Original Article

Epidemiology and composition of nephrolithiasis in a Lebanese tertiary care center: A descriptive study

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Abstract

Introduction: Nephrolithiasis is a common affliction with a prevalence of 12% in men and 7% in women. The incidence rate diverges with geographic location. Arab countries report high nephrolithiasis prevalence rates, with Saudi Arabia being the highest (20.1%). To date, there is little knowledge about the demographics and composition of stones in Lebanon.

Methods: A retrospective chart review was performed on stone composition at the American University of Beirut Medical Center, between 2005 and 2018. Patients' demographics and stone characteristics were obtained from electronic medical records. Analysis of frequencies and Chi-square test were adopted for potential risk factor correlations by the Statistical Package for the Social Sciences (SPSS).

Results: A total of 626 stone analyses were performed. Male patients predominated (69%). The mean age was 46.58 ± 16.5 years, and mean body mass index was 28.63 ± 5.6, for both sexes. Calcium oxalate was the most predominant stone in both sexes (70%). Uric acid stones followed (~16%), and calcium oxalate phosphate stones were the third most common (5%). Incidence of kidney stones peaks in the summer, with 11.86% presenting in July. Around 60% presented with flank pain to the Emergency Department, and 32% ended up with spontaneous passage of stones by medical expulsive therapies alone, with no further surgical intervention. Diabetes and hypertension were significantly correlated with stone recurrence in our cohort.

Conclusion: There is a significant gender disparity in stone prevalence in Lebanon. Calcium oxalate is the most common type in both sexes. Future investigations of dietary and environmental factors are recommended from our region.

Keywords: Kidney stones, Lebanon, MENA region, nephrolithiasis, ureteral stones

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INTRODUCTION

Kidney and ureteral stones have been investigated for over several years and are known to cause a series of symptoms (such as pain and restlessness) and complications (such as obstruction, kidney damage, and infection).[1] The prevalence of stone disease is growing across the world.[2] In the United States, the prevalence has augmented from 3.2% in 1976 to 1980, to 5.2% in 1988–1994, and 8.8% in 2007–2010.[3] In 2000, around 2 million outpatient visits in the US were due to urolithiasis.

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In 2009, 1.3 million ED visits in the US were linked to symptomatic kidney stones.[2] This variation is expected to be due to the increasing prevalence of the metabolic syndrome in the population.[4] It is also a widespread illness in other regions such as 5%–9% in Europe and 1%–5% in Asia.[5] The primary age group afflicted is the working-age population. The Urological Disease in America Project estimated the direct costs of stones to be 4.5 billion dollars in 2000 due to common ED visits, hospitalization and lost working hours.[2]

The relapsing rate for secondary stone formation is about 10%–23% per year; 50% in the next 5–10 years, and 75% in 20 years, in those who do not apply metaphylaxis.[1] A few epidemiological elements showed an augmented risk for stone formation such as genetics, sex, climate, geographic location, and weight.[1] Once diagnosed with the first kidney stone, about 50% will experience another episode in the following 10 years.[2]

There is a paucity of studies about the prevalence and composition of kidney stones from the Middle Eastern and the Levant countries. The following descriptive study aims to determine the prevalence of kidney and ureteral stones from a cohort of patients presenting to a tertiary care center in Beirut, Lebanon. The composition of stones has been emphasized along with the numerous risk factors that could prompt stone recurrence.

METHODS

The aim of this paper is to present and describe the epidemiology and composition of stones in Lebanon, part of the Middle Eastern, and North African countries. Lebanon is one of the Levant countries, facing the Mediterranean Sea. A retrospective review was performed of all adult patients who had the composition of their upper urinary tract calculi analyzed at the American University of Beirut Medical Center between 2005 and 2018. Patients' electronic medical records were accessed, and their demographics were obtained. The following information was collected: Sex, age, and seasonal time from which the stone was extracted and analyzed, weight and body mass index (BMI), among others.

Following the descriptive study, analysis of frequencies and Chi-square testing was done by the IBM SPSS Statistics for Windows, version 26 (IBM Corp., Armonk, N.Y., USA), to check for any statistically significant correlation between patients' comorbidities and the risk for developing stones. We anticipated different results, secondary to the diverse patients' genetics, comorbidities, dietary habits, and even due to the different geographical locations within the same country.

RESULTS

A total of 626 patients were included in the cohort study. The mean age of patients was 46.6 years. Most of the patients were from Beirut– the capital and the most populated area of Lebanon. Over two-thirds of patients were males (69%); 47.8% were active smokers, and 44.2% were hypertensive [Table 1]. There were 80.3% of patients with BMI of or <25 kg/m^2. Stone distribution according to patients' age for both genders is presented in Table 2. The overall Male:female (M:F) ratio was 2.28. The M:F ratio was the highest in the elderly in their 7th decade of life, whereas it was the lowest in extreme elderly in their 9th decade of life. The highest number of calculi was observed in the age group 40–49 years, in both males and females.

Calcium oxalate was the most frequently isolated type of calculi in both sexes (70% of all stones). Calcium phosphate was by far the least abundant component (0.5%) in both sexes (0.2% in males and 1.2% in females). Uric acid stones, accounting for a relative proportion of 16.0%, were the second most abundantly isolated composition [Table 3]. The struvite stones were almost twice as common in females as in males, and cysteine stones were twice as abundant in males as in females.

Figure 1 shows the variation of stone composition in terms of age and between sexes. Calcium oxalate is the most abundant type of calculi across all ages. Its occurrence seemed to increase with age to reach two peaks in the following age groups: 40–49 and 60–69 years. Calcium oxalate was the most abundantly isolated type of calculi in every age class from 10 years up to 89 years in both sexes. Struvite stones were seen to affect females at a younger age than male counterparts, mainly in the age group of 30–49 years among most age groups.

Table 1: Population characteristics (*n*=626)

Patients' characteristics	
Gender, *n* (%)	
Male	435 (69)
Female	191 (31)
Mean age (years)	46.58±16.5
Mean BMI (kg/m^2)	28.63±5.6
Smoker, *n* (%)	295 (47.2)
Hypertensive, *n* (%)	274 (43.8)
Diabetic, *n* (%)	155 (24.8)
Dyslipidemia, *n* (%)	212 (33.9)

BMI: Body mass index

Table 2: Distribution of urinary calculi according to age and sex of patients in our cohort

Age (years)	*n* (%)	Males	Percentage	Females	Percentage	Sex ratio male:female
10-19	12 (1.9)	8	1.8	4	2.1	2.00
20-29	92 (14.7)	56	12.9	36	18.8	1.56
30-39	106 (17)	77	17.7	29	15.2	2.65
40-49	142 (22.7)	100	23	42	22	2.38
50-9	79 (12.6)	54	12.4	25	13.1	2.16
60-69	133 (21.3)	98	22.6	35	18.3	2.80
70-79	39 (6.2)	28	6.5	11	5.8	2.54
80-89	23 (3.5)	13	3	9	4.7	1.44
Total	626 (100)	435	100	191	100	2.28

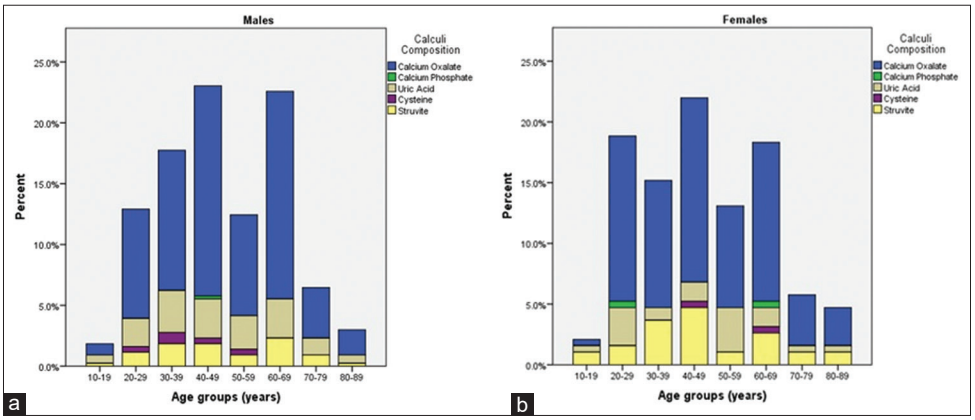

Figure 1: Distribution of the main types of calculi separately in males (a) and in females (b) according to age group

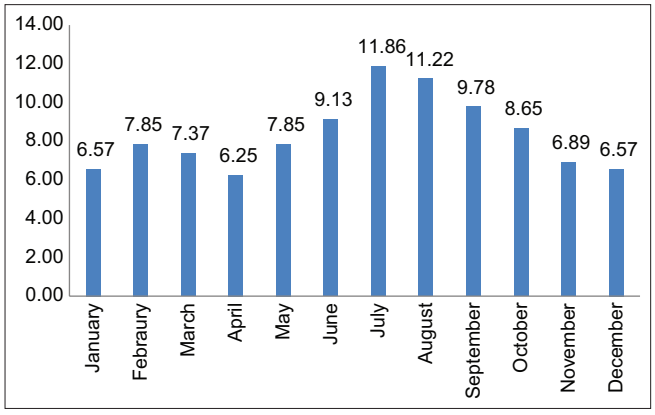

Figure 2: Monthly distribution of calculi across the year

The incidence of symptomatic stones, over the months of the year, was witnessed to peak during July (11.9% of stones analyzed) [Figure 2]. Geographical location of patients who had their ureteral/kidney stone(s) analyzed at our medical center, was also identified and analyzed. Figure 3 represents the density of calculi in terms of the original Mohafaza (Governorate) of those patients, expressed per 10,000 population. Lebanon has 8 governorates in total and Beirut is the capital and a governorate. The density was calculated by the ratio of participants coming from a given Mohafaza to the total number of the Mohafaza population (as estimated by the Central Administration of Statistics). Beirut had by far the highest stone density of 7.92 per 10,000 population. Interestingly, 87.5% of all cystine stones came from the region of Mount Lebanon.

Approximately, 60% of patients presented with flank pain to the Emergency Department, while the remaining patients were diagnosed on a nonemergent basis. One-third of patients (32%) passed their stones through conservative medical expulsive therapy, with 42% of patients requiring at least one endourological intervention, regardless of the type of stone. Figure 4 shows the several management options for the patients, including the different treatments utilized such as medical expulsive therapies, extracorporeal shock wave lithotripsy (ESWL), and ureteroscopy, etc. Calcium oxalate stones required either ESWL or ureteroscopy in 10% and 60% of the cases, respectively. Around two-thirds of calcium phosphate stones (66.7%) were passed spontaneously on medical expulsive therapy. Of the pertinent medical risk factors, ordinal logistic regression analysis of our cohort highlighted that both diabetes and hypertension were related to an increased risk of kidney stones recurrence with an odds ratio of 1.8 (95% confidence interval [CI] 1.18–2.78), and 1.4 (95% CI 1.21–2.13), respectively.

DISCUSSION

Urolithiasis distresses all age groups, sexes, and

races.[1] Notwithstanding the extensive improvements in the development of novel therapies, the incidence of urolithiasis is mounting across the globe.[1] The National Health and Nutrition Examination Survey examined stone epidemiology in North America (n = 12,110) during 2007 and 2010.[4] The prevalence of stone disease was 8.4% (95% CI, 7.7–9.0). Men were more like to have a history of stone disease than women. In the weighted analysis, BMI was linked to a history of stone disease. The prevalence of kidney stones was more in obese individuals (11.2% [95% CI, 10.0–12.3]) and overweight individuals (9.2% [95% CI, 7.9–10.5]), versus individuals with normal weight (6.1% [95% CI, 4.8–7.2]) ($P < 0.001$).[4]

Data on the chemical composition of stones are helpful in determining pathogenesis, indicating the type of treatment, and avoiding recurrence. The chemical composition of urinary stones comprises crystals and noncrystalline phases, i.e., the organic material (the matrix). Calcium is the major component of most stones in our Lebanese cohort, present in about 80% of the total urinary calculi. The same was also noted in studies from other countries such as Tunisia, Morocco, Oman, Kuwait, and Iraq.[6-11]

The proportion of calcium stones may account for pure calcium oxalate (CaOx) (50%), calcium phosphate (CaP, termed as apatite) (5%), and a mixture of both (45%).[1] There are several elements that cause CaOx stone formation (hypercalciuria, hyperuricosuria,

Table 3: Frequency of stones in our cohort of patients (n=624)

Stone type (n=624)	Frequency, n (%)
Calcium oxalate	435 (70)
Uric acid	101 (16)
Calcium oxalate phosphate	33 (5)
Struvite	23 (4)
Cystine	12 (2)
Calcium phosphate	9 (1.4)
Calcium carbonate	9 (1.4)
Matrix protein	1 (0.1)
Solitary particle	1 (0.1)

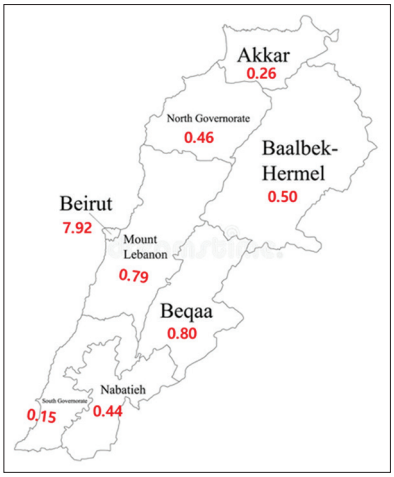

Figure 3: Density of our Lebanese cohort patients, presenting with renal colic, according to their governorates. Density is calculated as per 10,000 population

Table 4: Summary of studies conducted

Author	Place and date of publication	Materials	Results
Bouatia *et al*.	Morocco 2015	828 stones were collected from 537 men (67%) and 265 women (33%). The average 2015 age was 49 (range 20-87) years for the men and 48 (range 18-86) years for the women	The main component of nephrolithiasis was calcium oxalate (66.6%), followed by anhydrous uric acid (18.1%), carbapatite (7.9%), struvite (4.4%), and cystine (0.6%)
Alaya *et al*.	Tunisia 2012	781 males and 520 females	Calcium oxalate monohydrate was the most frequent stone component, even though its frequency decreased with age in favor of an increase in uric acid stones. Struvite stones were rare (3.8%) and more frequent in children than in adults
El-Reshaid *et al*.	Kuwait 1997	1191 patients	Calcium oxalate was the most common stone (65.8%), irrespective of age or sex. The proportion of urate stones was 15.4% of all stones formed and constituted a major cause of renal stones in children (24.1%), adults (14.4%), and elderly (12.5%). Cystine stones were found in 10 patients (2.4%).
Alaya *et al*.	Tunisia 2012	310 stone-forming children and teenagers, with ages ranging from 3 months to 19 years (mean age 8.6±1.2 years)	Calcium oxalate was the most common stone encountered (52.6%). It was the most abundant component of stones in all age classes
Qaader, Yousif and Mahdi	Iraq 2006	184 patients. Mean age was 38.3 years. Male to female ratio was 2.5:1	Calcium was the main constituent (91.0%), followed by phosphate (84.6%). The prevalence of staghorn stones was 8.9%. Calcium oxalate urinary stones occurred more frequently in males than in females
Al-Marhoon *et al*.	Oman 2015	255 patients. The mean age was 41 years, with male:female ratio of 3.7:1	The most common stones calcium oxalates 45% (114/255); mixed calcium phosphates and calcium oxalates 22% (55/255); uric acid 16% (40/255); and cystine 4% (10/255)

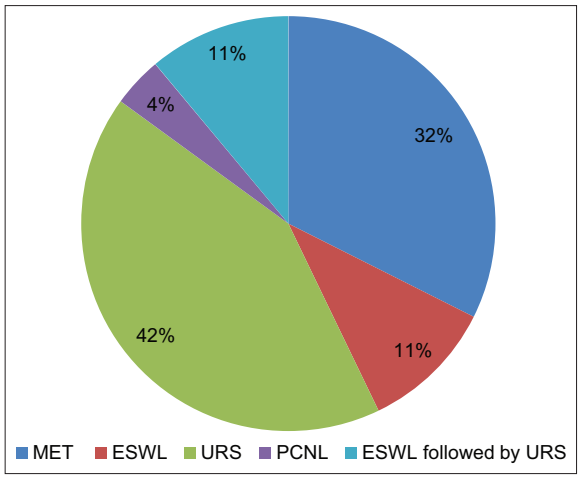

Figure 4: Various stone managements and treatment modalities utilized

hyperoxaluria, hypocitraturia, and hypomagnesuria). Stones are formed due to urinary infection or sepsis. Struvite stones or magnesium ammonium phosphate, account for 10%–15% and are known as infection stones or triple phosphate stones. Those are generally caused by urease-producing organisms such as Proteus, Pseudomonas, *Klebsiella*, and *Staphylococcus aureus* that make the urine alkaline.

Very few cohort studies from the MENA region have described the incidence of stones and their compositions [Table 4]. A study conducted in Tunisia analyzed 1,301 urolithiasis patients (6 months to 92 years old), 60% males and 40% females, and showed that average annual incidence of new stone formation was 31.7 per 100,000 population. Calcium oxalate monohydrate was the most recurrent stone constituent, and bladder stones were seen in 18.2% of cases.[6] Another large series from Kuwait of 1191 patients indicated that the average yearly incidence of new stone formation was 23.9/100,000 inhabitants. Calcium oxalate was the most prevalent stones (65.8%).[12] An increase in total dietary protein and sodium intake, obesity, sedentary lifestyle, and global warming may contribute to our results. In addition, other key agents may play a role like the noteworthy change in food behaviors, emphasis on industrialized diet, and preponderance of metabolite-related diseases in the MENA region.

CONCLUSION

There is a surge in urolithiasis incidence and prevalence worldwide predominantly due to the increase in diagnostic advancements and improvements in imaging techniques that help discover silent stones. This study represents one of the largest characterizations of stone composition in the Middle East and the first in Lebanon. There is a notable gender difference in stone prevalence in Lebanon, with males afflicted to a significantly larger extent. Calcium oxalate is the most prevalent kind of stone irrespective of gender and in agreement with the literature. Future research on dietary and environmental factors can help add value to these preliminary epidemiologic findings. Classifying stone formers according to their clinical presentation and stone composition can antedate the risk of future symptomatic stone episodes and help in personalization of stone prevention strategies.

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Conflicts of interest

There are no conflicts of interest.

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