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Effect of Age on the Clinical Presentation of Incident Symptomatic Urolithiasis in the General Population

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Abstract

Purpose—We characterized variation in the clinical presentation between older and younger first time symptomatic stone formers in the general population.

Materials and Methods—We studied a random sample of Olmsted County, Minnesota residents with their first diagnostic code for urolithiasis between 1984 and 2003. Chart validated symptomatic stone formers had a confirmed stone by imaging or stone passage. Clinical presentation characteristics were compared between age groups.

Results—Among the 3,473 charts reviewed there were 1,590 validated incident symptomatic stone formers (mean age 43 years, range 18 to 96). Older individuals were more likely to present with atypical or no pain, fever, diarrhea, pyuria, urinary tract infections and bacteremia ($p < 0.001$). Stone size and location did not differ by patient age. Calcium phosphate stone disease was associated with younger age, while uric acid stone and atypical stone composition was associated with older age ($p < 0.001$). Older individuals were less likely to pass the stone spontaneously and were more likely to require surgical intervention ($p < 0.001$). Surgical intervention was required in 516 (32.5%) individuals. Younger individuals were more likely to undergo ureteroscopy while older individuals were more likely to undergo shock wave lithotripsy, temporizing stent placement and percutaneous nephrolithotomy.

Conclusions—The detection of stone disease in older individuals can be challenging due to atypical pain or absence of pain, as well as the presence of other comorbid conditions such as urinary tract infections and diarrhea. A higher index of suspicion for urolithiasis may be needed in the elderly for a more timely diagnosis and intervention to prevent morbidity.

Keywords

urolithiasis; age factors; epidemiology; urinary tract infections

Urolithiasis is a common disorder affecting all age groups. Studies from the United States and other countries indicate that the incidence of upper tract stone disease has increased steadily during the last 5 decades.^{1–5} With improvements in medical care and overall life expectancy, stone disease could become more common in the geriatric population. However, little is known about the effect of age on urolithiasis and existing data on geriatric stone disease are inconsistent. Payne et al found that urinary stone disease was more likely to

develop in elderly patients,⁶ while others found geriatric stone disease to be uncommon and not related to age.^{7,8} More recent studies have demonstrated that geriatric patients compromise 10% to 12% of all patients referred to tertiary care centers for treatment of urolithiasis.^{9,10}

Population based studies confirm an increase in urinary stone disease in the elderly. The NHANES II (National Health and Nutrition Examination Survey) showed increasing rates of stone disease in men up to age 65 years and in women to age 70 years.¹¹ A population based epidemiological study focusing on Olmsted County, Minnesota found that incident stone disease peaked for men age 60 to 69 years, and 2 peaks were noted for women at ages 30 to 39 and 60 to 69 years.¹ Finally, another study focusing on Wisconsin residents showed an increase in stone incidence in the age 60 to 64 and age 80 to 84 cohorts.⁵ Given this evidence that stone disease has a significant impact on the aging population, in this study we characterize age differences in the clinical presentation and management of incident stone disease in a community setting.

MATERIALS AND METHODS

After institutional review board approval, data on individuals diagnosed with stone disease in Olmsted County, Minnesota were obtained through the REP (Rochester Epidemiology Project). This resource contains the linked medical records of all medical care providers for all residents of Olmsted County. Diagnostic codes dating back to 1935 are indexed.¹² The REP has been used to study the incidence of nephrolithiasis over time.¹ Residents with urolithiasis events between 1984 and 2003 were identified using ICD-9 codes 592, 594 and 274.11. The first stone event documented in Olmsted County in the 1984 to 2003 period was identified. Residents who did not have Minnesota Research Authorization¹³ and those with documented urolithiasis episodes before 1984 were excluded from study. Charts of 3,473 of the remaining patients were reviewed by a dedicated nurse abstractor who collected all data analyzed in this study under the supervision of 2 nephrologists (ADR, JCL) and a urologist (AEK). Criteria for a validated incident symptomatic stone were 1) documented imaging of a stone in the ureter or renal pelvis consistent with obstruction or intermittent obstruction, or 2) documentation of stone recovery after passage or removal. A stone was considered symptomatic if the patient presented for clinical care of gross hematuria or pain. Pain could be typical renal colic or atypical, defined as vague, nonlocalized abdominal, pelvic or back pain. A symptomatic UTI with a urease splitting organism (urinary pH greater than 7.0) from an infected kidney stone (struvite composition) was also considered a criterion for a symptomatic stone. Only imaging studies (CT, excretory urogram, KUB and US) obtained to evaluate presenting symptoms consistent with an obstructing or infected stone were used for validation. Patients with incidental asymptomatic stones (even if located in the ureter or subsequently removed by surgery), bladder stones, or those suspected of having stones but with inadequate confirmation by imaging or documented passage were excluded from study. Stone composition was based on the predominant component. Only those patients with a positive documented urine culture with more than 10^5 cfu were considered to have a UTI.

In terms of statistical analysis, age group associations were tested using chi-square and ANOVA tests. Stone composition and primary treatments were required to have been documented within 90 days after the first stone event. For continuous and binary characteristics, tests of trend with age group were also evaluated using rank correlations and the rank sum test. A statistically significant trend test was also reported when the chi-square or ANOVA test was not statistically significant. Logistic regression analysis was used to identify the risk of UTI or surgical intervention. All reported p values were 2-sided with p < 0.05 considered statistically significant. Statistical analyses were performed using SAS® software, version 9.1.

RESULTS

Of the 1,633 individuals who met the incident symptomatic stone criteria, 1,590 were 18 years old or older and were included in the study. Figure 1 shows the age distribution of the 1,590 patients. Presenting symptoms by age group are summarized in table 1. With increasing age, individuals were more likely to present with atypical pain or no pain, fever, gastrointestinal symptoms, pyuria and UTI. For each decade of life the risk of UTI increased (OR 1.26, 95% CI 1.12–1.45, $p = 0.004$). The most common organisms cultured were *Escherichia coli* in 38 (39%), *Klebsiella pneumonia* in 12 (12%), *Staphylococcus aureus* in 6 (6.2%) and *Proteus mirabilis* in 6 (6.2%). Overall, females were more likely to present with a UTI than males (82.6% vs 17.4%, $p < 0.0001$). Initial medical evaluation is presented in table 2. Older individuals were more likely to be hospitalized for evaluation and more likely to have a urological consultation at presentation. Older individuals were also more likely to undergo diagnostic CT imaging. In this community US imaging for stones was done only during pregnancy, which accounts for the absence of US use in the older age groups.

Stone number, size and location are presented in table 3 for the 1,454 patients with renal imaging. Although there was no difference in number of stones, older individuals were more likely to have larger diameter stones or staghorn calculi. There was no difference in the location of presenting stones based on age. Information on stone composition was available for 888 patients, with calcium oxalate and calcium phosphate being the most common primary components (fig. 2). Primary composition of the incident stone varied based on patient age. Calcium phosphate was associated with younger age, while uric acid and atypical (other) stones were associated with older age ($p < 0.0001$). Of the 8 brushite stones there were 0, 4 (0.7%), 1 (0.2%), 1 (0.7%) and 2 (2%) in the 18 to 29, 30 to 44, 45 to 59, 60 to 69 and 70 years or older age groups, respectively. In the small number of patients for whom data were available there was no association between spot urine pH and patient age (table 1).

The initial stone intervention is summarized in table 4. Younger individuals were more likely to require nonsteroidal anti-inflammatory drugs and narcotics for relief of pain symptoms. Older individuals were less likely to spontaneously pass their stone and more likely to require surgical intervention. Furthermore, bacteremia was more likely to develop in older individuals. Death occurred as a result of acute stone disease in 2 patients, both in the 70 years or older age group.

Younger patients were more likely to experience spontaneous resolution of their stone event compared to older patients (mean [SD] 42.10 [14.09] vs 45.33 [16.20], $p < 0.0001$). Of the 759 patients who spontaneously passed their stones 186 (24.5%) had stones located proximally compared to 381 (45.9%) of the 831 surgical patients ($p < 0.0001$). For distal stones there was no difference in spontaneous passage vs surgical intervention rates (228 of 759 [30%] vs 231 of 831 [27.8%], $p = 0.324$). Surgical intervention was required in 516 (32.5%) individuals within 6 months of presentation (table 4). Excluding cystoscopy with retrograde urography with or without stent placement in 133 (25.8%), ureteroscopy was the most common initial treatment in 206 patients (39.9%), followed by SWL in 116 (22.5%) and PCNL in 20 (3.9%). Surgical intervention increased with each decade of life (OR 1.24, 95% CI 1.16–1.33, $p < 0.001$). More patients in the older age group underwent cystoscopy with stent placement, PCNL and SWL, while individuals in the younger age groups were more likely to undergo ureteroscopy. Older individuals were more likely to undergo bilateral surgical intervention and were more likely to receive a perioperative ureteral stent. Although both genders were at increased risk for surgical intervention with older age, men were at greater risk (OR male 1.41 vs female 1.12, $p = 0.001$).

DISCUSSION

Although urolithiasis can affect individuals of any age, several studies have demonstrated that a relevant proportion of patients with the disease are older than 60 years.^{1,9-11} In this population based study of validated incident symptomatic stone formers, we found that 16% (248 of 1,590) were older than age 60 years. New onset urolithiasis in the aging population does not appear to be simply an extension of the disease that is observed in the younger stone forming population, but rather is a disease with unique characteristics.^{9,10,14} In this study we confirmed that there are indeed important differences in the presentation and treatment of urolithiasis between younger and older adults.

In this community based study, incident stone formers who presented with typical renal colic were significantly younger than patients with atypical pain or no pain at all. Furthermore, older individuals were more likely to present with fever, pyuria and gastrointestinal symptoms. UTI at stone presentation was more common in the older patients than in the younger patients. Older individuals were more likely to require hospitalization and were more likely to experience the complication of bacteremia. In fact, death secondary to stone disease was rare and only occurred among patients age 70 years or older. Older patients were less likely to spontaneously pass their stone and were more likely to undergo surgical intervention than younger individuals. Stone composition also varied based on age, with younger individuals more commonly having calcium phosphate stones and older individuals having uric acid stones or atypical stones.

Our finding of decreased or atypical pain presentation with incident stones in older individuals is novel. An atypical presentation of stone obstruction can delay diagnosis and timely treatment, especially in an individual without a history of stones. Thus, we suggest a high index of suspicion for urolithiasis in older individuals with hematuria and vague or absent pain symptoms. We also noted an increase in UTIs at presentation as age increased, which has been previously observed. Usui et al found a significantly higher rate of UTIs at the time of stone evaluation in patients older than 65 years (10.7%) compared to younger individuals (5.1%).⁹ Although the risk of UTI increased with age in our study, we did not see an increase in struvite as a primary stone composition. We speculate that although UTIs are a common presenting symptom, they are rarely a result of infected struvite stones. Similar findings were supported by Gentle et al, who noted that only 1% of geriatric stone formers had struvite stone disease.¹⁰ However, Usui et al noted a fairly high rate of struvite stone disease (4%) in their elderly population.⁹

Patients in our cohort with uric acid and atypical stones were significantly older than those with other stone compositions. Other investigators have noted similar increases in uric acid stone disease in the elderly population with rates ranging from 11% to 31.5%.^{9,10,15-17} Conversely, in our study calcium phosphate stone disease was more common in the younger age groups. However, when brushite stones were specifically examined they were more likely to present in older individuals. A lower urinary pH with increasing age has been described,¹⁴ and would contribute to the lower number of calcium phosphate stones and higher number of uric acid stones observed in our older population. However, this does not account for the unexpected increase in incident brushite stone disease. The increase in incident brushite stones does not support a prior hypothesis that previous urolithiasis related renal insult is a predisposing factor for brushite stones,¹⁸ but rather indicates that the disease may be related to changes in the aging kidney and its environment.

Pierratos et al found the mean age of COM stone formers to be higher than those with COD stones.¹⁸ The degree of hypercalciuria is a major determining factor in whether a COM or COD stone is developed, with lower degrees of hypercalciuria favoring monohydrate

formation.¹⁹ Goldfarb et al have demonstrated that the degree of hypercalciuria decreases with age.¹⁴ However, we did not see such an association between calcium oxalate stone disease and age, even when the calcium oxalate cohort was subdivided into COM and COD.

Our study also demonstrated that the morbidity of stone disease, expressed as the need for hospitalization or surgical intervention, or the presence of bacteremia, significantly increased with each decade of life. In fact, death secondary to stone disease and subsequent urosepsis was only noted in 2 individuals, both of whom were older than 70 years with limited comorbidities. The higher rate of UTI at stone presentation in our cohort may have contributed to more aggressive surgical intervention. While Coe et al found surgical intervention rates increased with age in men only,²⁰ we found surgical intervention increased with age in both genders, although the risk was significantly greater for men than for women. A review of surgical intervention in the elderly showed that treatment with ureteroscopy and PCNL is safe and effective, but there was a higher complication rate with SWL.²¹ Thus, data support the safety of surgical intervention when appropriate in the aging population.²¹ The more common use of ureteroscopy compared to other surgical interventions in younger patients in our study was consistent with their smaller stone size on presentation and was most likely not a result of patient age. Our data also indicate that stone disease in the elderly could be more costly. Not only were these patients more likely to require hospitalization, they were more likely to undergo CT and require consultation with a urological specialist.

This study has certain limitations. The population of Olmsted County in 2000 was approximately 124,000 (90% white). Socioeconomically the community resembles the United States white population¹² and findings in other ethnic groups may differ. However, NHANES II demonstrated that stone disease is more prevalent in whites.¹¹ Thus, the Olmsted County cohort should be a reasonable representative of the majority of the United States population with stone disease. In addition, this is a retrospective review and it is subject to certain limitations, namely nonstandardized followup and treatment. These data also may not be applicable to recurrent stone formers. Despite these limitations, this study is one of the few studies available that is not biased by selective referral of patients to subspecialty centers.

CONCLUSIONS

We found that older individuals presenting with their first stone were less likely to have typical renal colic and more likely to present with no pain or atypical pain. As patients age they are more likely to have atypical stones and concurrent UTI, and to require surgical intervention and experience morbidity as a result of stone disease. Due to the differences in presentation and outcomes noted in the aging community, a higher index of suspicion may be needed to diagnose urolithiasis in the maturing population and a lower threshold for intervention should also be considered.

Acknowledgments

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Abbreviations and Acronyms

COD calcium oxalate dihydrate

COM	calcium oxalate monohydrate
CT	computerized tomography
KUB	plain x-ray of the kidneys, ureters and bladder
PCNL	percutaneous nephrolithotomy
SWL	shock wave lithotripsy
US	ultrasound
UTI	urinary tract infection

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Figure 1.
Age distribution of 1,590 valid incident stone formers in Olmsted County, Minnesota, 1984 to 2003.

Figure 2.
Stone composition as function of age among Olmsted County, Minnesota residents.

Table 1

Presenting symptoms of 1,590 incident stone formers

	Age at Diagnosis					p Value
	18-29 Yrs	30-44 Yrs	45-59 Yrs	60-69 Yrs	70 Yrs or Older	
No. pts	325	589	428	148	100	
No. pain (%):						30.0001
Renal colic	305 (94)	530 (90)	378 (88)	127 (86)	73 (73)	
Atypical	16 (5)	43 (7)	34 (8)	12 (81)	17 (17)	
None	4 (1)	16 (3)	16 (4)	9 (6)	10 (10)	
No. nausea (%)	210 (65)	377 (64)	244 (57)	92 (62)	58 (58)	0.13 *
No. emesis (%)	144 (44)	237 (40)	138 (32)	56 (38)	38 (38)	0.014
No. fever greater than 38C or greater than 100.5F (%)	17 (5)	37 (6)	26 (6)	11 (7)	17 (17)	0.0010
No. voiding symptoms (%)	132 (41)	214 (36)	122 (29)	41 (28)	26 (26)	0.0008
No. loose stools or diarrhea (%)	36 (11)	51 (9)	33 (8)	17 (12)	19 (19)	0.0086
No. gross hematuria (%)	63 (19)	129 (22)	88 (21)	33 (22)	20 (20)	0.90
No. microscopic hematuria (%)	220 (68)	367 (62)	275 (64)	92 (62)	64 (64)	0.58
No. UTI with greater than 100,000 cfu/ml (%)	19 (6)	21 (4)	18 (4)	9 (6)	19 (19)	30.0001
No. pyuria (%)	21 (7)	22 (4)	20 (5)	15 (10)	15 (15)	30.0001
Spot urine pH:						0.058
No.	26	31	28	16	20	
Mean (SD)	6.39 (0.96)	6.26 (1.08)	6.03 (1.02)	5.75 (0.88)	6.60 (1.09)	

* Trend test p=0.04.

Table 2

Initial evaluation of stone formers

	No. Age at Diagnosis (%)					p Value
	18-29 Yrs	30-44 Yrs	45-59 Yrs	60-69 Yrs	70 Yrs or Older	
Initially misdiagnosed	50 (15)	76 (13)	48 (11)	23 (16)	17 (17)	0.32
Emergency room evaluation	279 (86)	487 (83)	333 (78)	117 (79)	81 (81)	0.058*
Hospitalized overnight	128 (39)	208 (35)	165 (39)	61 (41)	62 (62)	<0.0001
Urology evaluation	144 (44)	292 (56)	238 (56)	94 (64)	68 (68)	<0.0001
Imaging study type:						0.0009
None/unknown [†]	40 (12)	48 (8)	51 (12)	14 (10)	13 (13)	
CT	100 (31)	189 (32)	134 (31)	52 (35)	46 (46)	
KUB without tomograms	73 (23)	118 (20)	96 (22)	32 (22)	12 (12)	
KUB with tomograms	16 (5)	40 (7)	24 (6)	9 (6)	7 (7)	
Excretory urogram	83 (26)	182 (31)	123 (29)	41 (28)	22 (22)	
Retropertitoneal US	13 (4)	12 (2)	0 (0)	0 (0)	0 (0)	

*Trend test p=0.008.

[†]Includes 136 overall without imaging and 30 with imaging but unspecified image type.

Table 3

Size, location and number of stones found at initial presentation

	Age at Diagnosis						p Value
	18–29 Yrs	30–44 Yrs	45–59 Yrs	60–69 Yrs	70 or Older		
No. pts	291	547	388	140	88		
No. No. kidney stones (%):							0.027
0	51 (18)	101 (18)	63 (16)	20 (14)	14 (16)		
1	149 (51)	280 (51)	220 (57)	66 (47)	34 (39)		
Multiple	91 (31)	166 (30)	105 (27)	54 (39)	40 (45)		
Diameter of largest stone:							0.0025
No.	141	264	181	64	48		
Mean (SD)	4.47 (2.83)	4.59 (3.81)	5.21 (3.44)	5.16 (3.69)	6.68 (5.39)		
No. staghorn (%):							0.0002
No	289 (99)	543 (99)	386 (99)	136 (97)	83 (94)		
Yes	2 (1)	4 (1)	2 (1)	4 (3)	5 (6)		
No, lower calyx/pole or pelvic stone (%):							0.13
No	249 (86)	490 (90)	330 (85)	123 (88)	72 (82)		
Yes	42 (14)	57 (10)	58 (15)	17 (12)	16 (18)		
No, ureteropelvic junction stone (%):							0.73
No	277 (95)	521 (95)	365 (94)	133 (95)	81 (92)		
Yes	14 (5)	26 (5)	23 (6)	7 (5)	7 (8)		
No, ureteral stone (%):							0.37
No	181 (62)	370 (68)	264 (68)	95 (68)	54 (61)		
Yes	110 (38)	177 (32)	124 (32)	45 (32)	34 (39)		
No, ureterovesical junction stone (%):							0.11
No	204 (70)	358 (65)	263 (68)	101 (72)	69 (78)		
Yes	87 (30)	189 (35)	125 (32)	39 (28)	19 (22)		

Table 4

Initial intervention for presenting stone

	No. Age at Diagnosis (%)					p Value
	18-29 Yrs	30-44 Yrs	45-59 Yrs	60-69 Yrs	70 Yrs or Older	
Intravenous fluids	213 (66)	388 (66)	269 (63)	93 (63)	69 (69)	0.72
Nonsteroidal anti-inflammatory drugs for pain control	155 (48)	260 (44)	179 (42)	58 (39)	25 (25)	0.0015
Narcotics for pain control	247 (76)	404 (67)	281 (66)	92 (62)	61 (61)	0.0041
Development of bacteremia	4 (1)	9 (2)	6 (1)	4 (3)	9 (9)	<0.0001
Surgery type within 3 mos:						<0.0001
None	249 (77)	431 (73)	292 (68)	76 (51)	57 (57)	
Open lithotomy	2 (0.6)	0 (0)	2 (0.5)	3 (2)	0 (0)	
Ureteroscopic	37 (11)	65 (11)	62 (15)	34 (23)	8 (8)	
Percutaneous	0 (0)	8 (1)	4 (1)	4 (3)	4 (4)	
Laparoscopic	1 (0.3)	1 (0.2)	1 (0.2)	0 (0)	0 (0)	
SWL	12 (4)	39 (7)	42 (10)	15 (10)	8 (8)	
Cystoscopy with urogram with or without stent	24 (7)	45 (8)	25 (6)	16 (11)	23 (23)	
Totals with surgery	76	158	136	72	43	0.10
Stone surgery side:						
Rt	40 (53)	73 (47)	62 (47)	30 (44)	17 (41)	
Lt	35 (46)	77 (49)	69 (53)	36 (52)	20 (49)	
Both	1 (1)	6 (4)	0 (0)	3 (4)	4 (10)	
Periop ureteral stent	60 (79)	103 (65)	89 (65.4)	55 (76)	32 (74.4)	0.10
Eventual resolution of stone event:						<0.0001
Surgical intervention	84 (26)	161 (27)	155 (36)	76 (51)	45 (45)	
Stone voided/passed by pt	167 (51)	303 (51)	206 (48)	48 (32)	35 (35)	
Resolution, no evidence of stone voided/passed	22 (7)	47 (8)	21 (5)	16 (11)	10 (10)	
Pt died	0 (0)	0 (0)	0 (0)	0 (0)	2 (2)	
Unclear or pt lost to followup	52 (16)	78 (13)	46 (11)	8 (5)	9 (9)	