209 elderly urinary stone patients over 65 years of age. It was shown that the predominance of calcium oxalate stones commonly seen in general population was absent in the elderly group, probably due to reduced levels of supersaturation with calcium oxalate, a trend seen in aged people. Uric acid stones were more prevalent among the elderly, though the incidence of hyperuricemia or hyperuricosuria was not so high, as compared with the younger group. Eighteen (15.4 %) of 117 elderly stone formers followed for a long-term had recurrent stones, and, as contrary to the general trend of reduced urinary calcium excretion in the average elderly population, they had hypercalciuria that can be an important risk factor for stone recurrence in this age group.

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